



# Tree Planning and Planting CAMPAIGNS

## A Guide for Reforesting Cities and Towns

TREE MAPPING

CANOPY GOALS

SOCIAL TREE EQUITY

TREE BENEFITS



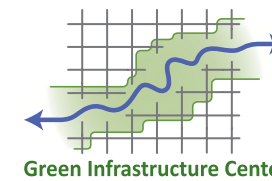
The Green Infrastructure Center Inc.

June 2022



Funded by the  
Southern Region  
of the USDA  
Forest Service.

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This report was created by staff at the nonprofit Green Infrastructure Center Inc. Writing by Karen Firehock; Case Study Research by Matt Lee; Maps by Stuart Sheppard; editing by Tim Lewis.

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Mike plants trees with staff and veterans at GIC's arboretum at McGuire Veterans Hospital, Richmond, Virginia.

## DEDICATION

This report is dedicated to our long-time board chair Mike Cook who guided the GIC through recessions, a pandemic, and the myriad ups and downs of running a nonprofit. Mike not only guided staff and board decisions, but he also helped in any way he could, from soliciting donations to bringing in new partners and, yes, planting trees. Long before he joined GIC, Mike held a long and distinguished career at the U.S. Environmental Protection Agency and served his country in Vietnam, where he met and married his beautiful bride, Kim. Mike passed away in 2021 and we promised Kim that we would make sure to get many trees planted in the following year in Mike's memory, and so we dedicate to Mike Cook this guide and the more than 10,000 trees we had planted or donated with our partners in the year since his passing.

May every sapling grow into a grand tree that lives on cleaning the air, shading our families, supporting our pollinators, birds and wildlife, and ensuring clean water for generations to come. Thank you Mike. You will always be with us in spirit, in the many trees that are growing today thanks to your wise counsel, and in the support you gave us, which has seen GIC into its 16th year and made all our work possible.



TREE MAPPING

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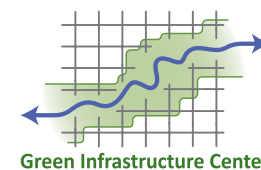
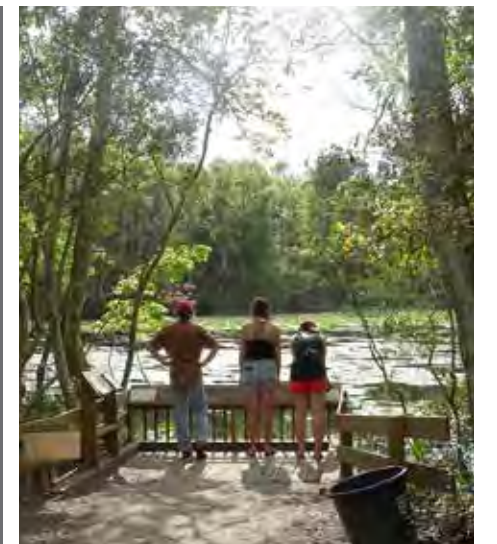


CANOPY GOALS

SOCIAL TREE EQUITY



TREE BENEFITS



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# I. Why We Need to Plan for and Plant Healthy Urban Forests

Many communities recognize the values their trees provide – beauty, shade, property values, fostering exercise, cleaner air and water, and reducing stormwater and urban flooding. Yet, the ability of trees to provide these benefits is declining as recent data show urban and suburban tree canopy cover trending downwards nationwide. America’s urban tree cover is declining at a rate of about 175,000 acres per year – around 36 million trees annually (Nowak and Greenfield 2018). Nowak and Greenfield estimated that annual U.S. tree loss is equivalent to a losing benefits valued at \$96 million per year! Clearly, we need to reverse the current trends of urban tree losses.

Why are we losing our urban trees? Causes for this decline arise from many sources, including land conversion for development, storm damage, hurricanes and lack of replacement as older trees die. However, unless there is a dramatic storm, we may not notice the losses that are happening daily. While many people and communities care about their city’s trees, they often lack data about their extent (how canopied are we?) or detailed strategies to conserve or restore them such as requiring tree canopy retention or replanting following development. Furthermore, when disasters strike, communities often have plans for tree debris removal, but not for tree replanting.



Cities often have plans in place to remove storm debris but not for replacing trees lost from storms.



In order to have a sustained tree canopy cover long term, communities need to create and implement strategies to stem tree loss and regrow canopy that has been lost. Perhaps the most compelling way to think about the need for a strategy is the fact that – like us – trees get old and die. Although trees usually seed the next generation – which is how forests keep going – in urban areas, the constant mowing and manicuring of the landscape, along with the loss of forests to new development, mean that trees cannot repopulate the landscape as they would in a wild setting.



Emerald ash borers are destroying ash trees along streams and in our downtowns.

New pests are another reason why we are losing trees. In some downtowns, singular species were planted in great abundance and are now subject to infestations by pests or disease. The emerald ash borer is rapidly killing ash trees in downtowns, where ashes are often the primary street tree. Unless there is a plan in place to treat or remove those trees, a hot, treeless downtown is in the not-too-distant future for those communities.

This guide provides the arguments for analyzing tree canopy coverage locations, tree condition and strategies for a community-wide strategic approach to tree conservation. Even if you -- the reader -- are an experienced arborist or forester, you may need better or different arguments to move a city council or county board to take action for tree planting or retention. Tree care professionals may not know how to obtain citywide data on tree coverage, while data managers may not understand how to engage field staff in reviewing and applying data to on-the-ground decision making. This guide bridges those gaps so that agencies, departments, tree care groups, tree professionals and elected officials can work better together to get the right data and make more informed decisions for our urban forests.



GIC's staff inventory trees in Florida at municipal properties.

## Audience

This guide is written for planners, landscape architects, urban foresters and arborists, elected officials, community tree advocates or anyone who wants to make the case for robust urban canopies, funding forest expansion and implementing strategic tree-planting campaigns. This guide shows how to craft a compelling argument for the urban forest. It also details the data needed to both set a canopy goal and create realistic, proven strategies for engaging both the public and private sector in growing and sustaining the urban forest. Case studies and examples are provided throughout this guide to show that these ideas really do work.

Be aware that not all of the statements in the box at right may actually be true for your community, even if you've heard them discussed. Although, your community may have plenty of room to add new trees, cities and towns often consider only publicly owned land in their planting strategies, which is why they say there is no more room to plant. On the other hand, if a city has established a canopy goal, it's unlikely it can meet it solely through public property plantings, since usually a city owns only 20% of the land area within the municipal boundary; and, of that 20%, it could be the case that only 1% is available to plant.

### We love trees, but...

See if any of the following statements apply to your community.

- We love our trees, but we don't have a goal for how much canopy coverage we need.
- We have a tree canopy goal, but we don't have specific tree retention or planting plans to achieve it.
- We have a tree map, but no goal. We don't know what to do next with the data.
- We are planting trees, but we don't know if we are getting ahead. Is the rate of trees added keeping up with, or falling behind, tree losses?
- We are planting a lot of trees but also losing a lot to development, age, storms and individual removal. We don't know if we are losing or gaining canopy overall.
- Our government leaders say that they appreciate trees, but the budget to plan and care for trees is very low, or nonexistent.
- We are planting trees, but our leadership expects one sector (public or private) to do all the work.
- We have a tree stewards' group, but its members are getting burned out; or they don't get involved in planting plans or projects; or they give advice, but nobody is listening.
- We have planted in all the available spaces, so there is no room left to plant anywhere else.
- We don't actively manage public/urban trees on a regular basis; we only "manage" them if they fall down during a storm.







Urban forests provide a chance for respite and recreation.

Given that only about 20% of urban and suburban land in cities and towns is under government ownership or control, if a canopy cover goal is to be successful, the city needs to substantively engage the private sector, which manages the other 80% of the landscape. Also keep in mind that, although publicly owned lands may be limited, it's important for local government to demonstrate good stewardship of the urban forest by doing its part to grow the canopy. Therefore, successful campaigns generally need to have programs for planting trees on both public and private property.

Community foresters or city arborists may be restricted to planting on public property, but that does not mean everyone is limited to only planting on public spaces. Motivating private sector planting is key to maintaining or increasing the city's tree canopy, and there are often ways for cities to contract with other groups, such as nonprofit tree conservation groups, to plant on private property and to assist residents with tree care.

## How to Use This Guide

In this **Section 1. Why We Need to Plan and Plant Urban Forests** we cover the compelling arguments for increasing or retaining urban trees.

- If you have already convinced your city to plan for its tree canopy, you can skip to: **Section 2. Plan the Urban Forest.**
- If you have already collected data on tree canopy coverage and tree inventory, but want to address the communities who most need, go to: **Section 3. Planning and Planting for Health and Social Equity.**
- If you know where you need to focus your work, but need help with implementation, you can skip to: **Section 4. Plant the Urban Forest —Launching a Tree Planting Campaign.**
- If you have already collected high-quality tree data, have plans in place for where and how to plant, and you simply need to show the provided, skip to: **Section 5. Demonstrating the Benefits and Maintaining the Urban Forest.**
- If you are developing proposals for expanding participation in tree care and planting and want to enlarge your network of support and engagement, **Sections Three and Four** can help with that too.



### Promotional Materials Available

Contact GIC to obtain free illustration art and promotional materials created for use with this guide, to customize for your planting or tree benefits campaigns. All sections of this guide are linked from the table of contents. Throughout the guide, we provide case examples and stories to demonstrate real world application for ideas in this guide.



Successful tree planting campaigns should plant trees on both public and private property.



Volunteers of all ages can plant trees. Photo credit: Town of Summerville



## Making the Case for Trees

Businesses often own large, plantable areas, especially around corporate headquarters or commercial areas.

If you are a nonprofit or community organization, you might be wondering how to get your city to plant more of its public spaces (to supplement your own work planting in back and front yards). In addition, businesses often own large, plantable areas, especially around corporate headquarters or commercial areas, all of which could provide much-needed habitat and healthier spaces for workers.

It's important to recognize who in the city or town would be most interested in expanding the urban forest. Among the professionals likely to be interested in benefits trees provide are the city's resilience or sustainability officer and those responsible for implementing a livability or health plan. It is also likely that the economic development director will be interested in the statistics for lower vacancy rates, improved commercial area revenues and greater marketing opportunities that an attractive, well-treed location offers to new businesses and future residents. Tree advocacy groups and city arborists can use the arguments we present to make the case for urban trees and request improved funding levels.

Following are the arguments broken down by stakeholder type (the ones you are trying to convince to do more). Key statistics you can cite as evidence for these claims are found throughout this guide and the Resources Section has links to download articles and studies with the supporting data.



Trees encourage people to walk and bicycle, which is beneficial to heart and lung health.

### Arguments to Make by Stakeholder Type

#### City Commissioner/Councilor

Trees increase property values and revenues in shopping districts, improve community health, make the community more resilient to climate change, and make it more attractive to new businesses and entrepreneurs. Trees will pay their way through more economic activity and better tax revenues from increased property values.

#### City Public Works/Engineering

Trees have been shown to take up stormwater, reduce standing water, lower surface temperatures, extend pavement life and improve air quality in terms of reduced particulates, greater ozone and fewer volatile organic compounds, while sequestering carbon to mitigate climate change. And, if yours is a coastal community, trees also provide a buffer against storms, reduce storm damage to infrastructure, minimize coastal erosion, and so on. Trees clean both the air and water and reduce flooding at a cost far cheaper than engineered solutions, such as stormwater ponds.

#### City Health Officials/Hospitals

Well-treed communities have better respiratory health and fewer hospital visits from chronic conditions, such as asthma. Trees encourage people to walk and bicycle more and farther, thus encouraging heart and lung health and reduced onset of Type II diabetes. Furthermore, patients heal up to 30% faster when they can see or access green spaces, children who suffer from Attention Deficit Hyperactivity Disorder (ADHD) benefit from living near forests and other natural areas, and children who live closer to green areas have improved cognitive function.

#### City Parks and Recreation:

Parks with good tree canopy are more inviting and healthier for users, for all the reasons outlined above. Trees also provide shade, and thus more options for diverse uses in parks, such as picnics, studying, hiking or outdoor education. Larger natural parks increase the value of nearby parcels more than skate parks or other developed parks, such as golf courses. They also provide greater biodiversity and the opportunity to increase the variety of trees in the city.







**Local Business Owners:**

Skilled professionals (also called the “creative class”) seek out communities that are greener and have protections in place for their parks, street trees and open spaces. So, a green community helps recruit skilled, higher-paid workers with more money to spend in the local community. In general, businesses and cities that are perceived as being green gain a competitive advantage.<sup>1</sup>

**Residents/Neighborhood Associations/HOAs:**

Less crime occurs in well-treed neighborhoods and trees have been shown to improve metabolic rates and moods. Since they increase walkability, more people strolling, jogging, or generally out and about around a neighborhood equates with safer communities and people who interact more as a community and watch out for each other. Trees do not hide criminals or make it easier to rob a home and well treed areas have lower crime rates. What’s more, property values are, on average, 18% higher for well-treed developments. They also save the average household about 20% on its summer energy bills.

**Conservation/Nature/Garden Clubs:**

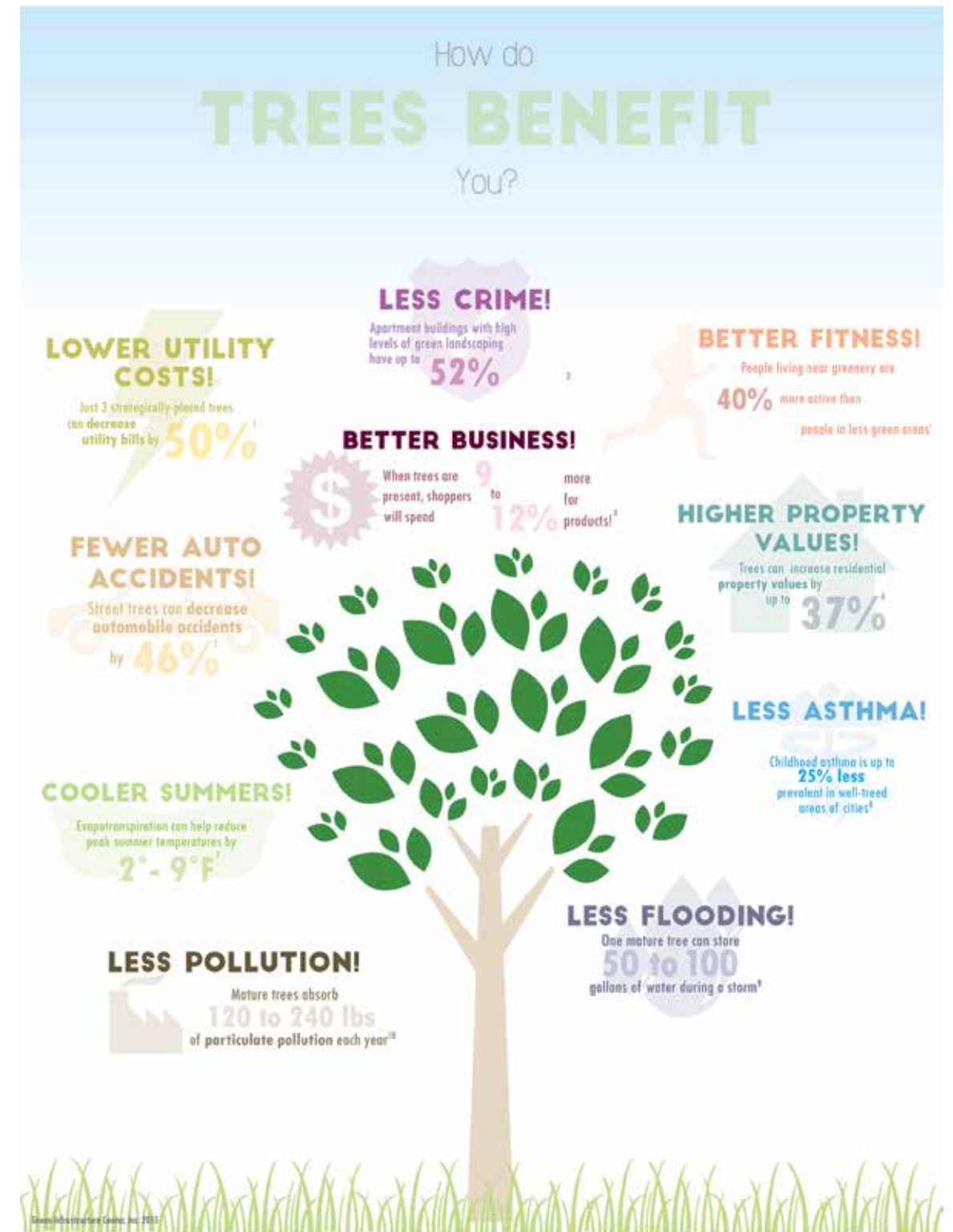
Native trees support beneficial insects and pollinators, which we need for a healthy food supply. Although trees in forests are usually pollinated by the wind, understory plants and some broadleaf forest trees rely on pollination services and so provide forage for native pollinators. A mature oak tree supports up to 534 species of insects, including moths and butterflies – key pollinators – which is more than any other native tree species.<sup>2</sup> Trees support a number of mammals, which also aids biodiversity and a healthy environment, especially if there is a large, wooded area adjacent to the development. They also clean the air and water of pollution and support healthy soil formation. In addition, tree shade reduces heat stress on both animals and people.

**Large landholders:**

If you are the owner of a significant forested landscape, it’s important to know its extent and its health. A privately owned forest provides many public benefits and may serve as a critical connector to other, off-site woodland areas. Forests provide habitat to pollinators that support our food supply, they sequester and clean greenhouse gases such as carbon dioxide and ozone, filter air pollutants and support native wildlife and songbirds, and capture stormwater pollutants from water and recharge aquifers. They also provide buffers against noise and road impacts. Surveys for pests, invasive species or other diseases can help flag problems that need to be addressed early to ensure a healthy forest long into the future.

**Benefit Stats**

The infographic below is a poster for community events and presentations. For additional statistics on the many benefits trees provide, see the text box on the following page and see the Appendix for citation references. Contact GIC to obtain a poster-sized copy of this graphic for display.



<sup>1</sup> <https://www.forbes.com/sites/forbesnycouncil/2018/11/21/do-customers-really-care-about-your-environmental-impact/#418a9fc8240d>

<sup>2</sup> <https://edgeofthewoodsnursery.com/nine-reasons-plant-oak#:~:text=Oaks%20support%20hundreds%20of%20butterfly,our%20ecosystem%20to%20function%20properly.>



## Statistics for the Economic, Environmental and Social Values Trees Provide

Methods to calculate actual contribution metrics for trees based on your canopy or inventory data are provided in Section Five of this guide. Following are some key statistics that can be used to argue the case to decision-makers.

### Key message:

Adding trees to lots and retaining trees in developed areas leads to improved sales and better real estate values, which also equates to more local tax revenue.

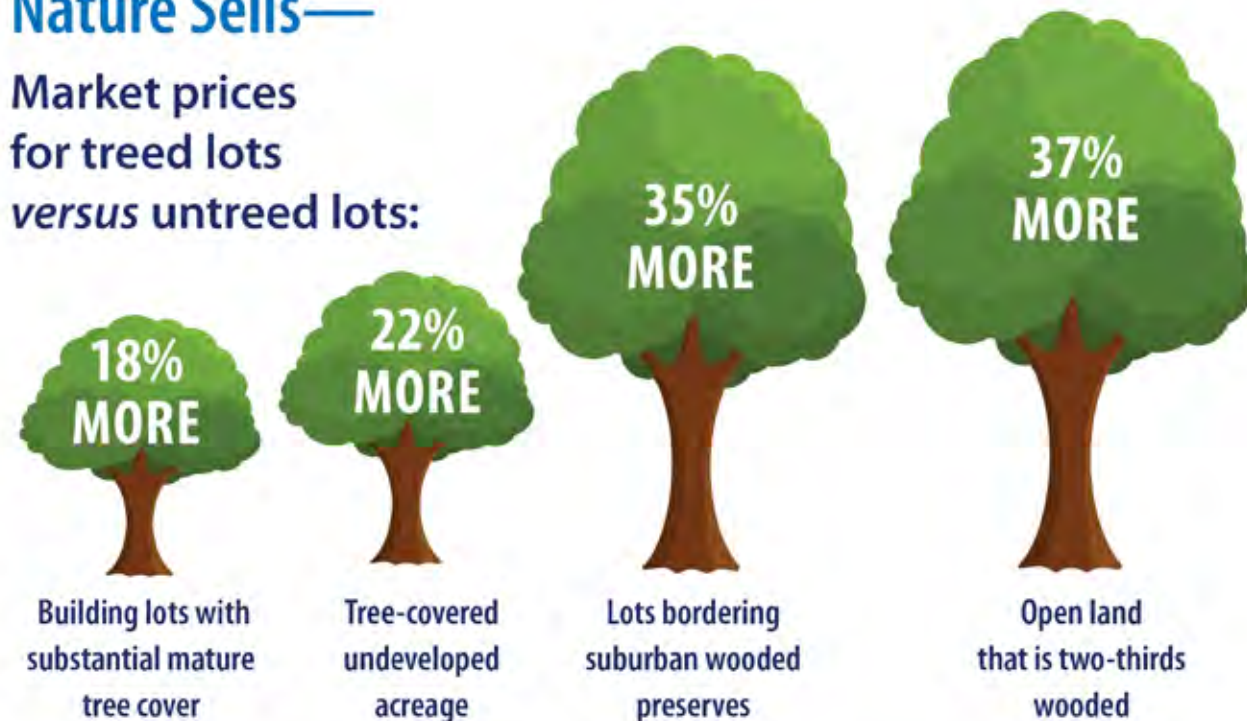
### PROPERTY VALUES:

#### Trees increase real estate values for new homes and resales

- Developments that include green space or natural areas sell homes faster and for higher prices than those that take the more traditional approach of building over an entire area without providing community green space (Benedict and McMahon 2006).
- 57% of voters are more likely to purchase a home near green space, while 50 percent would pay 10% more for a home located near a park or other protected area (National Association of Realtors).
- Trees on developed lots add to property assessments; about 18% more in real estate value. (Wolf 2007). See the Nature Sells graphic.

## Nature Sells—

### Market prices for treed lots versus untreed lots:



Source: Kathleen Wolf, 2007, *City Trees and Property Values*.



People shop longer on well shaded streets.



Urban residents who lack transportation are especially vulnerable to heat on unshaded streets.

### COST SAVINGS:

#### Trees save money while increasing revenue for local governments

- Three well-placed shade trees around a building can reduce cooling costs by 30% (Parker 1983).
- Shaded pavement has a longer lifespan, so maintenance costs associated with roadways and sidewalks are less (McPherson and Muchnick 2005).
- People shop longer and pay more per item in tree-lined retail areas, spending about 12 percent more money (Wolf 2007).

### HEALTH:

#### Trees make us cooler, clean our air and motivate exercise.

Tree cover shades streets, sidewalks, parking lots, homes and businesses, making urban locations cooler and more pleasant for walking, biking, shopping and working.

- Multiple studies have found significant cooling (2-7° F) and energy savings across a city from having an extensive canopy of shade trees (McPherson et al., 1997).

- Trees absorb volatile organic compounds and particulate matter from the air, improving air quality, and thereby reduce the rate of asthma, heart problems, and so on. Trees also clean the air of ground level ozone (O<sub>3</sub>), a key pollutant.

- Even at the neighborhood level, trees reduce pollutants. Well-treed neighborhoods suffer less respiratory illnesses, such as asthma, than communities without trees (Rao et al., 2014).

- When trees are not present, distances are perceived to be longer, hotter, less pleasant and farther away, making people less inclined to walk than if streets are well treed (Tilt, Unfried and Roca 2007).

### Key message:

Urban and community trees will pay the city back through lower utility bills and higher sales tax revenues.

### Key message:

Trees improve health, making people less likely to suffer ill effects from a variety of common complaints, such as asthma, flu or complications from corona virus. This, in turn, provides savings in medical costs.

### Key message:

Trees reduce urban heat islands, allowing people to enjoy the outside safely by avoiding heat stress, and reduce the overall temperature of a city, generally lowering heating bills and maintenance costs.





Volunteers with The City Citrus Program in Baton Rouge, LA. Photo credit: Baton Rouge Green

#### FOOD SECURITY:

##### Trees support pollinators and people

■ **Pollinators:** Many street trees, such as linden trees, rely on or are visited by pollinators. Forests harbor wild bees that provide important pollination services for crops and wild plants. Pollination services for crop plants decline with increasing distance from natural and semi-natural habitats, so accessing natural habitats is key for pollination (Ricketts et al., 2008), (Krishnan et al., 2020).

■ **Urban Orchards:** Many people appreciate trees for the fruit they provide, and some people are also urban foragers – people who gather fruits, such as walnuts, apples, mangos, mulberries and other products from the urban forest. Indeed, urban forests can lead to greater food security (Bunge et al., 2019) Some cities also plan urban orchards that they manage for public use, while other cities give away fruit trees, especially in lower income areas to provide better nutrition. See examples on urban orchards on the following pages 14-15.

#### Key message:

Forests and street trees support pollinators that we depend on for food security.

#### Key message:

Urban forests can support food security and healthier communities.

#### WATER QUALITY:

##### Trees clean surface waters and recharge aquifers.

■ Trees help capture and filter urban runoff, including such chemicals as nitrogen and phosphorus, before they reach waterways, where they could lead to algal blooms that result in lower oxygen for aquatic life. Trees also trap sediments, preventing soil runoff that clogs fish gills, smothers aquatic life and builds up in waterways and bays, harming recreation and the water transportation of goods.

#### Key message:

Healthy tree cover means cleaner and safer surface waters for swimming, fishing and access to healthy drinking water.

#### STORMWATER:

##### Trees reduce runoff and flooding.

■ Stormwater uptake: An acre of forest releases 750 gallons of water into local streams, whereas an acre of impervious pavement releases 27,000 gallons of water into those same streams during an average rain event (PennState). One mature large canopy tree can take up thousands of gallons of water annually. The more water that trees capture or evaporate, the less water runs off, avoiding overburdening stormwater infrastructure.

#### Key message:

Forests and trees dramatically reduce urban flooding.

#### AIR QUALITY:

##### Trees trap greenhouse gases and clean the air.

■ **Climate Change:** Trees sequester carbon, which contributes to such greenhouse gases as sulfur dioxide and carbon dioxide, thereby contributing to a warming planet. By storing carbon and preventing its release, trees mitigate the impacts of climate change.

■ **Particulate Matter:** Trees play a critical role, not only in providing oxygen, but also cleaning the air of particulate matter and ground level ozone (O<sub>3</sub>), which can damage human health. Mortality rates have declined in cities that have extensive tree cover and in those areas with more precipitation, trees have higher removal rates for particulate matter. Trees in Atlanta removed 64.5 tons of PM2.5 annually (Nowak et al., 2013).

#### Key message:

Trees mitigate and reduce the impacts of climate change, thus saving money and protecting lives and properties.

#### Key message:

Trees create healthy communities by cleaning the air.







## CASE STUDY: BATON ROUGE GREEN, LOUISIANA

### When Life Hands You a Lemon Tree, Plant it! How one organization in Louisiana is planting trees and addressing food insecurity.

One popular type of tree planting project is to establish a network of community orchards. **The City Citrus Project** run by the nonprofit tree advocacy and planting group Baton Rouge Green (BRG) is a great lesson in how to thoughtfully build and establish a network of community orchards and volunteers.

The project was started in 2013 when a local businessman noticed the underutilized greenspace beneath the billboards his company owned throughout the city. He wanted to add more benefit to these spaces but did not want shade trees that could grow tall and block the advertisements. Baton Rouge Green suggested planting citrus trees at the sites, since they are smaller trees, growing to a maximum of between 15-25 feet. They piloted three sites with citrus trees and developed a cohort of volunteers called Shepherds to tend to the trees. This successful pilot motivated other volunteers and community groups to reach out, asking for help to establish orchards in their communities. Seven years later, the City Citrus Project has two dozen active orchard sites and adds three to four new sites each year.

As part of their program, every December Baton Rouge Green holds a #SharetheFruit event at which 100 or more volunteers attend to learn citrus tree pruning techniques and to pick and pack fruit for the local Baton Rouge Food Bank. They harvest an average of 4,000 lbs. of citrus fruit annually, which they distribute to the regional food bank serving eight parishes. Baton Rouge Green has a total of 30 sites that supply the community pick events and also a City Citrus program, with mini orchards that range from several trees to dozens of trees.



Photos courtesy of: Baton Rouge Green

#### Location:

Baton Rouge, LA, and surrounding parishes.

#### 100:

Number of volunteer participants

#### 32,339lbs:

Pounds of fruit picked and shared with the local food bank (as of early 2022)

#### Partners:

Baton Rouge Food Bank

Orchards are popular because they achieve multiple goals simultaneously, such as increasing tree cover, providing ecosystem service benefits and addressing community food needs that are most acute in areas that are “food deserts” where fresh fruits and vegetables are lacking.

A few cautions to note. Fruit trees require a greater level of pruning and care than a typical shade tree. Sites should be selected with care to ensure good soil quality; avoid conflicts with underground or aboveground utilities; and ensure safe public access for fruit harvest and distribution.

Some of the community orchards in public parks do not have a planned harvest; rather, the fruit can be harvested as desired by the “residents” who can be two-legged, four-legged or winged. The City Citrus project also has orchards for passive enjoyment, but it ensures that each orchard has official “Sheppards” to get the trees established with scheduled watering and pruning, and who inspect the trees for disease or storm damage. To ensure that tree skills remain sharp, City Citrus provides 2-3 pruning trainings per year. City Citrus offers a holistic approach because it includes all the important elements from training, to planting, to long-term stewardship, as well as “giving back” through food bank donations.



#### Why Citrus trees?

Citrus trees are ideal for orchards in Louisiana’s climate as they are drought tolerant, require less pruning than other fruit trees, are very hardy once established, and can produce for several decades. The BRG also promotes certain cold hardy and frost tolerant varieties, such as satsumas, kumquats, Meyer’s lemon and navel oranges. Other fruit trees, such as pears, are avoided because they require too much structural pruning in the first several years, which can be daunting for novice tree caregivers. Citrus trees also can be trained and harvested easily and the fruit packs well for storage and distribution.



Photos courtesy of: Baton Rouge Green



## Getting FEMA to Reimburse Tree Losses

Trees are often at risk from disasters, such as storms or wildfires. But trees can also be replaced with help from FEMA if they are counted as “green infrastructure.” Utilizing trees as green infrastructure provides a basis for reimbursement from FEMA for storm-damaged trees. To qualify, trees must be inventoried before any storm or disaster event and specifically utilized for stormwater management, buffers or other “green infrastructure” functions. They should be catalogued in the tree inventory and plan as “green infrastructure.”



This tree in a bioswale is green infrastructure because it is part of a stormwater best management practice (BMP).

## It Takes a Village—To Plan for Trees

Tree planting and management programs run by cities may face reduced budgets over time, lowering their equipment, staffing and ability to plant and maintain their trees. Why is this so? Tree care, like many environmental functions, is often one of the first services to face budget cuts, especially during economic downturns because trees are not seen as important as other assets. This lack of a dedicated revenue stream for urban tree care results in funding competition from other city functions such as building or maintaining schools.

But why should communities have to choose between students and trees when children need trees to improve cognitive function, for exercise and outdoor study, as well as imaginative play and stress reduction (to name just a few of the benefits)? Some cities have overcome this budgeting conflict by creating a dedicated funding source for parks (e.g., allocating a percentage of the lodging tax, where parks are seen as vital to tourist revenue) or a fee on development applications that pays to replace trees lost due to urban growth.

Paying for trees is important and the costs should be spread across both the public and private sectors. This is because trees are our “green infrastructure.” They provide shade and cooling, pollution remediation, improved aesthetics, beautify entrance corridors and downtown areas, encourage shoppers and tourists, uptake stormwater, and act as storm buffers. So, they can and should be planned for, just as we plan for such grey infrastructure as sidewalks, roads and utilities. See Section Four of this guide covering Planting Campaigns to learn more about how to budget for and spread costs across public and private funders. Below are example statistics you can use to make the case for budgeting for trees.



## Why We Need Better Tree Data

Most localities don't have data on the extent and health of their urban canopies; nor do they have comprehensive tree inventories, so this section might best be titled, “Why do we need *any* data?” It's interesting to note that, while cities inventory sidewalks, roads, buildings and other public facilities, such as schools, they seldom catalog the condition and extent of their trees. However, since trees are our “green infrastructure,” we need to manage them, just as we do our “grey infrastructure.” Imagine trying to manage a city or county's Capital Improvement Plan (CIP) without any data. What if all the spreadsheets said, “Building condition unknown,” “Road projects needed unknown,” or that the master plan cost for a neighborhood was “Indeterminate.” Yet many cities treat their urban tree programs this way.



Cities inventory sidewalks, roads, buildings and schools, but they seldom catalog the condition and extent of their trees—the green infrastructure.

GIC staff surveys urban trees in communities in Florida's panhandle region.



We need better data if we are to plan better for a thriving urban forest. Section 2, covers the different types of data needed and for which purposes, but before you can fund data collection and analysis, it's likely you will need to make the case for obtaining such data.

Here, we give you some reasons. Better data about the urban forest can be used to answer questions such as:

### Overall Progress

Are we cheering ourselves for planting an urban orchard in one park while losing hundreds of acres of trees nearby to development? What is the net canopy today and what is it projected to be in the future (gains/losses), if we continue with current approaches to urban forests?

### Canopy Metrics

What is the desired canopy cover for our community, as a livable and successful city? How many trees do we need to plant to meet our canopy goal? Which neighborhoods have adequate canopy, and which do not? Is this linked to indicators of inequality in green space distribution? What is the space available to plant new trees in our parks and along our streets?

### Canopy Health

What species of trees do we have? Do we have a superabundance of one particular species, making those trees more susceptible to diseases and pests? What is the general condition of our street trees and trees in parks? Are they healthy? How old are they? When did we last perform an inventory (wellness check)? Is there an infestation of a pest or disease that needs to be addressed? Are there places where trees and utilities are in conflict? Are large shade trees aging out, without having the next generation to replace them?

## Who Needs To Be Engaged?

It might seem strange to list those people and groups that need to be engaged, but GIC staff have attended many meetings on city trees to which the city forgot to invite any staff from parks, public works or planning. And yet all these agencies play a role in tree care.

See the list on the opposite page to determine all the agencies/parties to invite. The convener of a city tree planning, mapping or planting effort may need to explain to each agency why they are being engaged. For example, planners may say that they are not in charge of trees. And yet those planners are making decisions every day about where green spaces should be located, how much canopy or green space should be in various zoning types, standards for tree planting, and much more. Similarly, a parks department is caring for many city trees throughout the park system. Furthermore, a tree advocacy group, while not a city agency, may be doing the majority of tree planting work in a city, especially since around 80 percent of city land is, on average, in private ownership.



Engage the community in canopy goal setting.

## WHO SHOULD BE ENGAGED?

ENTITY/PERSON	ROLES	NOTES
<b>City or Town Staff</b>		
City Arborist	Lead project/project support implementation.	If there is no arborist, then include entity in charge of trees, e.g., Public Works/Parks Director.
Parks Director	Tree care and planting city parks/education.	May be limited to parklands.
Public Works	Sometimes tree care in RoWs, utility conflicts.	May contract out for tree care.
Sustainability/Resilience Officer	Integrate tree plans with other city resiliency plans and goals.	Many cities have established this role; they may be project lead.
Planning Department	Integrate tree planting standards into site plans, ensure long term plans for trees in development.	May need additional explanation about their importance in site planning that includes trees.
City Councils, Commissions	Approve budgets for tree programs or maintenance.	May need education about tree importance.
Engineering Department	Review of stormwater plans/watershed plans.	May have key role in approving trees in or near stormwater facilities; may affect trees retained.
Economic Development	Marketing and branding city/town as green.	May need education on how to brand green.
Geographic Information Dept.	Responsible for data management.	May be trained to make and upkeep tree data.
<b>Private Sector</b>		
Garden Clubs/Civic Groups	Tree planting, public support.	May be utilized to plant trees, support work.
Tree Conservation Group	Implement tree planting, public support.	May be lead for project, if not city led.
Neighborhoods/HOAs	Tree care in common areas, street trees.	May need to enact plans and care standards.
Chambers of Commerce	Fundraise and support public trees and beautification.	Build support for trees in commercial areas.
Hospitals/City Health Officials	Plant arboretums/wellness gardens.	May link to existing healthy community plans.
Universities/other institutions	Manage large, treed landscapes. May add tree conservation to curricula.	May want data on their tree cover; students may help with inventories or planting.
Large landholders	May control large acreage of canopy.	Includes land conservancies and private nature preserves.
Power Company	Interest in reducing utility conflicts.	May fund planting of smaller trees/shade trees and adopt policies allowing smaller trees near power lines.







## CASE STUDY: IRMO, SOUTH CAROLINA

### Growing Future Trees and Tree Stewards

The Town of Irmo is a small bedroom community just outside Columbia, South Carolina, which is experiencing rapid suburban growth for three reasons in particular: its comparatively low housing prices; its high quality of life that includes a number of great parks and neighborhoods; and such popular events as the Irmo Okra Festival. While the town has a relatively high canopy cover, at 52.4%, new development is the main driver of tree canopy loss such that, without concerted actions, the canopy may significantly decline over time.

While Irmo is relatively well treed, canopy cover is being lost to new development. Town staff noted that it was important to find ways to introduce trees into new subdivisions and were considering whether or not to require new trees in future developments. They are also working to update the tree protection ordinance.

Fortunately, this small town has a very active tree board. GIC created Tree Canopy and Plantable Areas maps for the town. Using GIC's Tree Campaign Budget Calculator Tool, the Public Works Director, along with other town staff and the community, set a tree canopy goal of "no net loss." Strategic planting areas were identified as priorities for the town; they included school properties and newly constructed neighborhoods, which in Irmo often lack trees.



Photo courtesy of Town of Irmo SC

### Location:

Irmo, South Carolina  
Midlands Physiographic Province

12,483

City Population (est)

6.85

City size in square miles (approx.)

450

Number of seedlings given away to elementary students

100

Number of 3-gallon trees given away to residents

11

Number of years in a row as a Tree City USA

4

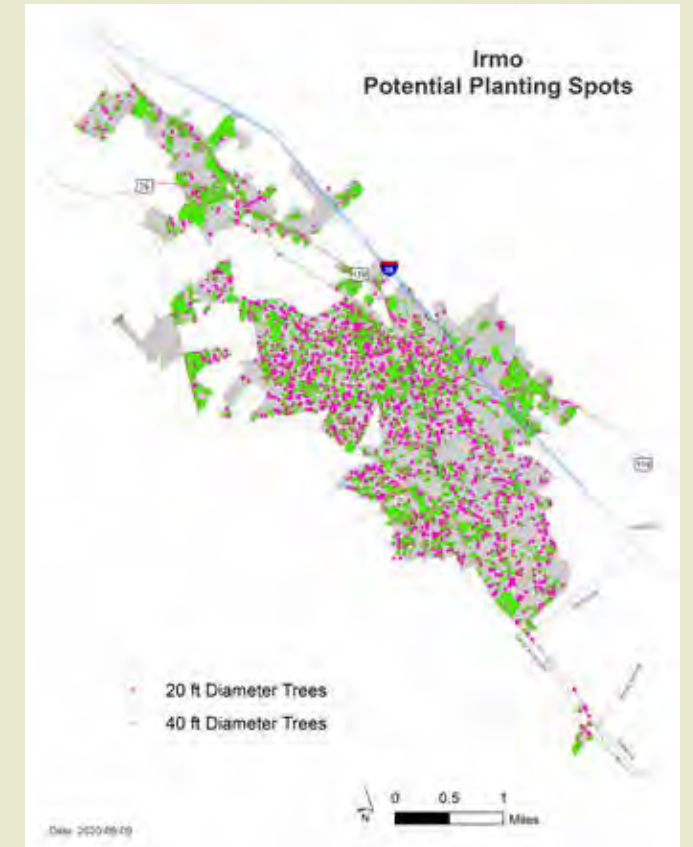
Number of tree giveaway events



GIC created this map of Irmo, to show where the existing tree canopy is located.

GIC facilitated meetings with the Irmo Arbor Day Committee to craft slogans and messaging for a town tree planting campaign. The town held a tree planting event at H. E. Corley Elementary School in the Spring of 2021. The town received a donation of 4 large 15-gallon trees from the Arbor Day Foundation and gave away 450 native oak tree seedlings for students to plant in their yards. Anecdotally, this strategy was less effective in planting trees on private property because it was easier for a resident to misplace a small seedling and forget to plant it. However, the education and engagement about trees and their benefits was a success, based on community feedback.

Planting at schools with Irmo's children—next generation tree stewards. Photo courtesy of Town of Irmo



This map shows all the locations where new trees can be planted. Although the town is relatively well treed today, projected development will cause tree losses, so the town needs to continue to plant to maintain canopy cover town wide.





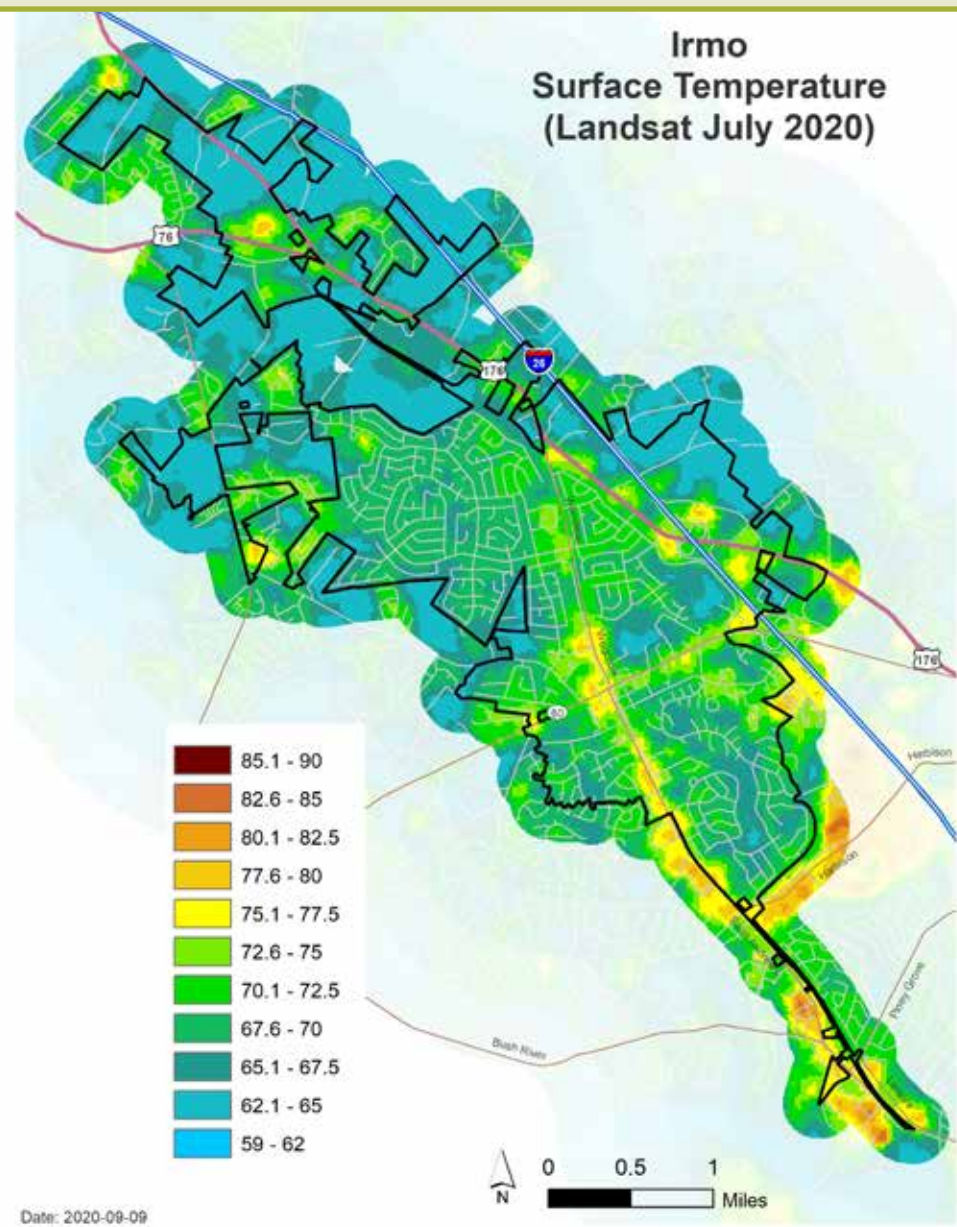
Strategic planting areas were identified as priorities for the town; they included school properties and newly constructed neighborhoods, which in Irmo often lack trees.

### CASE STUDY: IRMO, SOUTH CAROLINA (continued)

In December 2021 during their Arbor Day celebration, the town gave away 50, 3-gallon trees. After the experience of earlier campaigns, the town had determined that it was much easier for residents to avoid misplacing or forgetting to plant a larger tree and they plan to continue larger tree giveaways instead of seedlings.

Although Irmo is a small town, it also has the “small town advantage” of being able to act quickly and nimbly. Public Works Director Whit Kline noted that, when he needed to raise funds for trees, he could pick up the phone and call his tree board to raise money or organize a school planting.

This map shows neighborhoods in Irmo where tree canopy was lacking. To indicate the relationship between large, paved areas and urban heat island effects, GIC mapped surface temperatures and plantable open space to show how tree planting could abate future hot days (over 100°F), so that the town could use plantings to mitigate urban heat islands.



## Section Summary

In this section, we discussed who to engage and why to engage them. We provided compelling statistics and rationales for why trees need more focus by local governments and communities. We detailed strategies to ensure urban trees do not decline over time and emphasized that even a small town can launch a tree campaign.

Municipalities are often confused on what to focus on first and how to use any data they have gathered. Do we need more data? Should we carry out a tree inventory, map our tree canopy, or use statistical tools to estimate our tree coverage and establish our goals? And how should we measure progress/failure?

Cities are often surprised to learn that canopy coverage is lower than expected. They may not even know what is considered “good” canopy coverage. If they actually have data that shows canopy is being lost, they may have little idea why that is happening. What is the health of the canopy? What species are predominant, and are they diseased? Is such canopy loss inevitable? How can canopy be increased?

How to answer these questions, and more, is covered in **Section 2: Plan the Urban Forest.**







# 2. Plan the Urban Forest

## Determine Your Canopy Goals

Most communities are aware that planning for a sustained and healthy urban forest requires data. Knowing the extent and location of your tree canopy coverage is key to any successful tree planting campaign, since it will allow you to identify those areas that most need new trees and the types of trees you should plant.

You may also want to plant in specific areas to address wider ecosystem service goals – e.g., cleaner air, waterways buffered from runoff, reduced urban heat stress and reduced energy costs. Data relevant to those ecosystem service benefits are also important to know when setting goals, or for convincing elected officials, planners and natural resource managers about the need to evaluate and plan for urban and community forests. You should know, Where are trees abundant? Where are they lacking? Where could they do the most good (for health, the environment, cooler cities, beautification)?

Use the arguments presented earlier in this guide to make the case for tree conservation or planting to partners and decision makers as to why you need to have a healthy urban and community forest.

### You should know:

- Where are trees abundant?
- Where are they lacking?
- Where are the threats to them greatest?
- Where are the oldest trees and are there young trees to replace them as they age out?
- Where would new plantings do the most good?



Newly planted trees are a sign that the city will have canopy for the future too.



This tropical canopy creates a soothing escape from summer heat along Florida's Atlantic Coast.



Collecting these data requires GIS analysis using remote sensing and the creation of several maps with specific data layers.

To create a canopy goal, the current canopy needs to be known. Furthermore, if your city, town or group wishes to increase the canopy, it needs to know:

- The total available open space available for tree planting.
- How many trees can actually fill that space, given a variety of constraints.
- Whether that space is private or public, and whether private or public involvement is required.

Collecting these data requires GIS analysis using remote sensing and the creation of several maps with specific data layers. Customizing these data to your specific needs requires additional GIS tools, which are detailed below. If your community does not have those tools or skills, or your current GIS staff are not trained in remote sensing (analysis of aerial imagery), map creation and tree assessment, consider hiring consultants to help with this work, or pay for training to do the work in house. See **Appendix C** for what to include in a *Request for Proposals for Canopy Mapping*. If your local government staff want to learn how to create canopy maps, contact the authors of this guide to learn about training options. If you are an advocacy group, use the arguments in Section 4 to press local officials on the need to plan for and fund tree canopy analysis tools.

At right is an **Initial Canopy Goal Assessment**, to be conducted even if there are not reliable GIS data available. It can be carried out by city staff or volunteers and will represent an initial, general assessment of the present canopy and those threats facing it, such as future development. It will also allow you to determine what sort of data you have or that are missing, and what sort of tools you will need to formulate a realistic canopy goal. See the section after data collection for the final, data-driven canopy goal worksheet.



## Initial Canopy Assessment Worksheet.

1. Is your city well treed already (e.g., 40% or 50% tree-covered for residential areas and 30% for denser urban areas)?  
 Yes  No  Don't know

If Yes, have you also identified significant patches of mature forest? Have you evaluated ways to conserve them or maximize their retention?

2. Is your tree canopy at risk of significant loss, such as from a major development; or is the rate of development likely to eradicate a large area of current forest that is zoned or planned for development?  
 Yes  No

If Yes, you may need to strengthen policies to retain trees within developments, have incentives for cluster developments and also increase planting goals.

3. Do you have multi-year data to compare canopy loss (e.g., a canopy map of today versus one from 5 or more years ago) and does it show significant losses?  
 Yes  No

Note that accurate comparisons necessitate the same level of accuracy for each analysis.

If the answer is "yes" to the questions 1 and 2 above (and possibly 3, if data are available), then the goal might be to maintain the current canopy levels (and stem further losses). However, this will still require an active tree planting plan. If the data show the percentage canopy loss and a full open space analysis (PPA, PPS, PCA – see below) has been conducted, then it is possible to determine how many trees were lost (see the Boynton Beach Case Study on page 69 for an example).



## Questions a community might want answered:

- **Canopy Percentage:**  
How much canopy do we have now— what percent of our city or town is “tree covered”?
- **Canopy Distribution:**  
How evenly are trees distributed?
- **Are trees lacking in some areas of the city, such as downtown or business districts?**
- **Are trees absent alongside rivers and lakes where they could buffer runoff?**
- **How well treed are community spaces, such as parks and schools?**
- **Is tree cover distributed evenly and equitably— do lower income neighborhoods lack trees?**
- **Are newer subdivisions lacking canopy?**
- **What are the ecosystem services (e.g., air quality or heat reductions) performed by the city’s canopy?**
- **What is the rate of change for the city’s trees — is the canopy declining? Increasing? For public lands? For private lands?**
- **How old is the current tree canopy, and what is its life expectancy?**

Clearly, if a city hopes to simply maintain its canopy, but is losing 1,000 trees a year, then 1,000 new trees need to be planted annually just to maintain coverage levels. Also, the city will need to include any new developments proposed that may accelerate that loss. For example, if a new industrial plant is coming to town, its employees will need more homes, while a large area will need to be cleared for the plant and access roads so there may be more trees lost than in prior years, thereby requiring better tree protection codes and more tree planting. Existing zoning could possibly be changed to add minimum tree conservation and canopy coverage requirements, in order to reduce tree loss from developments.

### Using the Right Data to Plan Your Urban Forest

This section focuses on the types of data needed and how to obtain the most useful data to effectively plan for the urban forest. Of course, the first question when planning for the urban forest is, “What data do we need?”

If the city, tree group or agency has a low budget, statistical software such as i-Tree Canopy can estimate tree canopy coverage as a percentage of landcover. This software tool can estimate benefits provided by tree canopy for carbon capture, air quality and reduced stormwater runoff. This can generate knowledge and interest in how the community’s trees are benefiting society. These benefits are also known as “ecosystem services.”

It’s important to note that tools such as i-Tree Canopy use randomly sampled points to estimate canopy— there is no map produced for where canopy is located. To do any planning for planting or for setting realistic goals, a spatially derived canopy map is needed, which can be created using remote sensing tools. The imagery is then edited to fix such



Inventories are expensive and should be conducted in strategic areas such as parks or areas where trees pose a safety risk and need more care or replacement.

errors as shadows, which can be mistaken for trees; to eliminate large shrubs that are not trees; and to correct other problems that need to be rectified, in order to ensure that the final product is accurate. A canopy map is essential for any urban forest planning or goal setting, and, in this section, we discuss the methods and options available to you to obtain and improve your map.

A tree inventory is a catalog of your city trees— usually just those in your streets and parks. Inventories are expensive and time-consuming, so they only should be conducted with a specific purpose or question in mind, such as, “What is the condition of trees on such public lands as parks? Is more planting or care needed? Are more diverse species needed to ensure a healthy ecosystem or to improve survival?”

Alternatively, a city might decide to conduct a survey on its downtown commercial area or an enterprise zone. Or it might decide on a Tree Risk Assessment (TRA) survey, which is conducted in areas where there is potential risk to people, such as along public pathways or parks, areas used for assembly or bordering playgrounds. Some trees on private property may also pose a risk to public areas.

For more on preparing to address tree risks, see: [http://www.gjinc.org/storm\\_mit.htm](http://www.gjinc.org/storm_mit.htm).

A canopy map is essential for any urban forest planning or goal setting.



## Types of Tree Data That Can Be Collected

DATA TYPE	PURPOSE	PROS	CONS
<b>Canopy by Randomly Sampled Points</b>	Gather quick statistics on canopy percentage.	<ul style="list-style-type: none"> <li>• Quickly share data.</li> <li>• Inexpensive.</li> <li>• Can use or generate through i-Tree or other statistics software.</li> </ul>	<ul style="list-style-type: none"> <li>• Can overestimate tree cover since heights are not known/ confused with shrubs.</li> <li>• Cannot use data for spatial planning or planting plans.</li> </ul>
<b>Canopy by Imagery Analysis</b>	Create statistics on canopy percentage; determine where trees are; generate analysis data on tree distribution by income, public spaces, neighborhoods, master plans, etc.	<ul style="list-style-type: none"> <li>• Use for planning and comparisons from past to future (if done for multiple years).</li> <li>• Set realistic canopy goals.</li> <li>• Address planning needs.</li> <li>• Can also be used to generate ecosystem services statistics.</li> </ul>	<ul style="list-style-type: none"> <li>• Takes specialized software and skills to create.</li> </ul>
<b>Tree Inventory</b>	Determine health and needs of individual trees; calculate tree diversity (and needs for improvement); flag trees for removal or care.	<ul style="list-style-type: none"> <li>• Call attention to species' diversity needs.</li> <li>• Spot pests or disease outbreaks to address.</li> <li>• Identify areas where, or reasons why, trees are not surviving (e.g., undersized tree wells along a road).</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive to conduct inventories.</li> <li>• Consider using trained volunteers to conduct inventories.</li> </ul>
<b>Tree Risk Assessment</b>	Prepare for, and reduce the prevalence of, risk-prone trees; flag trees or limbs for removal, or for further monitoring.	<ul style="list-style-type: none"> <li>• Reduce costly damages from trees that may fail due to wind, storms, etc.</li> <li>• Prioritize areas for needed tree care and budget for maintenance or removals.</li> </ul>	<ul style="list-style-type: none"> <li>• Need to ensure that the municipality or facility can follow up with needed care/tree work (not just notate problems).</li> <li>• Some cities fear documenting risk as they think this increases liability – but that is irresponsible.</li> <li>• Staff must be certified/trained to perform the assessment.</li> </ul>



### Identify Outcomes to Set Goals

Setting your tree planting goal(s) requires that your first identify your desired outcomes. Do you want to increase shade and reduce temperatures, improve air quality, provide bird and wildlife habitat, foster natural beauty, reduce polluted runoff, create a coastal storm buffer, protect streams from erosion and sediment, or beautify a business or residential district?

### Setting a Canopy Goal

Whether your plans involve planting on public or private property, current data should inform your decision-making to ensure that your planting goals are realistic. Indeed, this cannot be stressed enough. For example, a city might set a goal to increase canopy by 5%, not realizing it equated to 100,000 trees— and it had only budgeted to plant 5,000! Either a radically new plan will be needed to plant the remaining 95,000 or the city will have to adjust its goal. If it chooses the former, it will need private sector partners and the public to achieve such an ambitious planting goal.

When launching a tree planting campaign or starting a new urban forestry focus, the first question most communities ask is, “How many trees should be planted?”

The number of trees to plant depends on two factors: first, the goal established for the community (city, county, neighborhood, watershed or other planning entity/boundary); and second, the amount of suitable public and private space there is actually available for planting trees.

Given that there is plenty of available space, setting your tree planting goal(s) requires that your first identify your desired outcomes. Do you want to increase shade and reduce temperatures, improve air quality, provide bird and wildlife habitat, foster natural beauty, reduce polluted runoff, create a coastal storm buffer, protect streams from erosion and sediment, or beautify a business or residential district? Articulate what outcomes your community wants to achieve, in order to inform goal development.

You may also want to prioritize your goals, especially if you have a large number of them. What is the most important goal you wish to achieve? And is there some easily achievable goal that will produce quick results, and will boost enthusiasm for the rest of your tree-planting program?

See page 45 for a longer discussion of different types of planting outcomes desired and appropriate goals.





## Why did many cities establish 40% as a canopy goal?

Many cities set a 40% canopy goal because a national forest advocacy group had recommended 40% as the desired percentage cover— almost half of a city should be covered with trees.

Since there was no particular basis for that number, it's no longer used as a generic goal. Rather, local goals and conditions are taken into account. The density of development within the city, available space for new trees, and the specific desires of the community all factor into establishing a worthwhile, realistic and achievable canopy goal.

## Options for Setting Your Goals

Cities often want to choose a standard goal, such as to increase its tree canopy by 5% in 5 years, or something catchy, such as “30% canopy by 2030!” However, setting numbers that sound good might not be realistic. One Southern city set a goal to plant 40% canopy. Unfortunately, this percentage coverage was higher than the available land to plant and would have resulted in planting every possible place, including schoolyards, playing fields and cemeteries, and would have required 100% participation from all private landowners and neighborhood homeowners’ associations. This would have equated to 100% shade (no more vegetable gardens or playing fields) and would even have required removal of buildings to create enough planting spaces. This example shows why it's not recommended to set a goal without understanding whether the open space physically exists in which to achieve it.

A city is unlikely to achieve an ambitious planting goal if it intends to plant only on publicly owned land. It will almost certainly require partnerships, laws and programs that incentivize the private sector to participate. Also consider that some of that publicly owned land makes for a difficult planting environment. While parks or schools are often excellent places to plant trees, some rights-of-way (RoWs) along sidewalks and streets may be too narrow or affected by conflicts with underground or overhead utilities. The aim is not only to determine what spaces are open, but what spaces are suitable to facilitate healthy tree growth.

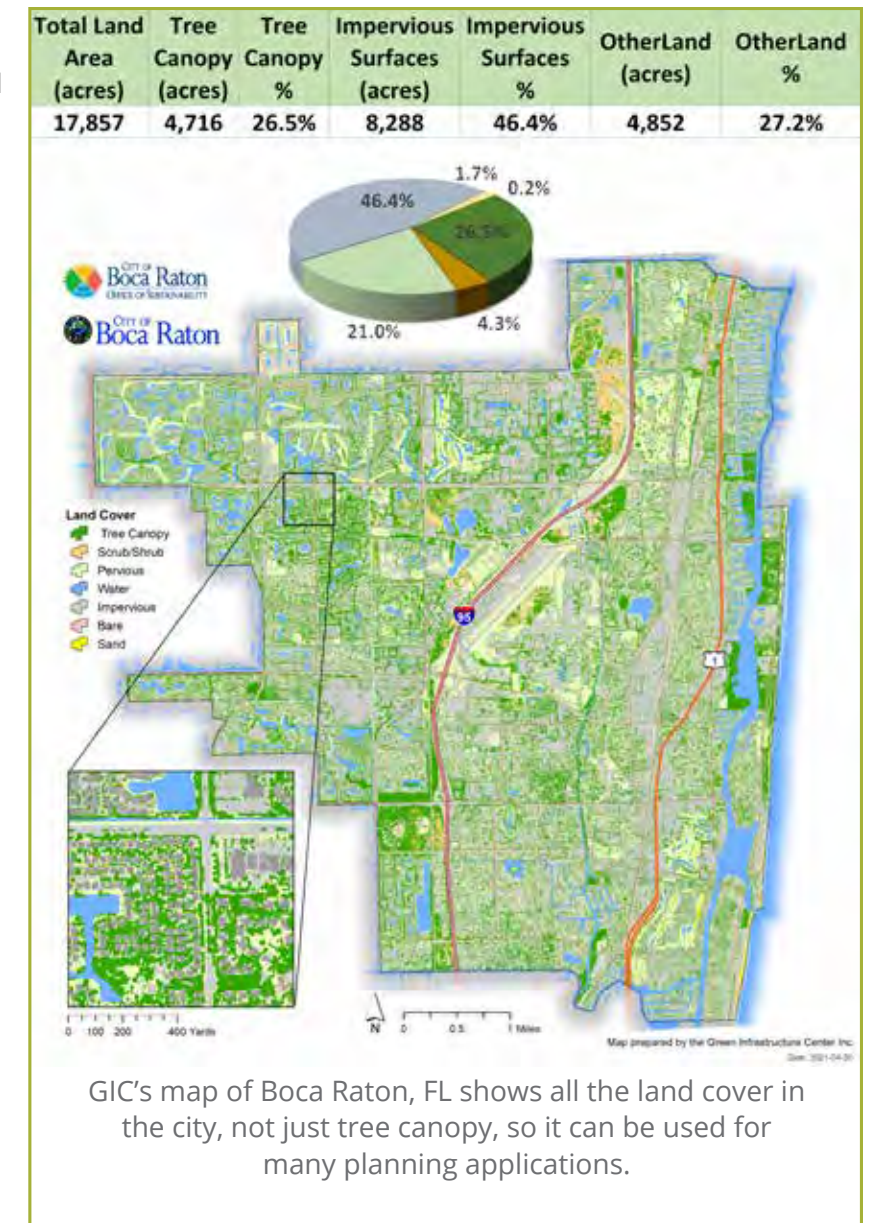
## Using Maps and Data

A map showing where tree canopy and open space are located is critical to establishing a realistic planting goal. The most important map needed is a general land cover map, which should include tree canopy. A land cover map accounts for every area of the earth, as seen from satellite imagery. A land cover map also includes other ‘classes’ of land cover including bare earth, grass, shrubs, impervious surfaces and water. Aerial imagery is analyzed to categorize different types of land cover, such as trees, shrubs, grass, bare earth, water and impervious surfaces. Usually, land cover maps do not distinguish individual trees.

There are many reasons to analyze all major types of land cover – not just trees. Although tree cover locations are important, planting plans also require knowledge of where there is open space to plant new trees. Areas where trees could be planted are referred to as Potential Planting Areas (PPA) and usually include areas that are identified as bare earth or turf. However, impermeable areas that are no longer needed, such as overbuilt mall parking, could also be utilized by removing the hard surface and improving the soil to create new plantable areas.

## Canopy Mapping Tools

There are various software tools that can recognize land cover types, based on the feature's physical properties. Commonly used tools apply light reflectance from the feature's surface. More advanced methods, such as object recognition tools, consider a feature's shape and locational context, and can be used for higher accuracy. The results from these applications can be combined with feature-height data derived from LiDAR, which is important if you are to distinguish trees from large shrubs and bushes, or marsh areas.





Analyzing imagery and creating a tree canopy map allows for planning and goal setting based on canopy location. This is an important distinction. Some software tools (such as i-Tree Canopy) only apply random sampling to estimate the tree cover. This means a subset of randomly sampled points from known land cover are analyzed and the resulting tree cover percentage is derived using statistical methods to model the likely canopy cover percentage, but it does not map individual trees, patches of woodland, or open plantable areas. In other words, while software tools that use randomly sampled points provide a quick, easy and relatively accurate way to derive a canopy coverage statistic, they do not determine where those trees are located. When canopy location is unknown, plans

cannot be made about where to conserve trees, determine the largest clusters or trees, identify plantable open space areas for increasing tree canopy, or for future comparisons concerning tree losses and gains.

In addition, the authors have observed that randomly sampled, user-defined observation points often produce a higher tree canopy percentage than actually exists. Remote sensing of aerial imagery (based on conducting analysis and comparing that to results generated through i-Tree Canopy) tends to show lower canopy coverage than randomly generated points methods. This is due, in part, to common identification errors that mistake other leafy vegetation, such as bushes, for

## Trees Can be Targets for Diseases and Pests.

There are many pests that can affect urban tree health and their prevalence may necessitate that a locality avoids planting more trees of the affected species that could soon die. For example, American elms were felled by Dutch elm disease, a fungal disease spread by bark beetles that wiped out



*Emerald ash borer is killing ash trees.*

Similarly, emerald ash borer is responsible for killing tens of millions of ash trees in 30 states and is now in 35 states in the Eastern and Central U.S. and Canada, so planting ash trees may be a risky choice in those regions. Similarly, a new pest, crape myrtle bark scale, is a small insect that appears as a white or gray, felt-like encrustation that can stunt the growth and blossoms of crape myrtle

almost all elms across the U.S. a century ago, killing an estimated 100 million trees. However, elms may be on the rebound thanks to disease-resistant cultivars. <https://blog.nature.org/science/2017/08/09/quest-restore-american-elms-nearing-finish-line/>

trees and has begun to infect them across the Southern U.S. So, when choosing which species of trees to plant, consider whether there are existing pests that could infect them and also ensure a diversity of tree species, so that, if one tree species is infected, other trees may not be.

## Software and Technical Tools Using Remote Sensing to Map Canopy Location

The **Normalized Difference Vegetation Index (NDVI)** is a standardized index allowing a GIS analyst to generate an image displaying greenness (relative biomass) based on imagery captured from above the Earth. This index imagery can pick out vegetation by using the contrast in the characteristics of two bands from a multispectral raster dataset. Vegetation can be identified through the chlorophyll pigment absorptions in the red (R) band and the high reflectivity of plant materials in the near-infrared (NIR) band.

The NDVI image, along with the source imagery from the **National Agricultural Imagery Project (NAIP)**, provide 4 spectral bands (red, blue, green and infrared), which are used to identify various features where they visually match the imagery most accurately; for example, the green reflected from the leaves of a tree. To learn more about NAIP, see [https://www.fsa.usda.gov/Internet/FSA\\_File/fourband\\_info\\_sheet\\_2011.pdf](https://www.fsa.usda.gov/Internet/FSA_File/fourband_info_sheet_2011.pdf). A tree canopy class is verified and refined using a **LiDAR Normalized Digital Surface Model (NDSM)** to differentiate trees from smaller green vegetation.

**LiDAR—Light Detection and Ranging**—is a remote sensing method used to examine the surface of the Earth. LiDAR fires laser beams to the ground and measures the return interval to determine obstacles and their distance. It can

especially be used to show height, since a taller object has a shorter distance for the light to bounce and return than an item lying closer to the ground. As such, LiDAR functions similarly to radar and sonar. To get the NDSM, those LiDAR beams that return first from the ground are subtracted from those that return last, giving the height of features above the ground; for example, a tree (vegetation above 10-15 feet) or a bush (vegetation below 10-15 feet).

Software tools such as **Feature Analyst**— an **ArcGIS** extension— can be used to perform the primary classification. Feature Analyst uses a model-based, object-recognition approach that extracts features based on their spectral signature, shape and locational context. It allows for rapid collection and analysis of vector feature data from high-resolution satellite and aerial imagery. For example, this can be used to quickly pick out buildings (e.g., a rectangle) and other geometrical features.

All these data together are collectively utilized to create a highly accurate tree canopy map, as well as show open spaces that may be suitable for planting. Using this process requires advanced GIS skills. GIC provides training in these methods through its Canopy Coach program for GIS analysts who want to learn these skills. Contact GIC to learn more about training.





Some states, such as Maryland and Virginia have created imagery at 1-meter resolution for their entire state.



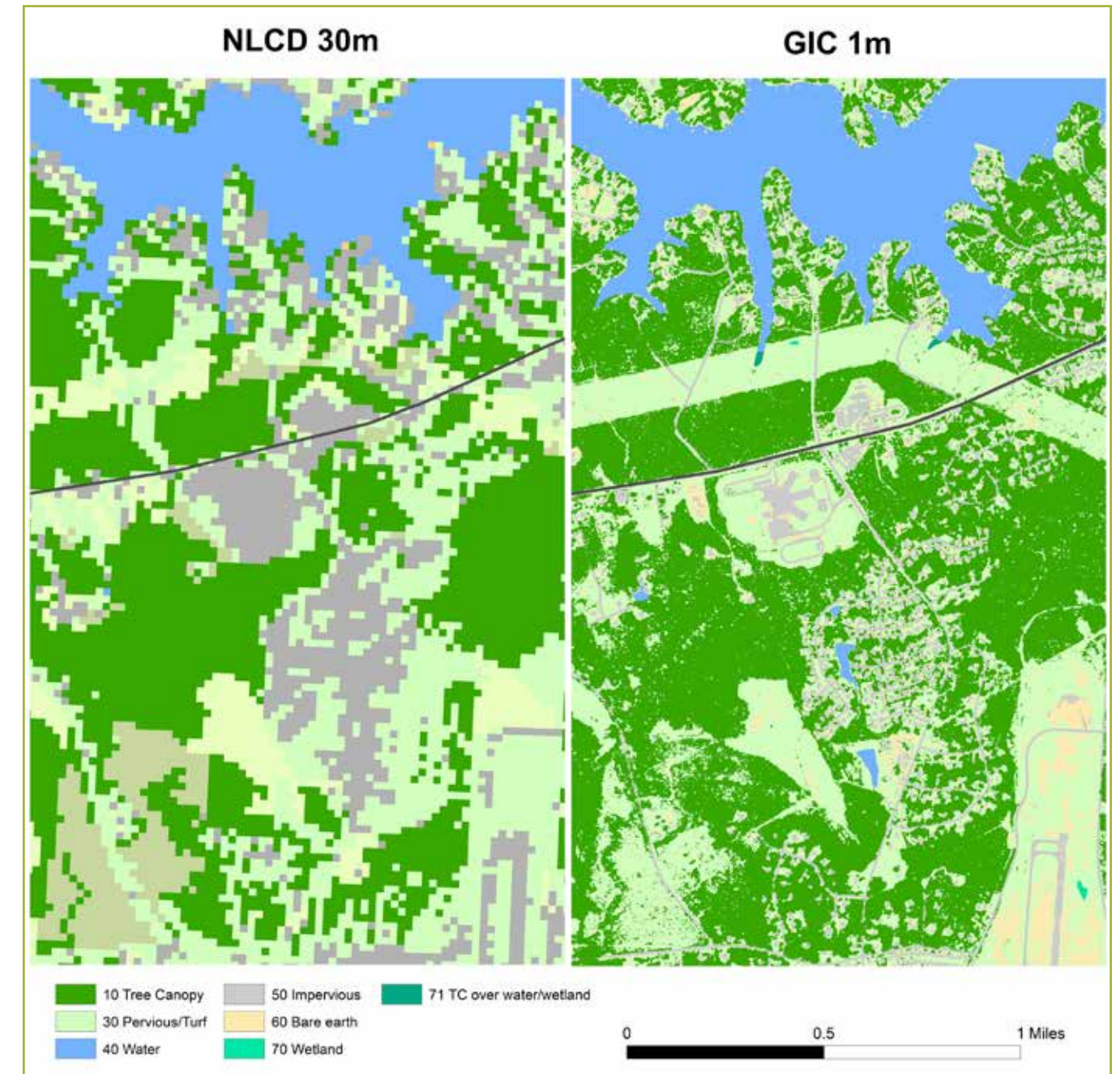
trees. Research comparing i-Tree and other random sampling tools to remote sensing methods bears this out (Parmehr et al., 2016).

Resolution of the imagery relates to its accuracy. A common level of resolution for land cover data is at a scale of 30 meters. This means that data are analyzed in large 30-meter x 30-meter squares, which is larger and far less detailed than using a much smaller area of analysis, such as 1 meter square. Data collected at the state scale is commonly at 30-meter resolution. So, if your state offers you a landcover map, it may not be fine-grained enough to pick up all the trees. While large-scale 30-meter maps tend to pick up large areas of tree cover fairly accurately and are adequate for mapping forest cores larger than 100 acres and forest corridors (300-meter-wide pathways), it is not good enough to create tree canopy maps in a city where land cover can change dramatically from one meter to the next.

Some states, such as Maryland and Virginia have created imagery at 1-meter resolution for their entire state. Many counties have also created new imagery maps at 1-meter that can be analyzed to create a tree canopy map. However, additional work is needed to pick out individual and street trees (see text box on Software and Technical Tools) and this extra work is typically not done for statewide maps. See the image at right comparing Virginia's 30-meter land cover map before and after additional analysis by GIC that mapped specific trees using 1-meter resolution imagery. Using NAIP imagery ensures that the right scale (minimum of 1-meter) is used. In some cases, NAIP maps are now being offered at even finer grained resolution (e.g., 0.6 meters).

## The Details are in the Resolution

These images show the differences of 30 meter resolution on the left versus 1 meter on the right. Urban canopy maps needs to be at 1 meter or less in order for trees to show up. The 30 meter resolution at left misses many additional trees found when using 1 meter resolution imagery shown at right.





## Example Statistics From Canopy Data

The chart at right shows examples of ways to divide and analyze canopy data. Tree data can be clipped to any area, such as a master planned area or a region; or it can be clipped by political boundaries, such as council, commission or board districts. Some politicians enjoy competing to have the most trees or using the data to point out the need for more tree investment in their districts.



Canopy can be analyzed in many ways such as by neighborhoods or by street shade.

## Analyzing Canopy Data

TYPE OF ANALYSIS— PERCENT OF TREES BY:	Combine canopy and PPA data to see tree location/plantable areas in relation to specific areas of concern	Applications to Target Planting (See example maps on pages 38 and 71.)
INCOME/RACE	Overlay census tracts with canopy data to review canopy distribution.	Compare income or race to canopy cover. Are there social equity issues? Is canopy less in low-income or minority areas?
NEIGHBORHOOD	Use local neighborhoods shape file (from GIS department) and clip (show) canopy by neighborhood.	Which neighborhoods have more/less trees? Which need more trees?
WATERSHED	Use local watershed boundaries and clip canopy to each.	Used to set watershed plan goals, using trees as a BMP, buffer coasts from storms or prevent runoff from uplands.
DOWNTOWN, HISTORIC OR OTHER IMPORTANT DISTRICTS, SUCH AS ECONOMIC OPPORTUNITY ZONES	Use planning districts or master plan area shape files and clip canopy data to each district.	Beautify/revitalize downtowns and improve property values/ set goals for areas being restored.
PARKS	Use locality park boundaries and clip canopy data by parks.	Which parks have more/less trees? Compare to plantable areas - is there room for more trees? Consider reviewing these data with census race/ income data.
TREES AS BUFFERS (BY MILES OR FEET)	Extend a boundary from surface waters (e.g., 100, 50 or 30 feet from stream or lake edges.)	Which areas lack forested buffers for water quality or for wildlife habitat?
TREE CANOPY OVER STREETS	Use local road network and clip canopy from 5 to 15 feet in from edge of RoW (creating a shape file over street corridor). Also calculate canopy within the shape file by block.	Which streets are at least 50% or more tree covered, 25-49% covered, 10% to 24%, 15% or less, 0%? Code streets by coverage and target low-canopy streets for planting.





Some trees, such as the American sycamore give off irritants that can cause respiratory distress. An entire neighborhood of this tree could cause distress for people who suffer from allergies or asthma.

### Tree Inventories

Tree inventories catalog the location of individual trees and usually include other information as well, such as tree diameter at breast height (DBH), species, canopy condition (good, fair, poor), estimated height, etc. Inventories are usually done for street trees, or for trees in such public spaces as parks and schools.

There is a great variety of software for counting trees and storing the data, including interactive maps, tools to map diversity, etc. Platforms such as Open Tree Map or Tree Plotter are proprietary software that can store your mapped trees for a fee. Note that this type of software is rapidly expanding and there are likely other firms too. A city that has a publicly viewable GIS portal also could just load the tree planting points for the public to view.

Tree inventories can be performed either by professionals or by trained volunteers. When working with volunteers, good training is essential. Definitions and evaluation criteria will need to be standardized, such as when ranking a tree's condition as good, fair or poor, or for assessing the condition of the tree canopy.

Inventory data can be stored or exported to a simple spreadsheet and used to analyze such statistics as the diversity of trees, the numbers of small, medium and large trees, and other factors. These data can then be used to inform tree planting goals. For example, after a volunteer-conducted street tree inventory, one city found that half of its street trees were crepe myrtles. While crepes are pretty, they do not provide the same benefits for shade, pollinators or stormwater uptake as does a traditional native canopy tree and they can also be subject to pests, such as bark scale. In that case, the city could educate residents about planting other trees instead, and not include crepe myrtles in tree giveaway programs.

It is also important to ensure a high level of tree diversity throughout an urban forest. When communities have an overabundance of the same species, there can be dire and dramatic consequences. A whole neighborhood of one species

of trees, or a beautiful tree-lined street, can die off entirely within a few months. For example, in Pennsylvania and New York, certain species of maple have been attacked, destroying large numbers of trees in several historic downtowns. If a street (or multiple streets) has only one tree species, it may be subject to greater risks if a particular pest or disease enters the community.

Furthermore, some trees, such as the American sycamore (*Platanus occidentalis*), give off irritants that can cause respiratory distress. A few of these trees on a block are not a concern, but an entire neighborhood of this tree (as is the case in some cities) could cause distress for people who suffer from allergies or asthma.<sup>3</sup>

### Examples of statistics from tree inventories that can inform planting goals:

- **Diversity:** Numbers of different species; numbers of large versus small canopy trees; street by street analysis; neighborhood analysis, etc.)
- **Location:** Miles of streets with or without trees: by neighborhood; by historic district; along walking routes to schools or parks; in central business districts; by council district; by age and income by linking to census data, etc.
- **Tree Condition:** number of street trees by excellent, good or fair condition.
- **Eco-system services:** carbon sequestration; stormwater uptake; particulate uptake; etc. For methods, see the calculation tools in Section 5 of this guide.

If the inventory has also tracked empty tree pits and stumps, those 'missing tree' locations can also be included in an inventory.

<sup>3</sup> Sycamores have trichomes, very small, fine hairs on the back of each leaf, which can cause physical irritation to the eyes and nose and bouts of coughing or nausea.

## What tree data are most needed?

In priority order, a city or town should have in place:

1. A canopy map showing the locations of its forest cover.
2. An inventory of trees that break data down into specific locations, types and species for specific purposes, and that can provide such information as tree diversity and health in the downtown, tree diversity in parks, etc.
3. TRAC assessments to determine the condition of trees and likelihood of their failure. (Some trees may have been flagged for risk assessment follow-up during the inventory process.) TRAC requires specialized training and analysis and should be used strategically for areas of concern, such as places where failing trees would likely impact people, infrastructure, or property.

OPTIONAL:

4. Sample plots. These can be used to run additional statistical analysis, such as an urban Forest Inventory and Analysis (FIA) or for inputs into i-Tree tools, such as i-Tree eco, in order to determine the environmental benefits of the citywide canopy. These can also generate other useful statistics, such as the species composition of the canopy (if enough sample plots were conducted), and provide estimated percentages of hardwoods versus pines, natives versus invasives, dominant species in the canopy, and so on. However, it requires a trained crew to gather these data and up to 200 plots which can be time consuming.



## Tree Risk Assessments (TRAQ)

Tree risk assessments are more formal evaluations of tree conditions performed by certified professionals and are designed to evaluate tree risk. Data concerning these tree risks can guide the removal of unsafe trees or limbs to increase the safety of urban and community trees. This can reassure the public that tree plantings do not equate to greater safety risks. For more on TRAQ certification, see <https://www.isa-arbor.com/Credentials/ISA-Tree-Risk-Assessment-Qualification>.

Risk is determined by whether the tree has the potential to affect people or property. So, when a rotting tree falls in a remote forest, it would have a low-risk assessment ranking versus a tree with a rotten limb overhanging a public sidewalk. A tree risk assessment should be performed for high-traffic areas (e.g., trees in public plazas) or high-risk areas, such as trees subject to excess wind or wave action, at major road interchanges, overhanging pedestrian shopping areas, and other areas with potential human targets if failure occurs.

Not all cities perform tree risk assessments. Some have urban foresters or trained volunteers collecting these data. However, for highly trafficked areas, public plazas and trees in high-use areas in parks (e.g., playgrounds), trees should be surveyed annually. Cities should consider sponsoring their arborist staff to obtain TRAQ certification.

The following questions can help establish where to plant trees to achieve your goal(s). A canopy goal should be informed by planting data (how much canopy you have and where) as well as how much space is available to plant. The canopy map (1-meter resolution or finer), once checked over for quality assurance by a GIS analyst and forester/arborist, should provide an accurate measurement of the extent (percentage) of canopy city wide. As noted earlier, LiDAR data should have been used to rule out shrubs and other green vegetation (under 10 feet tall).

## Potential Planting Area Data

An open space Potential Planting Area (PPA) assessment will be needed, even if the community's goal is simply to maintain current canopy. This will include creating a PPA map, especially if the intent is to increase the canopy. Plantable spaces need to be mapped and available planting areas calculated. Unless this area has been calculated, the community cannot set a realistic planting goal. GIC uses a PPA map to digitally fit trees into the landscape. In doing so, it allows for buffering around structures, utility lines, or other uses that would interfere with trees. This is the actual planting area available in any city. Then, once the open

spaces have been mapped, trees can be added in digitally to model how much area can be planted, and with how many trees.

Three key data layers are needed to model how many trees can be planted. They use the landcover layer and other relevant data as their basic sources of digital information:

- **Potential Planting Area (PPA)** — open space available.
- **Potential Planting Spots (PPS)** — locations where planting trees is actually possible.
- **Potential Canopy Area (PCA)** — modeled canopy at maturity (e.g., 25 years).

When it comes to buffering utility lines, facilities or other structures that would interfere with tree health and that could cause damage, either to the tree or the structure, the following exclusions are selected from GIS-created land cover.

### Exclusion Features:

- A 10-ft. buffer is placed around impervious surfaces, including buildings and roads.
- Sports fields are identified using imagery or other city park data.
- Open areas that have a programmed use, such as fairgrounds, and that appear as public lawn, are excluded.
- Areas that are already approved for imminent development are excluded for planting, unless there is a tree conservation plan in place, in which case the site plan should be used to inform editing out areas to be developed from the available plantable area.

### The Potential Planting Area.



NAIP Image.



Potential Planting Area (PPA).



Potential Planting Spots (PPS).



Potential Canopy Area (PCA).

When a rotting tree falls in a remote forest, it would have a low-risk assessment ranking versus a tree with a rotten limb overhanging a public sidewalk.



*Potential Planting Area (PPA)* data should be reviewed by the city's arborist and planners to point out areas that need to be digitally edited to represent city expectations of where planting is or is not allowed. These and other exclusions should be applied during this review phase. Also, check the map against any planned changes of use that might have been missed when compiling the map. This additional work to exclude known areas that cannot be planted results in a more accurate and realistic calculation of plantable areas and potential numbers of new trees.



Residents review canopy maps

### Potential Planting Spots.

The *Potential Planting Spots (PPS)* overlay is created from the PPA. To do this, the PPA is run through a GIS model that selects those spots where a tree can be planted, depending on the desired sizes of the trees when mature. Planting scenarios can be based on a 20 ft. or a 40 ft. wide mature tree canopy cover, with a 30% overlap. As a result, planting spots are either 16 ft. or 32 ft. apart, respectively. If very large trees, such as live oaks, are anticipated, some tree canopies can be estimated at 60 ft. or wider per tree.

### Potential Canopy Area.

The *Potential Canopy Area (PCA)* is then created from the PPS. The possible planting spots are given a buffer around each point that represents a tree's mature canopy. First, larger canopy trees are digitally added, followed by smaller ones, which are fitted into the remaining spaces. Planting spots are assigned a buffer of 10 or 20 ft., to result in trees 20 and 40 ft. apart, with a 30% overlap. This utilizes gaps that would otherwise be found between adjacent circles and reflects the reality that trees overhang and intermingle with each other. By taking the open space data and converting it into circles that represent the mature spread of each tree, the total number of trees that can actually be fitted into an open space is known.

Next, foresters and planners can determine the total number of large and small trees that could potentially be planted in the open spaces available. These spaces can then be classified according to the city's ownership data to determine if planting spots are on public or private property. As noted earlier, a general rule of thumb is that 80 percent of land within a city or town is privately owned, and about 20 percent is in the public domain. So plantable areas can be considered similarly.

The final map of available planting spaces and total number of tree planting spots can then be used to calculate the cost of meeting a specific canopy goal— and to determine whether that goal is realistic or not. The GIC uses the available planting space and the number of trees that can be fitted within the PPA to create a tree planting calculator. This makes it far easier for planners to convert plantable area into number of trees when setting goals. Additional cells are added in the calculator to cover the cost of planting trees. See section on calculating the planting numbers and costs, pages 48-49.

Once you have collected and assembled all the relevant data, use this final, data-driven canopy goal worksheet (opposite page).

## Final, Data-Driven Canopy Goal Worksheet

1.  Yes  No Our city is not well treed and open space (PPA) analysis shows we have room to plant significantly more trees. If Yes, skip to Question 3.
2.  Yes  No Open space analysis shows that we have a small canopy, but not a lot of room to add trees overall. So, we plan to add trees as strategically as possible. If Yes, go to Question 3. If No, it is assumed the city will focus on a no-net-loss goal, discussed on page 46. However, still consider the strategies in Question 3.
3. Following are some examples of where to plant. Check those that apply to your situation:
  - A.  Yes  No Is the city revitalizing a downtown, a particular business district or creating an economic opportunity zone? Clip the canopy to those areas in GIS – if canopy is very low (e.g., 8-11%), then more trees are needed.
  - B.  Yes  No Is the city interested in protecting water quality? If yes, add trees to buffer plantings.
  - C.  Yes  No Are local rivers or bays under a TMDL plan? If yes, plant trees to clean runoff.
  - D.  Yes  No Are trees lacking alongside rivers and lakes? Clip the canopy in GIS from the edge of the river or bay to several distances inland, e.g., 30, 50, 75, or 100 ft. from the water's edge. Where are there gaps in canopy? Plant trees along those areas and consider adopting a stream buffer ordinance to require trees be retained along streams for cleaner water.
  - E.  Yes  No Is the city seeking to ensure healthy children, provide opportunities for outdoor learning, reduce student stress and raise learning readiness or reduce cooling costs of school buildings? Clip the tree data to school properties. Excluding playing fields, are there areas to plant more trees? Consider linking tree growth and care to the curricula (e.g., engaging students in tree selection, planting, measurements and care, as well as learning about careers in community forestry).
  - F.  Yes  No Is the city committed to cleaner air or has a climate action plan? Consider adding canopy to achieve a health goal, such as improving air quality. Use i-Tree's equations for values per acre of trees to determine the benefits of adding canopy. (e.g., planting 5 acres of new trees = \_\_ reductions in particulate matter and ground level ozone while

taking up \_\_ of greenhouse gases and sequestering \_\_ pounds of carbon, For an example, see the Boynton Beach Case example and Section 5 of this guide to calculate air quality based on acres of trees.

- G.  Yes  No Does the city suffer from excessive urban heat, especially in the summer? This effect is known as an urban heat island. Since canopied sidewalks can be 12°F cooler in the summer, use the possible planting maps to determine which streets with open space could become shaded green streets. For more, see Section 3 of this guide on planning and planting for social equity. Or use a heat map to target areas of the city that show up as particularly hot (or simply low-canopy areas).
- H.  Yes  No Is recreation and exercise a key focus for the city? Add tree planting to the health campaign.
- I.  Good  Average  Poor How well treed are city and town parks, greenways and trails, or playgrounds? Consider community engagement in park and trail planting campaigns.
- J.  Yes  No Is the city or town interested in social justice and equity? Clip tree data to analyze by census block groups and look at tree cover by race and income, or for public housing areas.
- K.  Yes  No Is the canopy lower in low-income areas, in neighborhoods with a high percentage of minority classes? Consider a community engagement process to join with residents in planting and caring for trees. Hire local youth to provide tree care and train them in skills such as pruning.
- L.  Yes  No Are some neighborhoods less well treed than others? Clip the data to neighborhoods (if boundaries are known) and see which areas lack trees. Choose those neighborhoods with low canopy for replanting. Also, consider whether older neighborhoods may need an infusion of new tree planting to replace trees before they all age out. Do some newer subdivisions lack canopy?
- M.  Yes  No Is the city interested in greenways, wildlife corridors, birds or biodiversity? A connected landscape is important for fostering biodiverse ecosystems. Focus on establishing or protecting forested corridors, connecting patches of trees, and use rivers with forest buffers to connect the landscape. Consider treed corridors that can help pollinators across backyards.





## No-Net-Loss Goals

No-net-loss goals are still valuable. While not as exciting (at first) as the notion of expanding the urban canopy, goals to avoid tree loss can be couched as maintaining a city's health and quality of life. Since hundreds or thousands of trees could be removed or lost annually due to development, disease, or simply old age, a no-net-loss goal requires active tree planting to achieve. Assuming 1,000 trees are lost annually (which can be verified by comparing canopy maps every several years), at least that many replacement trees need to be planted every year.

In addition to trees lost from age or storms, a no-net-loss goal also requires looking at city policies that may lead to a change in coverage. For example, excessive parking requirements for new developments may pave the landscape beyond what is needed. Similarly, if land can be cleared (lot line to lot line clearing) before a site plan is approved, then tree conservation is almost impossible, since there is no review of which or how much canopy to retain. To evaluate city policies that contribute to tree conservation and policies that foster excessive land conversion or pavement, see GIC's Trees and Stormwater Codes and Policies Audit tool as a guide to which policies may need to be changed. See [http://www.gicinc.org/trees\\_stormwater.htm](http://www.gicinc.org/trees_stormwater.htm)

## Specific Considerations When Setting Goals: An Example Scenario

A goal can be a city-wide goal or can be determined for the city by aggregating a number of smaller goals together. Following is an example scenario for building goals for social equity, air quality, and health.

**Social equity:** Increase canopy on four city public housing lands from 10% to 20% = 8,300 trees.

**Air quality:** Increase canopy in low-canopied neighborhoods to achieve a minimum of 20% = 10,200 trees. This will sequester \_\_\_ lbs of carbon, clean the air by filtering \_\_\_ lbs. of particulate matter, and \_\_\_.

**Walking and health:** Plant trees along downtown streets to increase property values and foster walkability along six additional miles of city streets annually = 1,100 additional trees.

Adding the above tree needs together = a net increase in city canopy of 19,600 trees.

Plug these trees into the calculator tool to get to the new canopy percentage.

For urban areas, GIC plans for 64 trees per acre with a canopy spread of 40 feet. So, calculate 40 trees = one acre of coverage.

In this scenario, a city was adding 3% more canopy to result in coverage of 20% total canopy coverage over 20 years but targeting planting to meet specific area needs.<sup>5</sup>

Once trees numbers are established, the benefits of the resultant canopy can be quantified. For example, the new trees will mitigate climate change. Prevent climate change by sequestering \_\_\_ additional pounds of carbon and \_\_\_ greenhouse gasses from the 20,000 new trees to be added to the city's canopy coverage.

See Section 5 of this guide for pollutants removed per acre of trees.

<sup>5</sup> Note that when planning trees per acre in an eastern natural forest with many large overstory and smaller understory trees, a good number to estimate is 435 trees according to the SC Forestry Commission. In natural forests, trees grow more densely. The minimum tree coverage for USFS funded forestry projects is 300 trees per acre.



These trees in a plaza were planted at the same time. The trees at left appear to have more open planting beds, yet they are smaller and stunted compared to the trees on the right. What's the difference? The trees at right actually have more space and structural support underneath and are getting more water and nutrients due to adequately sized planting area. Thanks to GreenBlue Urban for these images.

## Million Tree Goals: Do They Make Sense?

A million trees— sounds like a lot! A big inspirational number, right? But planners should be careful to avoid planting new trees in places where they failed before. Before beginning such a campaign, consider:

- How many trees are lost annually and what is the cause of those losses?
- Were the tree wells too small?
- Were there too many utilities underneath?
- Were they not properly planted or maintained?
- Also, if trees are being put back into former tree wells, why did the original trees die, is there a reason to avoid or improve the planting space? Or were they the wrong tree for that site?
- What will the net number of new trees be once annual losses are factored in?

A careful assessment is needed before adopting lofty goals that may not succeed in the long run.



## Calculating the Cost to Achieve a Planting Goal

As we have seen, the first step when it comes to calculating your canopy goal is to assemble all the relevant data together into a series of map overlays that provide you with a realistic estimate of available open space and its tree planting capacity. When linked to city/private property boundaries, this gives you the base data for a range of city goals for your trees— not just overall canopy size. For example, it will highlight those areas of the city that have a paucity of trees. It will also show where walking routes, to schools, for example, or to parks, are devoid of any shade. It will provide data on where there are trees present or absent from the downtown shopping area, or where trees would make shopping and other leisure activities, such as cycling and fishing, cooler and more enjoyable.

It is only when such wider social and cultural concerns have been considered, alongside more general city plans, that a realistic and targeted canopy goal should be implemented, which can address a whole range of issues— such as walkability, tourism, economic benefits for shops, helping the downtown become successful, greening the entrance corridors, cleaner air and water, stormwater protection, and so on.

### And then, it comes down to what all of this will cost.

**Cost per tree:** The cost per tree to be planted depends principally on city or group policy for the size of the trees required, such as large caliper (1-2" diameter) or saplings. It also depends on labor costs. Are those planting the trees volunteers or city staff, or a combination of both? If large caliper trees

are to be planted, and then maintained by staff, both planting and maintenance hours (mulching, pruning and watering) need to be included in per-tree costs. On the other hand, a tree given away to the public through a give-away program will not have any costs associated with care (unless you wish to monitor their survival rate) but will have additional costs of publicity and organizing give-away events.

You may also wish to add in other costs associated with any planting plan you devise such as marketing, signage, educational workshops, training staff in tree care practices etc.

These costs are then added together to calculate a complete cost per tree. See the chart on the next page for an example.

**Removal-replacement cost:** Annual tree loss is also important to consider, not so much for removal costs (although that is a key consideration in some storm-prone communities), but to subtract those losses from the total planting number, so that replacement costs can be calculated. For example, if a city is planting 1,000 trees per year, but overall, the city is losing 1,000 trees to storms, development, disease or old age then their net trees added is 0. To meet an annual goal of 1,000 trees added per year, the city actually needs to plant 2,000 trees annually. If the city only wants to maintain existing canopy cover, then they can simply plant 1,000 trees to make up for trees lost. However, even if the goal is just to maintain existing canopy coverage, it is still recommended that city also consider where trees are being lost in case the city wants to target planting to areas in greatest need of reforestation, as described on page 46.



### Tree Planting Calculator for Increasing Tree Canopy Coverage

TREE COST (1 to 2 inch caliper)		Cost	
MATERIALS	Tree purchase price each	\$100.00	
	Gator Bag*	\$40.00	
	Stakes/Rope/Mulch	\$15.00	
Subtotal Materials per Tree		\$155.00	
INSTALLATION AND MAINTENANCE COSTS		Quantity/Cost	
STAFF HOURS	PLANTING—number of staff hours	1	
	PRUNING—number of staff hours	+2	
	Subtotal Plant & Prune Hours		3
	WATERING—number of staff hours	0.25	
	Multiply by days of watering		X12
	Subtotal Watering Hours		3
	Subtotal staff hours (plant, prune, water)		6
Multiply by staff hourly rate		x \$20.00	
Subtotal Labor Costs, per tree, first 2 years		\$120.00	
Total Costs Per Tree (materials & labor)		\$275.00	
Multiply by total number of trees		x 5	
Total Costs All Trees (materials & labor)		\$1,375.00	

\*A self watering bag can save on costs <https://www.treeddiaper.com/>

You may also wish to add in other costs associated with any planting plan you devise such as marketing, signage, educational workshops, training staff in tree care practices etc.



## Planting Calculator for Increasing Tree Canopy Coverage

Potential number of trees that can be planted in PPA		
40' Canopy spread	214,826	49.0%
20' Canopy (Understory)	223,696	51.0%
<b>Total trees that can be fitted into available open space</b>	<b>438,522</b>	
Current Tree Canopy Coverage	58.0%	
Current Possible Planting Area	5.7%	
Additional Tree Canopy Possible	5.7%	
<b>Max. Possible Tree Canopy Coverage</b>	<b>63.7%</b>	

Scenario Testing		
Timeframe (in years)	20	
New Tree Canopy Coverage Goal	61%	
Tree Canopy Coverage Increase to Reach Goal	3.0%	
Percent PPA to Plant to Reach Goal	52.6%	
	Number of Scenario Trees	
Percent Canopy Trees	49.0%	117,965
Percent Understory Trees	51.0%	122,836
<b>TOTAL</b>		<b>240,801</b>
Estimated Cost to Install and Maintain Canopy Tree	\$275.00	
Estimated Cost to Install and Maintain Understory Tree	\$275.00	
<b>Total Cost of Scenario CANOPY Trees</b>	<b>\$32,440,424</b>	
<b>Total Cost of Scenario UNDERSTORY Trees</b>	<b>\$33,779,864</b>	
<b>TOTAL COST All Trees</b>	<b>\$66,220,288</b>	
City Assumed Costs to Plant Canopy Trees*	30%	
City Assumed Costs to Plant Understory Trees*	30%	
<b>TOTAL CITY COST for Achievement of Scenario Goal</b>	<b>\$39,732,173</b>	
<b>TOTAL CITY COST PER YEAR for Achievement of Scenario Goal</b>	<b>\$1,986,609</b>	

\* Assumes the private sector assumes the other 70% of costs. This requires a planting campaign, many partners and a process to log where volunteered trees are planted.

## Using GIC's Tree Planting Calculator Tool

The GIC's Tree Planting Budget Calculator Tool applies the number of trees to fill the plantable area to the established goal. It allows a forester or planner to determine how many trees it would take to reach a certain canopy goal. For example, a city has about 15% canopy coverage and could plant 7.4% more trees to reach a total of 22.4% canopy. However, a city would not want, or be able, to plant every open space (both public and private), so instead a city might choose to plant 50% of the available space – or about a 3% canopy increase to reach 18% canopy cover. The calculator – using the potential planting spots derived through GIS -- makes it easy to determine how many large and small trees can be planted. In the example city, it comes to 14,283 large canopy trees and 32,214 smaller trees.

Once the number of trees that can be planted in available open space is determined and plugged into a planting calculator, a net planting number can be determined to meet the canopy goal. For example, if the city plants 200 trees per year, but loses 1000 trees per year that's a net loss of 800 trees annually, so in this scenario, the city needs to plant an additional 1800 trees per year to net 1000 total new trees. If the need is for 10,000 trees, then it will take the city 10 years to meet its goal, by planting 1,800 trees per year. In other words, reaching the goal of 10,000 new trees is based on:

X trees needed per year to achieve Y canopy value  
+ trees lost/timeframe in years = \_\_ Z trees to plant annually.

Combining these data with the cost per tree which includes maintenance = an annual budget for tree planting. It requires advanced GIS work first as noted. Contact the GIC to learn more about mapping canopy cover and setting up a tree planting calculator.

Using the GIC tree planting calculator tools, planners can grab cost data to determine a total cost for the planting program. The number of years to achieve the goal is included to derive the annual costs. Using the calculator tool requires having calculated plantable open space and the numbers of trees that can be fitted onto the landscape.

This type of planting calculator tool can be refined by adding three cost variables, one for paid or volunteer labor and, one for planting a variety of tree sizes which have varying costs (bare root seedlings versus 2-inch caliper large trees), and one for whether the trees were donated, part of a give-away program or paid for by the city. Thus, the calculator tool can be as simple or as sophisticated as needed. The key is to use actual data for how many trees can be realistically fitted into the existing open spaces so that the planting goal is matched to the actual available planting space by using GIS-derived figures for the numbers of small and large trees.





## Protecting Forests— Not Just Trees

The old English expression, “Can’t see the forest for the trees,” can be applied to the process of canopy goal setting. It’s important not to become so focused on numbers of total trees that one forgets to see important patches of urban forests that should be retained. Tree canopy makes up the “urban forest” overall, but there are patches of trees that can be considered a complete woodland or forest in themselves. There is no technical definition of a forest, but a cluster of many trees together, especially those in a forested area that has not been recently harvested or mowed under and that exist in a somewhat natural state, provide more habitat and water storage benefits than individual trees.

Once the canopy map has been created, it can be examined to locate places where there are patches of intact trees that form a woodland or forest. Those intact treed areas provide the greatest value for wildlife habitat, birds, pollinators, air quality and reduction of heat island impacts.



Mature, older forests also have a thick layer of organic matter, called the duff layer, beneath them. This organic layer builds up over time as leaves, bark and other detritus collect on the forest floor. The duff layer plays a key role in the biogeochemical processes of the forest, helping transfer nutrients as materials decay, keeping soils moist and absorbing the impact of rainfall. The duff layer acts like a sponge, holding water and filtering it so that there is less runoff, less erosion and cleaner water for both wildlife and people.

The duff layer acts as a sponge on the forest floor, soaking up water and providing nutrients to the soil.

Although the duff layer of a well-established forest supports a rich variety of microbes that play a key role in the forest ecosystem, in newer forests, this layer is very thin, or is almost non-existent, since it takes many years to build up. Furthermore, tree roots and microbes in surface soils trap and take up nitrogen and phosphorus, preventing these pollutants from reaching surface waters where they can cause algal blooms and low oxygen levels that harm fish. The soil layer in the forest traps more carbon than the trees do, so those wanting to achieve climate change goals should also consider the importance of healthy forest soils and their contribution to mitigating climate change.

A new forest of small trees, which is re-growing in a previously disturbed area, such as an old field, is not the same as a mature forest, which will tend to support rarer species of indigenous plants, animals and larger trees. Trees that



are growing in a former field may be stunted by poor soils from overly intensive uses, leading to more invasive or opportunistic species, such as ailanthus (also called tree of heaven). Oftentimes, trees growing in disturbed areas consist of invasive species that are adept at taking over such areas. Although young forests provide other values (more open meadows for quail or ruffed grouse, for example), they can’t provide the same assets and functions as a mature forest. This means that urban canopy goals should include conservation of mature, existing forests wherever possible.

The soil layer in the forest traps more carbon than the trees do, so those wanting to achieve climate change goals should also consider the importance of healthy forest soils and their contribution to mitigating climate change.

### Mature Trees Matter More!

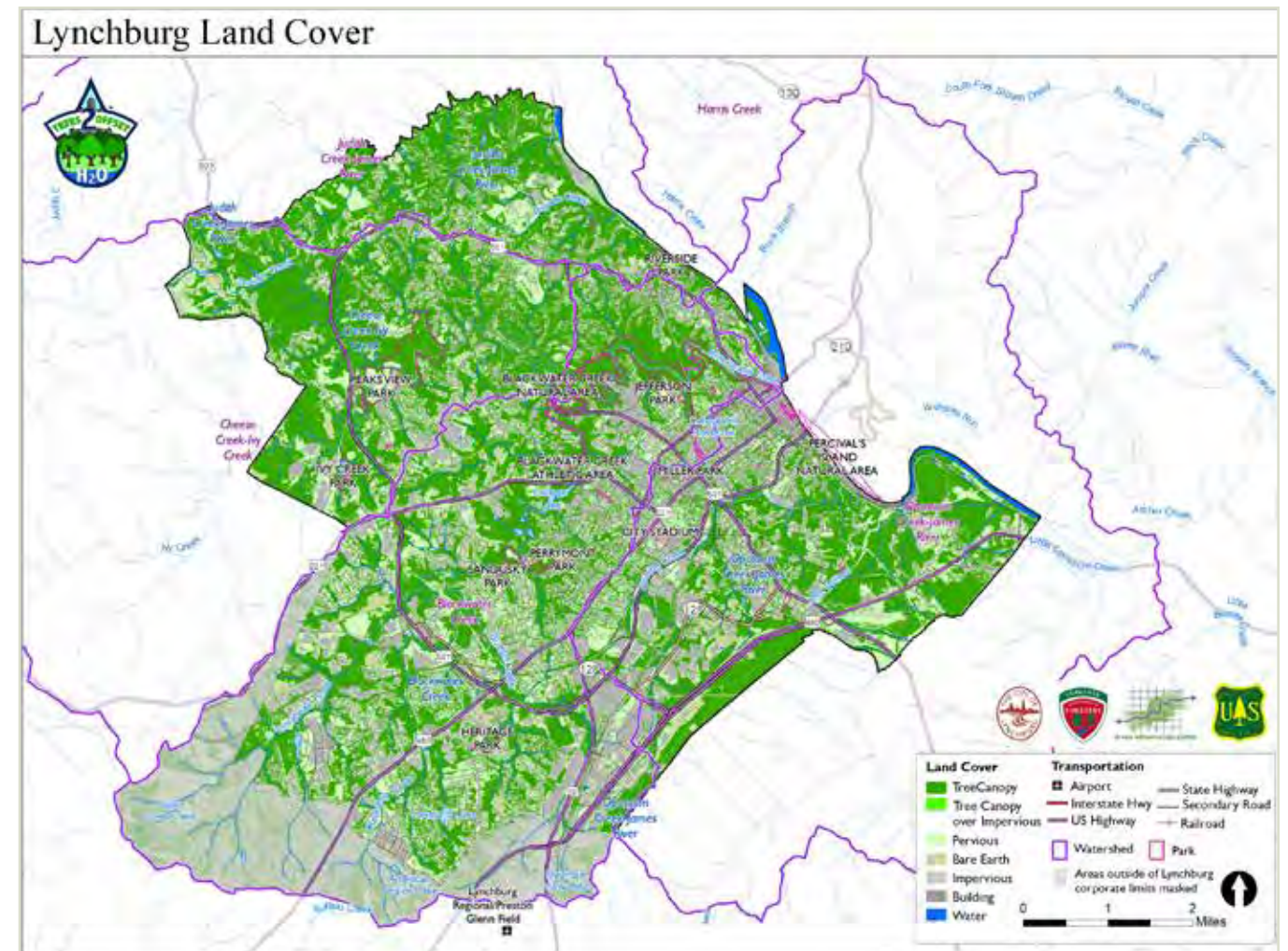
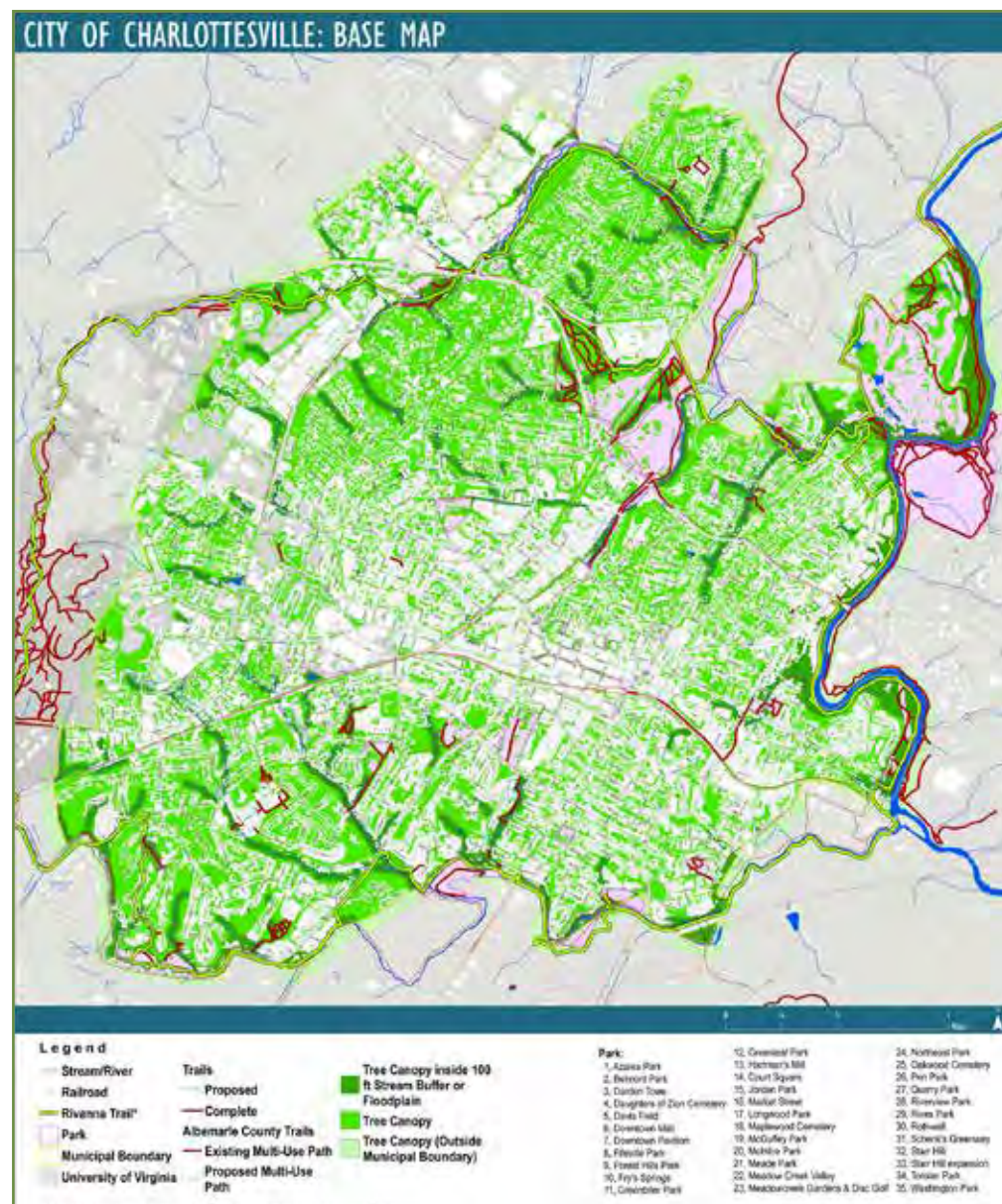
When considering canopy goals, emphasis should be placed on retention of mature trees. A large diameter live oak provides far more benefits for air, water and wildlife health than a newly planted tree. So, setting goals that recognize and protect mature trees first is the most effective strategy for ensuring a healthy forest and realizing maximum community benefits. According to the USFS, a large tree contributes \$65.00 per year in benefits such as for cleaner air versus a small tree that contributes \$17.96. Large trees often live decades longer than smaller growing species of trees so the overall benefits for the lifetime of the large tree are greater too. For more, see the Large Tree Argument brochure <https://urbanforestrysouth.org/resources/library/citations/the-large-tree-argument-1-up>





To determine if the city or town has areas that could be considered as forest, a canopy map needs to be evaluated for areas where there are thick areas of closed canopy that encompass areas larger than an acre. GIS can be used to identify areas that are forest patches/woodlands. How large a cluster of trees needs to be in order to be considered important to protect, depends on the relative size of such forests in the city. So, for example, in downtown Charlottesville, VA, an acre of trees would be considered significant, whereas in Lynchburg VA to the south, which has larger forested parks, they might consider ten acres of forest significant. Or, consider a city such as Charleston, SC which has many large intact forests remaining and where there are still 100-acre forests that can be preserved, especially those containing wetlands that are also holding and filtering water and providing key habitats.

How large a cluster of trees needs to be in order to be considered important to protect, depends on the relative size of such forests in a city.



Urban forest size values are relative, so in Charlottesville, (map at left) which is mostly developed, an acre of trees is significant whereas in Lynchburg, which has many forested parks, ten acres is more significant.

### Fostering Forest Connectivity

Connectivity is key when planning for a healthy forested landscape. Even in urban areas, forest connectivity can be protected or restored. Wildlife, pollinators and plants need to move between forest patches along corridors, which can either be continuous, such as a riparian corridor along a river or stream, or in patches that together form a series of steppingstones between larger forest patches. When these corridors are along streams and rivers, they are referred to as riparian buffers. The corridors support biodiversity as they allow species to intermingle and to repopulate areas following disturbances.





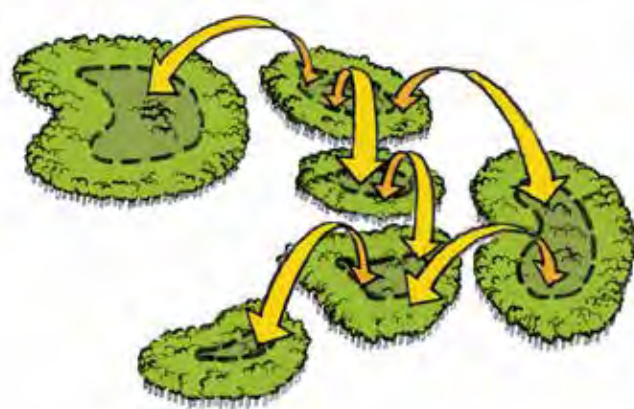
Connectivity can be maintained as growth happens, but it requires planning at a larger scale. Densities can be maintained while also allowing for healthy rivers and forested greenways. The image at left disconnects the forested river while the image at right allows for connectivity by concentrating development in areas where it does not bisect the landscape.

In cities and suburbs, there are few large tracts of undisturbed habitat, which means that species have to rely upon smaller areas, such as parks and streams, to move around. But even in cities, corridors can be provided along streams and pathways for smaller animals, such as birds and pollinators, can be maintained through lines of interconnecting forests across back yards.

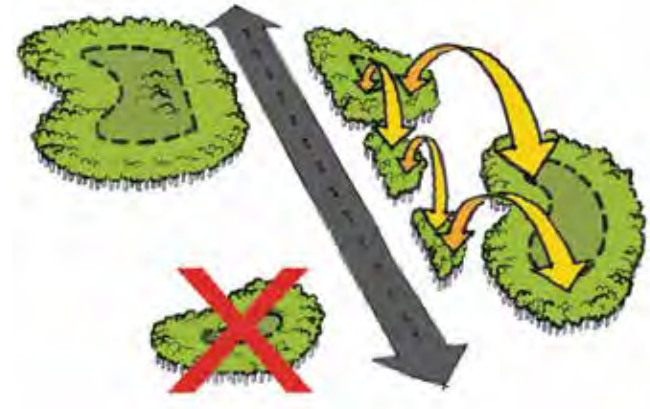
In areas where this connectivity has been lost, corridors can be replanted, especially if there are vacant lots. See the illustration on the following page of using GIS data to find vacant lands through which a new forest corridor can be planted for use by both people and wildlife.

Daylighting (unburying) piped streams is another way to recreate riparian corridors. Green streets—streets planted with shade trees, bioswales, benches, bike lanes and other pedestrian friendly amenities— can also serve as corridors for pollinators and birds. So, in the absence of natural corridors in a city, consider where green pathways can be added by converting traditional streets to green streets.

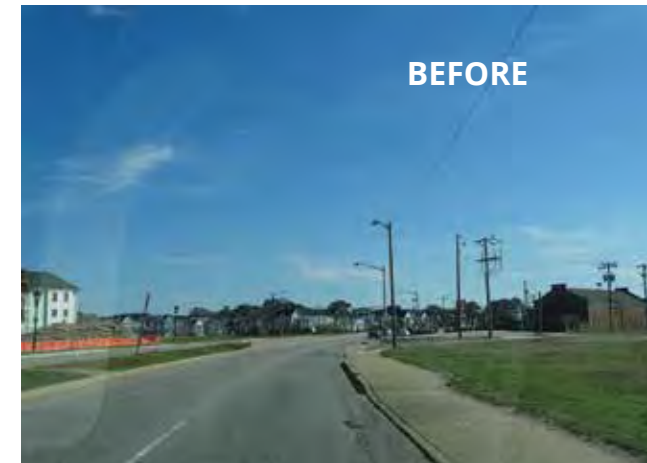
Taken together, this network of intact forest, wetland or riparian habitats can be considered as our 'green infrastructure' because they support our health (air quality, recreation, food) and our economy (property values and tourism).



When corridors are missing, wildlife can sometimes use patches to move across the landscape.



If the habitat patches are lost, movement is disturbed, and damaged areas may not repopulate.



Many urban streets are overly wide and look like highways (photo above). Those with lower traffic volumes can lose a lane to add street trees, thus attracting pedestrians and bicyclists to reclaim the street. Adding visualizations to existing streets (photo below) can help local governments see the possibilities.



Just as we plan for grey infrastructure, we also need to plan for "green infrastructure." For more, on green infrastructure planning, see the resources section of this guide. For communities that are still developing new land, check out GIC's guide: *Forest Connectivity in the Developing Landscape: A Design Guide for Conservation Subdivisions* at <http://www.gicinc.org/resourcesonlinelit.htm>

### Recreating Forested Corridors

Forested corridors can be recreated in cities to reconnect habitats. The two habitat patches (green areas) were separated by vacant parcels. By replanting the parcels, establishing a greenway and then infilling with homes, a once neglected area can become a vital corridor for birds, wildlife and people. Mapping vacant parcels across an entire city can help highlight these opportunities for greening and reconnecting the landscape.





## Section Summary

This section focused on what to map and how to use the data to set a canopy goal that is realistic and with a known price tag so that goals match affordability. In the next section, we focus on how to ensure planting plans address community needs and then in the following section we cover how to get those trees in the ground and thriving. Hint— It takes a village! A successful planting strategy requires everyone to participate. High participation from both the public and private sectors ensures that there will be strong public support for a robust urban forestry program. Many people have never considered the notion of an urban forest— or that we need to foster, fund and care for the forest too.



## 3. Planning and Planting for Health and Social Equity

In this section, we delve into the disproportionate social and health impacts for low income and minority communities who lack adequate tree canopy cover as well tips for how to use data to uncover where and why these impacts occur. Understanding the disparities is a first step in making improvements, so we provide examples for how to investigate urban heat issues and how to use canopy data to tease out problem causes and solutions. Finally, we'll use several examples to show how to work effectively in low income and diverse communities who may not have access to the same resources as wealthier neighborhoods or who may be reluctant to participate in tree planting programs.

### Urban Heat Health Impacts

When canopy cover is lower, there are several distinct health concerns that arise. Increased surface temperature is a predominant outcome from lowered canopy cover. Low canopied areas that are also highly paved are much hotter. Having less tree cover means there are fewer trees to filter harmful pollutants from the air and water. These heat and air quality impacts can be more impactful for residents who can't afford to relocate or who lack the knowledge or means to change their environment by planting trees or buying air conditioners.

The problem of climate impacts is also getting worse. While hot summer days are nothing new, climate change is causing daily global temperatures to rise in many cities and towns. Today there are more days over 100°F in many southern cities than during our childhoods. This urban warming produces a phenomenon known as urban heat island. Urban heat islands are caused as paved urban areas absorb heat during the day and re-radiate that heat, causing air temperatures in cities to be hotter than surrounding rural areas. These urban heat islands can create localized weather patterns that are not only hotter, but also wetter, as excess evaporation of surface water allows for more moisture to build up in the atmosphere. This results in heavier or more frequent rainfall in cities and areas just downwind.

When urban areas get much hotter, this can have severe consequences for residents who are young, elderly or who have other underlying health





Researchers found that for every 10°F (5.6°C) increase in temperature, there is a 2.6% increase in cardiovascular deaths.

conditions that make them more susceptible to urban heat impacts. And most importantly, extreme heat can kill. From 2004 to 2018, the Centers for Disease Control and Prevention recorded 10,527 heat-related deaths in the United States, an average of 702 per year (US EPA). And these impacts can be greater for lower income residents. In a study of nine California counties from May through September of 1999–2003, researchers found that for every 10°F (5.6°C) increase in temperature, there is a 2.6% increase in cardiovascular deaths. Heat-related risks were higher for persons 65 years of age or older, infants one year of age or less, and African Americans (Basu et al., 2008). Researchers have also linked these higher death rates to jobs occupied by lower income and minority populations that are more likely to be outdoors, such as jobs in construction or tourism, or in unairconditioned environments (Frosch et al., 2018). And the more humid an area is, the greater the impacts from heat as the body begins to lose its ability to self-regulate internal temperatures (Rogers et al., 2021). Men have also been found to suffer more than women because they perspire more and become dehydrated faster.

Urban heating also affects the elderly and young children more severely than the general population. For older adults, this is partly due to the fact that aging changes the lungs of older adults, but it's also true that sensitivities developed to pollution exposures earlier in life can result in greater respiratory impacts during the elder years (Gamble et al., 2013). So those who grew up in areas with higher air pollution may also be more sensitive to those impacts when they are elderly. The lungs of older adults also undergo physiological changes that can tend to impair breathing to a greater degree (Wang et al., 2013).



Higher heat-related death rates have been linked to jobs occupied by lower income and minority populations that are more likely to be outdoors, such as jobs in construction or tourism, or in unairconditioned environments.



Older Americans experience disproportionate risks of heat-related mortality.

In addition to having more fragile lungs, older Americans experience disproportionate risks of heat-related mortality because they have a greater prevalence of diabetes and cardiovascular disease and other illnesses (Ebi and Meehl 2007; Oudin Åström et al., 2011). Income also plays a role as older residents with lower incomes may be less mobile and unable to relocate to cooler areas, as well as social factors that can cause people to remain in less healthy areas such as needing to remain closer to generational care givers, or simply a reluctance to leave social support systems. For those residents who remain in hotter places, higher temperatures result in higher costs for air conditioning. Electricity demand for air conditioning increases approximately 1–9% for each 2°F increase in temperature (U.S. EPA).

Urban heating also leads to other detrimental effects such as chemical changes that lead to more pollution. As temperatures warm, more ozone (O<sub>3</sub>) is produced. Ozone can affect respiratory health and is even more problematic for people with underlying respiratory issues such as asthma or bronchitis. For more see <https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution>. Vehicle and industrial emissions can form ozone when exposed to sunlight and hot temperatures. Days when ozone

is at unsafe levels increase when areas are hotter, which is why ozone pollution is often worse in the summertime and also potentially greater in poorly treed areas lacking shade.

## Reversing the Trend – Regreening

Mitigating urban heat in very dense built urban environments can be a significant challenge. While it's well understood that paved areas are hotter because impervious surfaces absorb and radiate a lot of heat, there are also impacts to tree survival. Pavement constrains tree growth by limiting available soil area and space to grow and prevents water, oxygen and nutrients from reaching tree roots. Heat radiating from pavement also causes heat stress to trees. The combination of limited growing space and hotter conditions creates a harsh environment which reduces tree health and survival, thus limiting the ability of urban trees as an urban heat mitigation solution. For example, Red Maples (*Acer rubrum*) are often selected as street trees for their beautiful fall foliage, but they are also susceptible to heat damage and are a poor choice for planting in parking lots or as street trees since they don't tolerate drought conditions that are common in paved landscapes.





Finding problems in tree cover and social equity is just the first step. The land cover data also allow for assessment of the potential tree canopy for a particular neighborhood to inform replanting or conservation strategies.



The U.S. has many abandoned shopping malls for which parking was overbuilt. Infilling open paved spaces with affordable housing and adding vegetated islands to these areas is one solution to reduce urban heating.

Once a community is largely paved, it is much harder to reverse those impacts without significantly retrofitting the built environment such as removing pavement or buildings and replacing them with permeable, vegetated landscapes. Changing land cover back from impervious to pervious can be both costly and difficult. Green rooftops are one way to cool surfaces and can also save costs on building heating and cooling costs, but they are expensive to install. This makes urban heat mitigation analogous to many of the same factors that make stormwater management difficult in older cities that developed much of their landscapes before modern stormwater regulations were in place.

When looking at cities and considering how best to help re-green or keep neighborhoods green, it's important to dig into the data. There are several tools available to look at air pollution values using urban canopy, investigate

### What is redlining?

Redlining is the discriminatory practice of denying services (typically financial) to residents of certain areas based on their race or ethnicity. Under fair lending laws, these factors cannot be used for making lending or underwriting decisions. However, this still happens today both to renters and buyers. Years of this practice led to segregated neighborhoods where minority persons could not get loans or even be shown housing in white neighborhoods. Disinvestment in these communities over many decades led to some areas having fewer or no parks, less trees, and other outdoor amenities such as trails or water access.

past, present and future city temperatures, investigate social equity and redlining and so on and so forth. But the best way, is to use a tree canopy map (in GIS) and “clip” (sort) the canopy data by census blocks, and to review census data by blocks or tracts by race, income, age and other variables. Putting these data into a spreadsheet allows for sorting tree data by census block groups with low canopy cover, census block groups with low canopy and low income, census blocks by race etc. This can be used to flag areas for further investigation. Of course, finding problems in tree cover and social equity is just the first step. The land cover data also allow for assessment of the potential tree canopy for a particular neighborhood to inform replanting or conservation strategies.

Taking a strategic approach to analyzing tree canopy, urban heating and social equity is done by first setting an analysis threshold temperature for urban heat of 100°F, using Landsat data to find those hottest locations in a city, and filtering Census Block Group (CBG) data to identify those areas which are majority people of color (POC). To determine solutions, use a plantable areas map to identify the CBGs with the greatest potential for adding trees to mitigate heat or provide for other needs such as cleaner air.

Once a block of neighborhoods is identified that meet a set of equity related criteria, a coalition of city and community partners can begin to discuss opportunities and constraints for mitigating heat. Further analyses can be done on these CBGs to identify other vulnerable populations that are disproportionately impacted by heat, such as children, the elderly, low-income households or other specific groups.

### Heat Inequality

Although everyone knows that landscapes are hotter where trees are lacking, they may not recognize that these hotter places in cities and towns are more often in places with lower incomes and comprised of minority populations. There are many possible reasons why poorer, or minority areas are often less treed. Following are just a few of them:

- Lack of investment by the city or town in community planting or greening projects or programs.
- Past segregation (also known as "redlining" where people were kept out of wealthy/white neighborhoods) that led to people of lesser means ending up concentrated in less green/less desirable neighborhoods.
- Urban renewal projects that cleared vast areas of downtowns and low-income areas in the 1960s and early 1970s, removing not just houses, but landscapes as buildings were torn down and replaced with highways or malls.
- Lack of awareness, lack of an ability to obtain and plant trees, or lack of property ownership.
- Lack of parks or green spaces, especially those that are well vegetated.





The next step is to examine the history and existing conditions of the areas that come up in your search. The reasons why the observed conditions of low canopy are in place may not be clear at first and require further research. For example, in one city, evaluated by GIC, the urban center became downtrodden and people who could afford it left the area after disinvestment, leaving behind those who could not afford to relocate or who had other social ties, while another city reinvested in their downtown and it became more desirable to live or work near new shops, the river park or jobs. Both cities have low canopy downtown, but one is poor while the other is wealthy. Both are affected by lower canopy cover, and this demonstrates that wealth alone does not necessarily predict low canopy cover; however the area that is wealthier could end up with more canopy cover as it continues to be revitalized.

Tree canopy can also be lower depending on the city's native environment. Each city, and similarly every neighborhood, should be investigated with these native landscape considerations in mind.

Tree canopy can also be lower depending on the city's native environment. For example, trees would not be the predominant native land cover in a place such as Oklahoma City, which is located in a landscape that was once a tallgrass prairie. So, assuming that all cities should have high tree canopy cover may not make sense. Similarly, a city with a great deal of marshland, such as the coastal communities of South Carolina, would also not expect to see high canopy cover as a percent of total land cover due to the prevalence of marshes. Each city, and similarly every neighborhood, should be investigated with these native landscape considerations in mind.

In short, the history – both natural and cultural -- matters. Whether you are a resident yourself, or a forester or planner trying to work with the community, knowing the history of how the community developed is key to determining how to work in or with that community. In the next section we summarize the findings across 13 communities and then provide examples for using census data to uncover opportunities for improving tree cover.



## Urban Heating, Tree Canopy and Social Equity Across 13 Communities

Under a grant from the U.S. Forest Service, the Green Infrastructure Center developed a project to determine the value of urban trees for taking up stormwater. This entailed creating high-resolution land cover data to map tree canopy and impervious surfaces. A *Trees and Stormwater Calculator Tool* was developed to model the volume of stormwater uptake by a community's trees along with the reductions in nitrogen, phosphorus and sediment as trees filter land runoff. This link has all the information on the project, including case studies (at [http://www.gicinc.org/trees\\_stormwater.htm](http://www.gicinc.org/trees_stormwater.htm)) and a summary report can be found at <http://www.gicinc.org/PDFs/TreesStormwaterSummaryReportJune2019.pdf>.

Using the data already created for land cover, GIC was able to conduct a separate study in 2021 to examine urban heating. The new study's goal was to evaluate the impacts of urban heat, tree canopy and equity for 13 communities in the Southeastern United States (see full list of cities studied below). The study used high-resolution land cover data (1-meter pixels) created by GIC using NAIP imagery, Landsat imagery and demographic data from the American Community Survey (ACS) to assess the relationship between urban heat (surface temperature), tree canopy, impervious surfaces, race and income. Unsurprisingly, there was a very strong relationship between urban heat and the amount of impervious surface area in a city (11 out of 13 cities) with the remaining cities showing a moderate relationship. This was true, regardless of the size of the city or the density of the built landscape.

The new study's goal was to evaluate the impacts of urban heat, tree canopy, and equity for 13 communities in the Southeastern United States.

### Communities Evaluated

- Apex, North Carolina
- Boynton Beach, Florida
- Wilmington, North Carolina
- Orange County, Florida
- Miami Beach, Florida
- Jacksonville, Florida
- Norcross, Georgia
- Alpharetta, Georgia
- Harrisonburg, Virginia
- Lynchburg, Virginia
- Norfolk, Virginia
- Charleston, South Carolina
- Auburn, Alabama







Overall, GIC's case studies showed that as income increased, so did tree canopy cover. However, tree canopy decreased as the percentage of people of color increased.

In the analysis, urban heat had a strong inverse relationship to tree canopy, such that temperature decreased as tree canopy increased in 9 of the 14 cities, with coastal cities having a weaker, more moderate relationship between the two variables than inland cities. In regard to urban heat and race, Census Block Groups (CBGs) with higher percentages of people of color (POC) had a weak but consistent relationship with higher-than-average temperatures in 11 of the 14 cities studied. The CBGs with lower median household income had mixed relationships, with higher-than-average temperatures ranging from moderate (4 cities), to weak (7 cities), to no relationship at all (3 cities).

When examining the relationship between tree canopy and income, there was a consistent but weak relationship in 12 of the 14 cities, where, *as income increased, so did tree canopy cover*. However, the relationship between race and tree canopy was inverse, with tree canopy decreasing as the percentage of people of color increased. But this relationship was much more inconsistent than the income-canopy relationship, with 1 city having a moderate relationship, 7 cities a weak relationship, and 6 cities showing no relationship at all.

The weaker strength of the relationships between income, race, urban heat and tree canopy is due to differences in how populations of people are distributed within a city and between cities, as well as the general demographic make-up of a city. For example, in Greenville, South Carolina, the central downtown area is higher income and majority white, but it has some of the lowest canopy cover in the city. Compare that with Harrisonburg, Virginia's downtown that has a majority African American and low-income population, but also has a low tree canopy coverage. The built environment, zoning, land use patterns,

In many cities, tree canopy is not well-integrated for people of color, creating issues around access to the canopy and the ecosystem benefits the canopy provides, including shade, stormwater mitigation and clean air.

urban growth, past investment, or disinvestment by the city, and culturally and ethnically identified neighborhoods, are all examples of factors that influence how inequity in tree canopy and urban heat varies between and within cities.

An additional analysis concerned how well-integrated tree canopy was across a city based on race. This analysis is known as an index of dissimilarity and examines both the proportion of tree canopy available within a Census Block Group (CBG) to its racial make-up, and the proportion of that racial diversity to the total population of those racial groups within the city as a whole.

GIC used an index score of 35 as a threshold; a score less than 35 showed the canopy was more evenly integrated; a score greater than 35, that it

was not evenly integrated<sup>6</sup>. This resulted in a finding that, among the white residents in eight cities, the canopy was well-integrated and in six cities it was not. However, comparing these standards for people of color and integration of tree canopy resulted in only 1 of the 14 cities meeting the criteria for a well-integrated tree canopy among the population.

This analysis demonstrates that the tree canopy was not well-integrated for people of color in the cities studied, thus creating issues around equitable access to trees and the ecosystem service benefits they provide (shade, stormwater, clean air, etc.).

The key takeaway from this analysis is that more work is needed to identify inequities in canopy distribution and then engage in outreach, funding, planting and program changes to ensure that all communities benefit from urban tree programs that result in better tree cover and improved health.. For more on how to better engage with communities, see the case study on Tree Knoxville's pop-up tree stores on page 94 and GIC's project in Richmond, Virginia, on page 73.

<sup>6</sup> A break point of 35 is recommended in the literature as the best threshold value for splitting out dissimilarities.

As part of this study, GIC developed GIS tools to assist planners, city arborists and communities to identify the best spots for planting trees, in order to mitigate urban heat. The tools rely on land cover data, Landsat imagery and exclusions of incompatible land uses for planting trees (e.g., golf courses, airports, landfills, cemeteries, etc.). The different types of GIS data produced by these tools include:



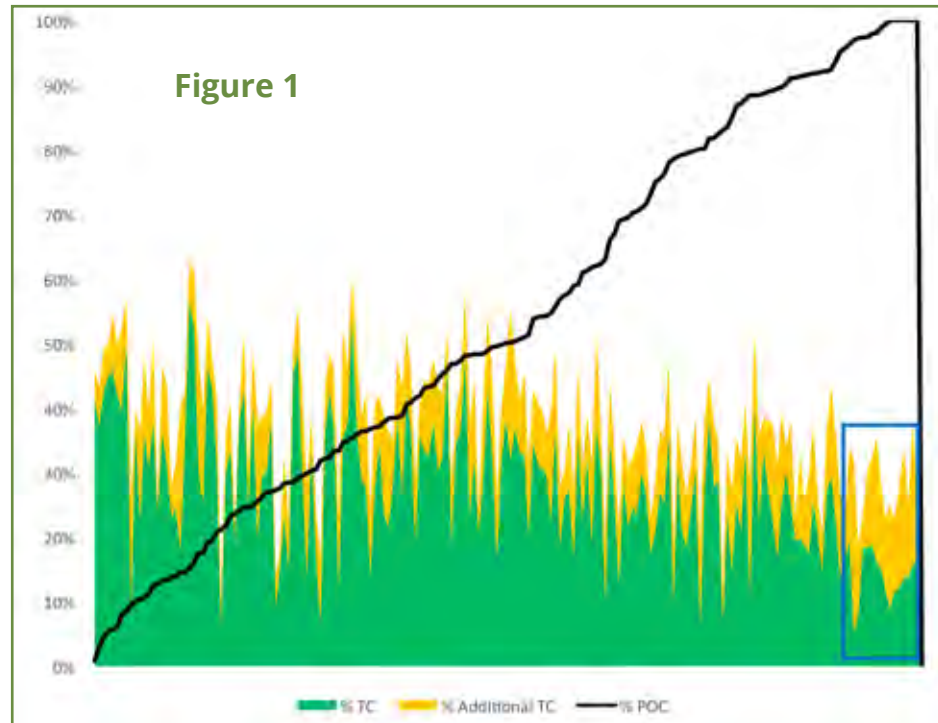
The hottest plantable areas in a city.

The best planting spots where trees can shade and cool buildings.

The best planting spots for energy efficiency of a building.

Best places to retain existing canopy to maximize cooling effects.

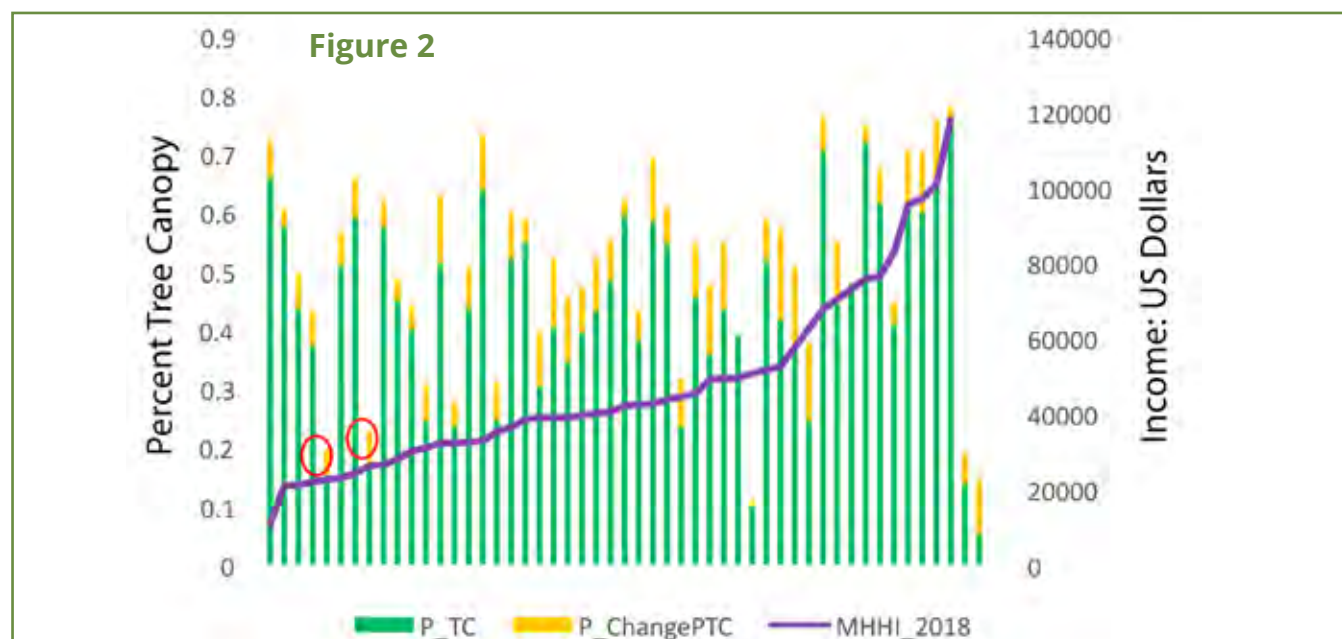




Spatial data for canopy cover and satellite imagery of surface temperatures can be used in conjunction with U.S. Census data to identify communities that have the greatest need for additional tree canopy or heat mitigation strategies. Only by combining all of the data available (environmental, social and demographic) can a community begin to approach challenges such as urban heat or stormwater in an equitable manner. For each of the cities, we created an example for how tree canopy can be used to address problems of urban heating. Case studies for each city can be found on GIC's website at <http://www.gicinc.org/resiliency.htm>

Figure-1: Green areas show existing tree canopy while orange areas show the amount of tree canopy that could be added within the Census Block Groups (CBGs). The highest potential for adding new canopy exists in CBGs with the highest percentages of people of color (POC) – blue box.

Figure-2: A graph of tree canopy versus increasing median household income. By sorting the data, low-income and low-canopied neighborhoods (circled in red) can be identified and engaged in projects to increase tree canopy. P\_TC = Percent Canopy, P\_Change = Potential Canopy and MHHI = Median Household Income



## Using Data to Make A Difference for Social Equity

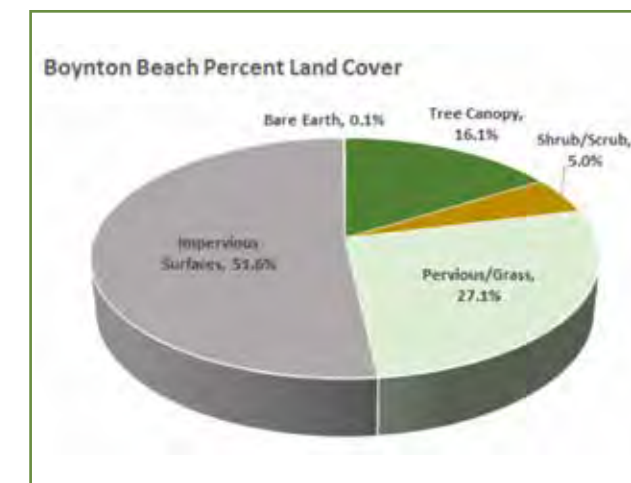
Using data to discern inequities in canopy cover is critical for addressing canopy gaps in communities. However, the most important question is whether these data can make a difference to decisions made for tree budgets, planting, or where to focus efforts. In short, yes, they can.

### Focusing on Communities with the Greatest Needs for Canopy Cover, Boynton Beach FL

Let's take Boynton Beach Florida as an example of using data to change focus. Located in southcentral Florida along the Atlantic Coast, the city has lost trees over time to development and the many storms that have struck Florida's central coast over the past decades. In 2020, the city hired GIC to map the city's tree canopy and help them create a goal for canopy cover. As part of this work, GIC documented the many benefits the trees provide and offered tools to model future benefits. This work supported city environmental goals, such as reducing greenhouse gases 50% by 2035 and its vision to "Create a greener Boynton Beach by enhancing the tree canopy and native plant and wildlife communities," along with the city's associated strategy, "Urban Forestry: Maintain and enhance the urban tree canopy to sequester carbon and provide multiple other ecosystem services."



Only by combining all of the data available (environmental, social and demographic) can a community begin to approach challenges such as urban heat or stormwater in an equitable manner.



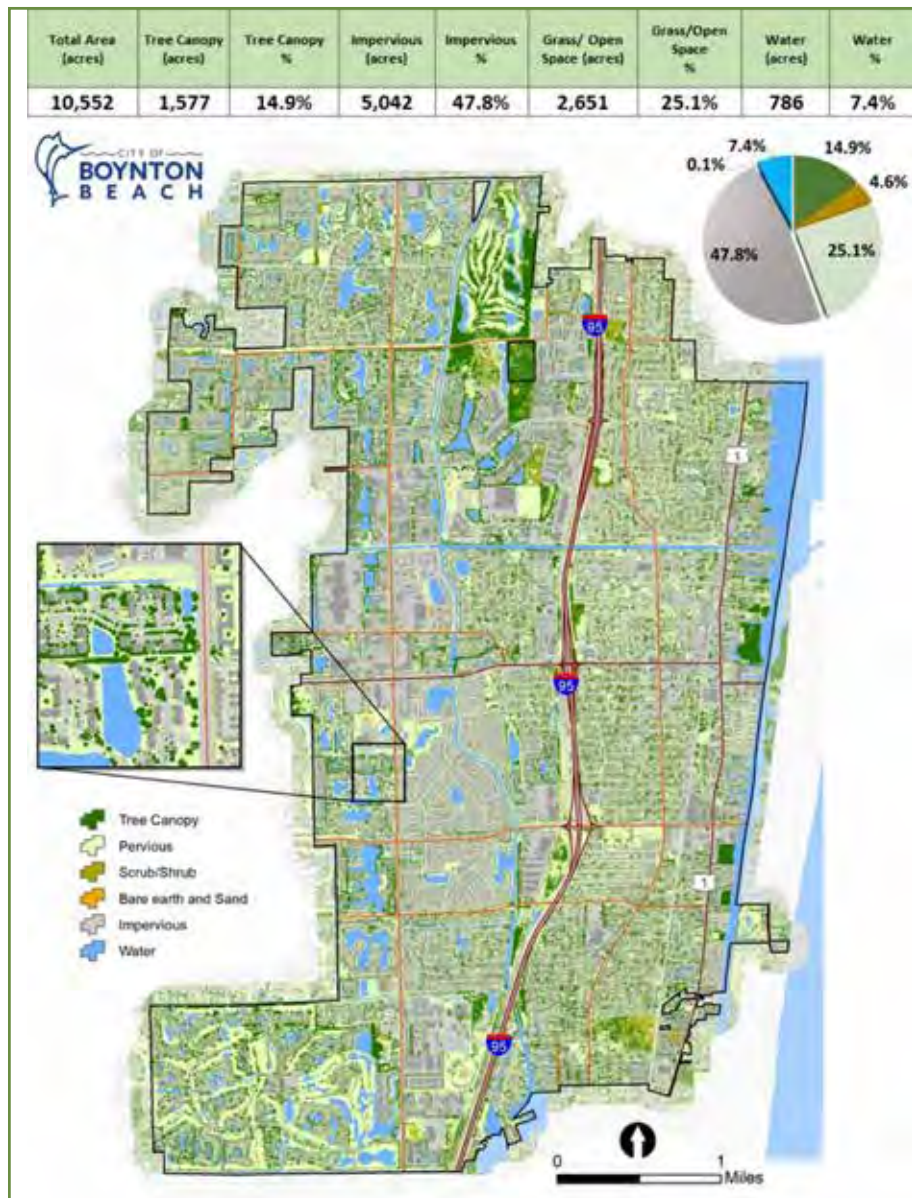
Boynton Beach's canopy is important for buffering the Intracoastal Waterway from stormwater runoff.







Many streets in Boynton Beach have room for more trees to add shade, beauty, and air quality.

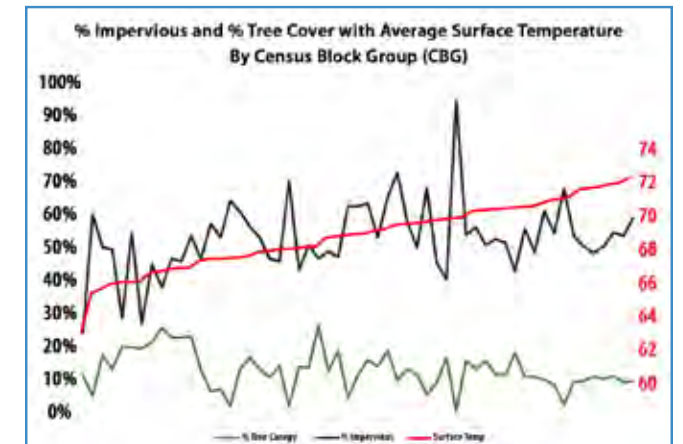


GIC helped the city create a new tree canopy goal by showing that there was room to add more canopy cover in available open spaces. GIC also created maps depicting the distribution of tree canopy by race and income. GIC chose a relatively low cloud cover day (April 6, 2019) for surface visibility and to correlate closely to the date the original imagery used to map tree canopy was flown. This allowed GIC to depict surface temperature and correlate it to the type of landcover present. Not surprisingly, lower treed areas were much hotter— see the graph at top right, showing imperviousness and tree cover and the map of urban heating.

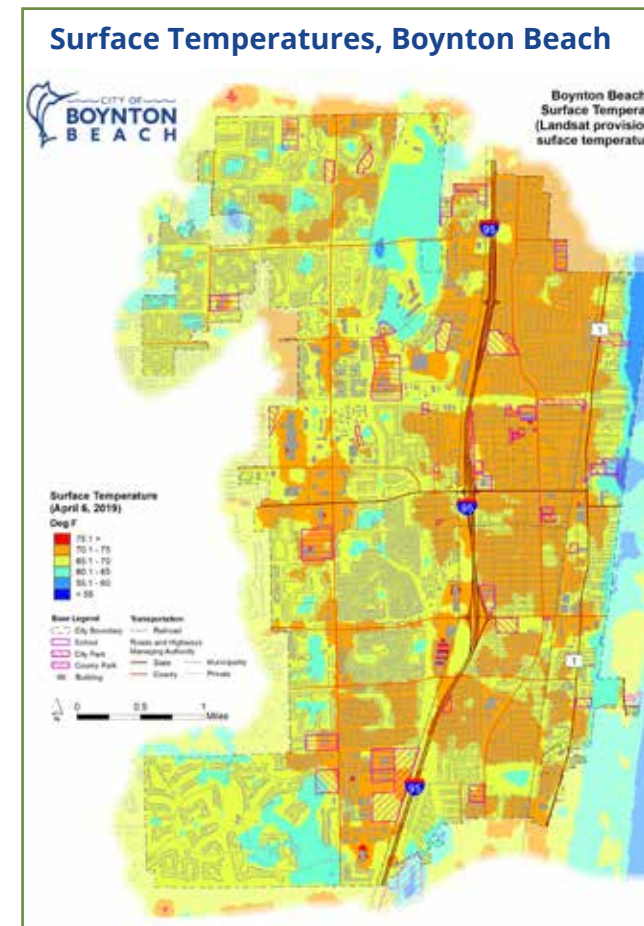
### Pounds of air pollution and greenhouse gases removed annually by trees in Boynton Beach FL

CO	NO <sub>2</sub>	O <sub>3</sub>	PM10	PM2.5	SO <sub>2</sub>	CO <sub>2</sub> Sequestered	CO <sub>2</sub> Stored
1,648	9,104	79,331	19,960	3,593	7,993	14,602,774	366,730,433

Next, GIC sorted the data by census block groups and heat, as well as income. Poorer CBGs and those with higher percentages of African American and Hispanic populations were found to have the highest mean temperatures in the city.

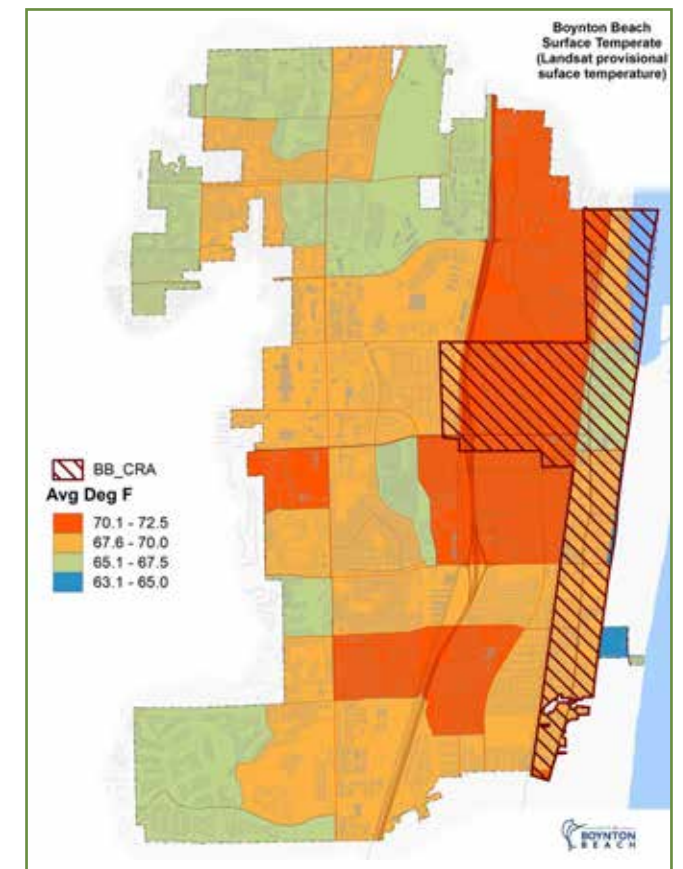


Trees are positively correlated with reductions in surface temperatures.



Hot areas of the city are also those with the lowest tree canopy. This map shows temperatures in April.

Poorer Census Block Groups (CBG) and CBGs with higher percentage of African American and Hispanic populations also experienced the highest mean temperatures in the city.





These data caused concern among city planners. They decided to take action to right the inequity in their city's tree canopy cover by, not only adopting a new ambitious canopy goal to increase coverage by 30%, but also by focusing tree planting first in the lower-income and minority neighborhoods. And realizing that it takes many partners to make this work possible, the city partnered with Community Greening, a grassroots tree planting group. This partnership continues to help the city get more trees planted on both public and private lands. One year after the adoption of their new canopy goal on September 1, 2020, the city and Community Greening had planted 917 new trees in the city. The city will continue to accelerate this pace until they reach their canopy goal of 20% coverage. To learn more about Community Greening see the case study on page 69.

These data caused concern among city planners. They decided to take action to right the inequity in their city's tree canopy cover by, not only adopting a new ambitious canopy goal but also by focusing tree planting first in the lower-income and minority neighborhoods.



Photo Courtesy of Community Greening

Partnership with Community Greening is enabling the City of Boynton Beach to meet its planting goal.

## Engaging Disenfranchised Communities in Tree Campaigns

Working on communities that have been marginalized over their history brings with it distinct challenges that require new ways (less traditional) methods of working with communities. Understanding those histories and stories – without first making assumptions – is critical to have successful outcomes. It's also important that the community be engaged early on in defining what that success looks like.

### Bringing Tree Canopy to Southside, Richmond, VA

Another story of addressing canopy cover inequity is found in the historic City of Richmond, VA. The city was fortunate to receive technical support in the form of a tree canopy map from the Virginia Department of Forestry, which showed that citywide canopy coverage was 44%. Although that is a good average coverage for a Southern U.S. city, the coverage was not consistent citywide. Downtown areas had only 9% tree cover. The James River, which flows through the center of the city, served as a social and economic dividing line, with incomes much lower south of the river, along with higher proportions of people of color than their wealthier neighborhoods north of the river.

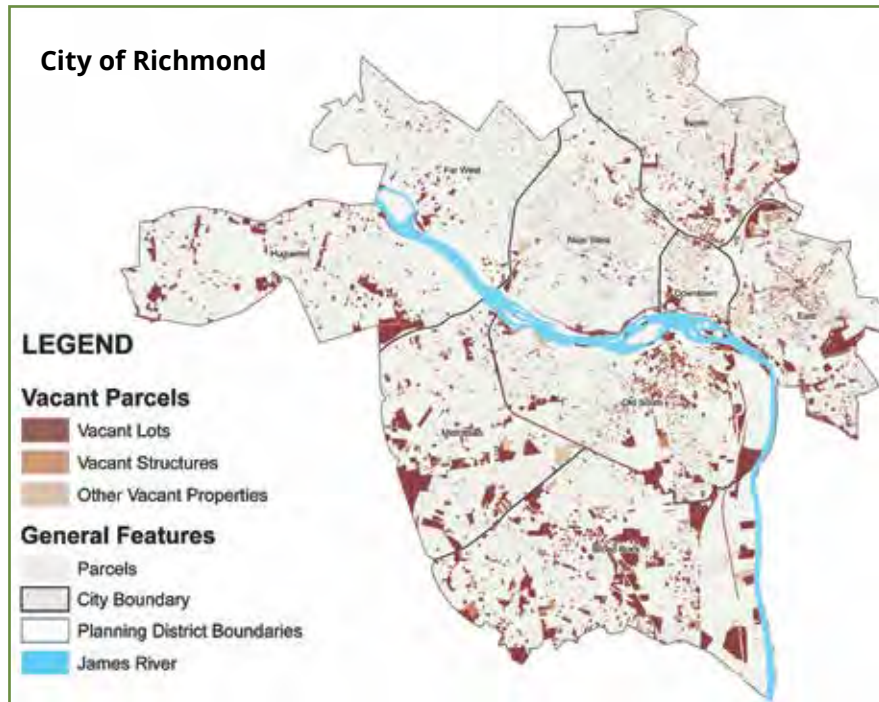
Staff at GIC, who had championed the city's canopy mapping, obtained the data and sorted it by the city's neighborhood planning districts. This showed that canopy coverage south of the James was far lower than to the north. Although, at the time, the city was planting close to 2,000 trees annually, they were being planted in wealthier neighborhoods north of the river, since much of the program was driven by requests. Planting requests come from people who know of these programs, and they tend to be those residents with higher education levels, and greater wealth, who also tended to be white and to live in the city's northern neighborhoods. After GIC showed the canopy divide to the city's arborists, they realized that little, if any, planting was happening in neighborhoods south of the James River, which led the city to switch its emphasis, beginning with planting hundreds of street trees in neighborhoods along Jefferson Davis Highway<sup>7</sup>, around the Veterans Hospital and along other major thoroughfares.



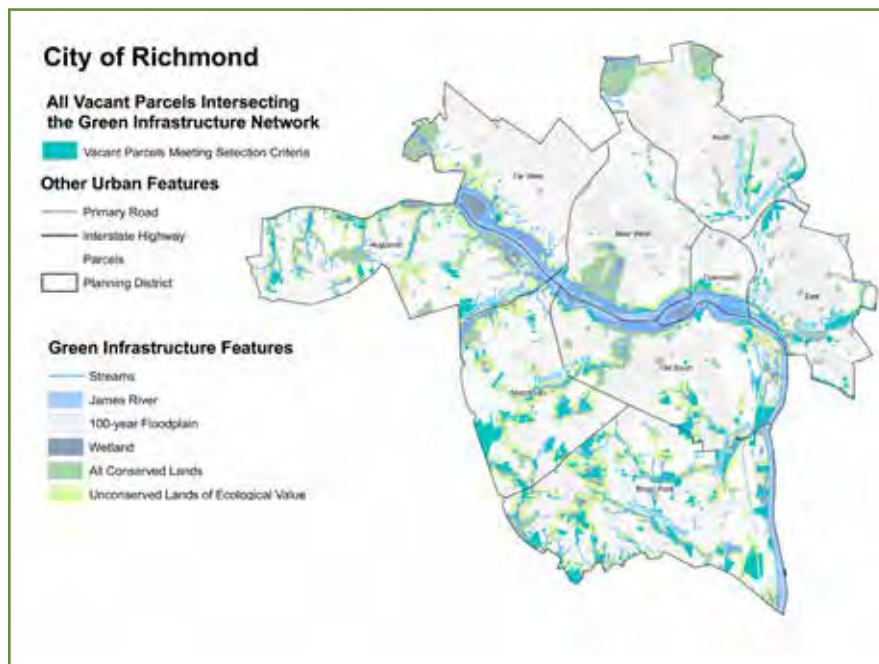
The city was planting close to 2,000 trees annually, in wealthier neighborhoods mostly by request. Planting requests tend to come from those residents with higher education levels, and greater wealth, who also tended to be white and to live in the city's northern neighborhoods.

<sup>7</sup> This road has since been renamed Richmond Highway to remove references to the past confederate president Jefferson Davis.





By combining multiple city databases, 9,000 vacant and underutilized parcels could be examined for potential to use in a city re-greening strategy. Coding each parcel for its potential to protect existing green resources or to be re-greened helped the city find new opportunities for trails, greenways or parks. The map below codes the vacant parcels for whether they can add value to the city's green infrastructure network. Parcels in teal color are important to protect or add to the green network.



The GIC also mapped other opportunities for re-greening Richmond. As part of its citywide mapping of green infrastructure opportunities, 9000 vacant parcels were cataloged and mapped as potential areas to expand green spaces. Since these parcels were in lists held by different agencies (planning, economic development, housing), there was no one source for this information, and GIC had to build a database to bring all these parcels into one sortable tool, which then allowed analysis of where opportunities to expand or support natural resources in the city lay.

The map showed that many areas south of the James River had high-value canopy cover, wetlands and streams, and also a lot of vacant parcels that could be regreened. GIC proposed a demonstration project to show the city how a concerted effort could yield better results for the community by bringing many partners together to regreen the southside.

A key component of regreening is expanding the urban tree cover. The data showed the community needed trees— but did the community want them? Well, yes and no.

A church group had recently completed a door-to-door survey that asked residents what they most wanted. The top two requests were for places for children to play safely outside and for more green space. This showed a need for environmental and community restoration. Working through the school, the neighborhood associations, churches, city agencies and regional conservation groups, a coalition was formed to identify needs and projects. As a result, GIC raised funds to create the Bellemeade Watershed Coalition, which brought all of these groups together.

One of the main takeaways from the Bellemeade, Richmond, project is that every community needs a “sparkplug” and these sparkplugs include the many volunteers from the neighborhood associations and local churches, who put in all the extra effort to keep the work going.

One apparent catalyst was a proposed new school in the Bellemeade neighborhood. As part of this building project, children would be redistricted to the new school from adjacent neighborhoods and a public housing site. GIS analysis showed that nearby vacant parcels touching the school property were also owned by the city, so GIC and partners approached the city to ask if these vacant properties could become a new park for the children. It was a suggestion the city supported and GIC formed a coalition of groups to take on the work. Another opportunity to plant trees was tied to helping the students walk to school safely and under shade. Lack of sidewalks, blighted properties, a broken bridge, lack of shade and other hazards made walking to school unappealing, if not dangerous.

A community campaign led by the coalition engaged residents in design exercises to re-imagine the streets and vacant parcels around the school. In addition to



Education was a key component of the festival, along with free food, games, tree planting and shrub giveaways. Local resident and GIC-hired Coordinator Mack Brown (above) explains the importance of creating a new park from vacant lots, as state and city elected officials offer their support too.

Community police and fire agencies helped the neighborhood address and remove hazards.





Children plant trees in the new park.



The coalition included the Richmond Police who suggested they change patrols for the new park to their horseback team— to provide a more community friendly and engaging way to patrol for safety.



Corporate and individual donors contributed both funds and volunteers.

workshops, several festivals were held to make input fun, with local businesses donating free food and games provided by the project sponsors.

This led to a plan for the areas surrounding the new school that included new sidewalks, trees, treed stream buffers, a fixed stream crossing and an additional bridge, new stormwater bioswales and trees along streets, safer street crossings, a community garden and other projects, such as new environmental programs for both children and adults. City agencies were engaged in funding, technical support and other programmatic changes, such as community policing, with horses to help police officers and residents interact in a positive manner.

Corporate funders, such as Wells Fargo, Federal Express, United Parcel Service, Dominion Power, Altria Group and individual donors accepted invitations to contribute both funds and volunteers. The U.S. Environmental Protection Agency's Urban Waters Program supported the staffing of the coalition and the Virginia Department of Forestry and USDA Forest Service supported tree planting. As of writing this report (Spring, 2022), most of the plan has been realized, with a repaired bridge, new bridge, new permeable sidewalks, street trees and stream buffers and a green street to walk to school. A new green corps called Groundworks RVA was hired to take care of ongoing maintenance for the park.

Traditional tactics used for community tree planting often don't work. They usually result in low rates of participation, which is often communicated as, "That neighborhood doesn't want trees, it doesn't like them." Instead of giving up on the community, planners should ask, "What were the methods we used and were they the reason why community involvement was ineffective?" For example, existing conservation groups in the City of Richmond, VA, usually provided coupons for tree discounts (e.g., 20% off the full tree price at a tree nursery). However, a discount is not helpful when incomes are severely limited in the first place. Also, residents of low-income, inner-city neighborhoods didn't all have trucks or the time to get to a tree nursery or garden center (which are usually far away since they tend not to be located in urban neighborhoods). Similarly, giving away trees in neighborhoods for which half or more residents are renters is difficult, since the landlord's permission is required before planting can occur.

The ability of people to care for trees long-term also needs to be addressed. Residents may also be afraid of trees falling on their houses, which can be a greater risk in low-income communities because taking down limbs or removing failing trees is expensive, so those hazardous overhangs are left in place, increasing the risk of property damage or injury. Showing how to care for trees or providing that care, such as pruning trees during the first 1-2 years after planting, are ways to avoid problematic tree forms later. In the neighborhood highlighted in this story, older residents said they didn't have the ability to rake leaves. So, one of the partners from a local church group found funds to hire youth leaf brigades to rake yards – this gave local youth jobs and helped older residents maintain their treed properties.

## Tips for more effective engagement:

Several community participation elements made the Bellemeade project a success and they are detailed below as tips for other programs that are evolving, just starting up or re-engaging.

- 1) Ensure the process is community led. Create local committees and provide support in the form of data, maps or graphics, but ensure leadership is from the community first and foremost. This can require training local leaders, or simply providing the support they require.
- 2) If formal staffing is needed (it usually is) hire a local resident and provide the training and support, as well as technology (laptops, printers, transport) so they have the tools they need to participate and lead.
- 3) Bring city leadership to the community. Rather than meeting downtown, invite city staff to join the group in their neighborhoods.
- 4) Engagement can't just be going to meetings (people are busy, they have multiple jobs, they are not used to lots of meetings). Instead go to community events – many engagements for the Richmond project were held at existing events, such as junior football games, or at the school. A fair was held that included a free lunch and lots of fun games and plant giveaways.
- 5) Engage all generations, including kids and elders. Parents will often participate with their kids. In this case, children showed the adults the routes they wanted to walk to school and where they would like trees. Elders may have specific concerns about safety or tree care that need to be addressed first before they'll say "Yes!" to a tree.



## CASE STUDY: CHARLOTTE, NORTH CAROLINA

# NeighborWoods and TreeStores: Bringing Trees to the People – TreesCharlotte

TreesCharlotte is a public-private non-profit serving the City of Charlotte and Mecklenburg County, North Carolina. The city provides two employees as staff. They run two tree

give-away programs: NeighborWoods and Zip Code TreeStores, with the aim of getting 5,000 trees planted annually. In the 2020-21 planting season, they planted or gave away 5,581 trees, and as of 2021, they had given away or planted more than 70,000 trees and seedlings.

Both the NeighborWoods and Zip Code TreeStores projects were started to improve equity in tree planting across the city. Staff found that, although they succeeded in giving away thousands of trees annually, many tree customers were repeats and often comprised residents from the most affluent neighborhoods, where canopy coverage was already high. To engage and enlist new people as tree stewards, particularly low-income people and people of color from low-treed areas, TreesCharlotte instituted the NeighborWoods program. It is open to any community group, nonprofit, church, homeowner association or business, with trees provided at a sliding scale cost, while free trees are limited to neighborhoods where the median home value is \$182,000 or less, with prices increasing up to \$20 per tree for neighborhoods with median home prices of \$500,000 or more.

NeighborWoods events last one hour and donated native trees (small, medium and large) range



from 3-4 years old, and are in 7-gallon containers. Event preparation includes months of advance work with the community on marketing, registration, and location. Outreach materials, such

as flyers, brochures, posters and social media content, along with tree benefit messaging for event promotion are provided to neighbors by TreesCharlotte. During the event, volunteer “TreeMasters” train “Treeipients” who learn tree planting and maintenance and then sign a tree care pledge to receive their tree.



Images courtesy of TreesCharlotte



Despite the project’s success however, TreesCharlotte found the NeighborWoods model of bringing trees to specific neighborhoods to be less effective for reaching low-income neighborhoods. Navigating lower-income neighborhood residents through the application process, finding open planting space in low-canopy neighborhoods, the high preponderance of rental properties, and other social factors made program implementation difficult. The advance community work required by the NeighborWoods program proved to be too time intensive, especially for those residents who had other time constraints such as multiple jobs, elderly parent or childcare, or where neighborhood leadership was lacking. To overcome these issues, TreesCharlotte found a more workable model in TreePhilly, of Philadelphia, PA, which had a program for “Zip Code TreeStores.” Using 2018 canopy maps, TreesCharlotte merged canopy coverage with home price data to identify communities with low canopy and an affordability gap for tree purchases. They targeted these lower canopy, lower priced neighborhoods for pop-up tree-giveaways, with the goal that every zip code received its own a pop-up tree event.

Zip Code TreeStore events are now held multiple times a year in various sections of the city. Residents show proof of city residency and get up to two trees per address. TreesCharlotte tracks



Images courtesy of TreesCharlotte

all of the trees it plants and gives away through a web-based map. Meanwhile, residents get the same training as in the NeighborWoods program and take the same tree care pledge. These events have proven very successful.

### Pro Tips

- Start with a small number of trees and then scale the event up after it has several successes, especially if the community doesn’t know or have a strong relationship with the organization.
- Popular varieties at the pop-up stores are small flowering trees and evergreens.
- Lean on partners to get the word out, to recruit volunteers and to pick event locations that people know and are comfortable with. Avoid locations where it is hard to park, such as college campuses; provide clear directions.
- Have pre-registration for tree pick-ups, but also have some trees for walk-ins. Have a back-up plan for storing trees afterwards for those people who couldn’t show up, or get inspired later, as well as a method to get them their trees.



## Tips to Encourage Tree Adoption

- 1) Begin with asking what the community needs generally. Don't simply ask, "How many trees do you need?" Instead, discover their most pressing needs and then see whether and how trees can fit into those wider requirements. In the case example for southside Richmond, the community wanted safe spaces for their children to play and the ability to walk safely to and from school – trees and parks helped with both of these concerns.
- 2) Engage volunteers and workers from the local community (see step 2 under engagement tips) and meet people at their own doorsteps – go to them; do not expect them to come to you.
- 3) Reassure people about costs. Let them know there are free trees that can beautify their yards, save on cooling costs, even boost the property's value. When they are renters (often 50 percent or more of low-income neighborhood residents rent), offer to engage their landlords to obtain permission to plant.
- 4) Hire and train a local paid crew to plant the trees – this will allay fears of older residents or those who don't know how to plant when they know their neighbors are the staff. Invite residents to participate in the planting if they want to.
- 5) Ensure long-term tree care needs are understood. Make the planting official with a "tree adoption certificate" so residents know they are the tree's primary caretaker and provide the steps, such as watering schedules or those pests to look out for, and how to eradicate them.
- 6) Use the psychology of social norming. Recycling programs have shown that widespread adoption is achieved by getting one adopter per block first. People want to participate when they see neighbors doing so. In Richmond, extra trees were purchased and stocked. When residents saw their neighbors getting trees, many of those who said "No" at first then later asked if there were any more of those trees. Of course, those trees were stored nearby and ready in anticipation of residents changing their minds.



Once neighbors saw the pretty flowering trees planted in yards along the new walking route to school, everybody wanted a yard tree.

## Gentrification

The fear of gentrification is often a concern in community planting projects in lower income neighborhoods. The concern is that beautifying a neighborhood with numerous shade trees, adding street medians with more trees, planting trees in front yards, and having more or improved parks and other open spaces nearby will raise property values and make houses unaffordable for low-income families, spur landlords to raise rents and result in property tax increases. As a result, some people have argued against planting trees in low-income and minority communities. However, that is really is a counter-productive argument. It would be like denying those neighborhoods streetlights or sidewalks. Everyone has the right to cleaner air, cooler summers, less flooding, lower energy costs and the general social wellbeing that trees provide— regardless of their race or income. Raised house prices actually help those who already own their homes to accumulate capital for their retirement.

Instead of keeping places less treed and more polluted, cities should address the sources of those problems associated with affordability. One example would be an agreement with landlords not to raise rents within five years of a planting project; another

Instead of keeping places less treed and more polluted, for fear of gentrification, cities should address the sources of affordability problems.

would be to engage the community housing and development staff in providing more affordable housing. In the example of Bellemeade in Richmond, affordable houses owned by the housing authority stood empty. There, renovating those properties and providing them to local families was seen as part of the solution. It is quite possible to enlist developers to take advantage of low-income tax credits that require affordability be maintained for 30 years. In other words, address such wider problems as affordable housing head-on with the city, town or local partners, rather than allow the neglect to continue and refuse to support a livable neighborhood. Bring affordable housing groups into your coalition and focus funders on the issue too.

For more examples of how to evaluate urban heat island effects and prioritize where to plant for healthy communities, see the case studies on GIC's website at [www.gicinc.org](http://www.gicinc.org). While there are likely hundreds of options within any city, the scenarios show the diversity of ways to examine urban heating and social equity for tree canopy and potential solutions to address inequities and create cooler, more healthy landscapes. Hopefully, these ideas will spur you to look differently at your own city to uncover new opportunities.

## Section Summary

In this section we covered some of the reasons why communities might be reluctant to participate in tree plantings, suggestions for how to understand and engage better with the community and why and how to link urban planting goals to reducing urban heat island and other health effects. In the next section we get into the details for launching a planting campaign along with additional case studies showing the many creative ways that communities are making these campaigns relevant, inclusive and successful.





# 4. Plant the Urban Forest— Launching a Tree Planting Campaign

In this section, we address tips and strategies for launching a community planting campaign. These tips and tools are based on GIC’s extensive practical experience in planting trees, as well as interviews GIC has conducted with community tree groups and both local and state foresters across the country – and internationally. This section assumes that you have already established a planting goal and determined how many trees you need to plant each year. But if not, read on for inspiration.

## Overcoming Barriers— Why Cities and Towns Need Campaigns

Before we discuss the “how” of launching a campaign, we want to acknowledge those attitudes or perspectives that can be initial roadblocks to getting a successful campaign off the ground. Sometimes, getting a local government on board to have a planting campaign can be difficult. This is true whether you are a concerned citizen, a tree advocacy group, or local government itself.

If you are a local government staffer, you may have heard these same refrains from your own agency or other departments. The most common difficulties cited by local governments with respect to why they can’t or won’t plant more trees include:

- We can only plant on city-owned lands, so we can only plant in 20% of the city.
- We’ve used up all our available space, so we can’t plant any more trees. The parks are already full.
- We’re not allowed to plant in rights-of-ways (RoW) or, trees planted in RoW will die because people will walk over their roots or cars will drive over them.



- We can plant trees, but we don’t have the resources for watering and maintenance, and we won’t be able to keep them alive.
- Trees are liabilities, they drop their limbs and fall over, so we can’t plant any because we’ll get sued.
- Trees are messy (they drop leaves, seeds, etc.); and we can’t clean up after them; plus, their leaves clog storm drains, which overflow.
- Leaves in streams cause a decline in water quality because they use oxygen when they decompose.
- Trees increase the presence of homeless people, who are just waiting to sleep under them.
- Trees cause crime because people do bad things behind them.

These arguments have been made by city staff to this guide’s authors. However, all of the above are either non-issues or easily solvable. The blue text box offers quick responses, and we’ll also address these issues throughout this section, along with tips for success and example case studies.

## Overcoming Urban Forest Myths and Objections

There are many reasons given for why tree planting can’t happen or for why trees need to be removed. Below we offer common arguments heard by this guide’s authors and recommended responses.

### ■ We’ve used all of our available space!

Use the Possible Planting Area (PPA) map to determine where trees can actually be planted. Some parks have far too much unprogrammed open space (as if there were a kite flying or concert event planned daily). Especially in warmer southern states, hot open spaces end up un-used. One city in South Carolina passed a rule against having shade trees on or near the playground. It may be necessary to change city rules.

### ■ Trees are messy.

Certain species of trees can drop excessive seeds or berries, such as the mulberry and sycamore, and should not be planted along a public RoW, or in playgrounds or playing fields. It may be possible to remove problem trees and plant others that will not drop spikey seed pods. Sweetgum (*Liquidambar styraciflua*), buckeye or horse chestnut (*Aesculus hippocastanum*), are common southern trees that produce spikey casings to protect their seeds. Choosing less messy trees for areas overhanging highly used or trafficked areas is an easy way to alleviate this concern.

### ■ Trees cannot be maintained.

Cities should not plant more trees than they can maintain, but the most intense maintenance is in the first year or two. This includes watering, pruning and checking in on trees to ensure there is no disease or infestations. However, some of this work can be done by volunteers in partnership with cities (see text box on the next page about Charlottesville).

### ■ Trees in the Right-of-Way (RoW) will die.

It is true that a RoW is a tough place to plant a tree. This is often because it also has underground and overhead utilities. When it comes to sidewalks, there might not be large enough tree boxes to plant in or the surface space may be too narrow. In that case, consider whether the RoW can be enlarged, or if larger tree boxes can be added, or if new technologies, such as underground tree cells, can provide added structure in those areas. See the images showing differences when using underground tree cells on page 47 and the resource section for GreenBlue Urban’s planting guide that covers planting in difficult spaces. Generally, if a space is too small for trees, then trees should not be planted there anyway (consider low growing shrubs or pollinator plants for those spaces, not just turf).



It’s not the tree’s fault that this planting area was never large enough for this tree.



## Overcoming Urban Forest Myths and Objections *(continued)*

### ■ Trees cause liability risks of dropping limbs or falling, so we shouldn't plant any.

Cities that use this excuse probably should not have roads, sidewalks or recreation facilities either, since roads cause car accidents, sidewalks heave and cause pedestrians to trip, and recreation facilities cause sprains and bruises. People can sue anyone for any reason, but the law is generally clear that cities' liability risk is less if the tree was being well maintained. Thus, to reduce liability, urban trees need to be well cared for. By performing a routine risk assessment and doing due diligence, cities can significantly reduce their exposure to lawsuits by making sure that trees overhanging rights-of-ways are safe. For more, see the section on Tree Risk Assessments on page 42.

### ■ Trees facilitate crime/homelessness.

Research into crime statistics and vegetative cover (controlling for location, income and housing type) has shown that less crime occurs in well-treed neighborhoods. Although public spaces can be taken over by those selling drugs, drinking or sleeping outside, this occurs most often in areas that are neglected or not well used. A public park that is busy with families, sports enthusiasts, joggers and picnickers is less likely to be used by criminals or the homeless. Local police can also be asked to add the park or open space to their regular patrols. (See the example of Bellemeade Park on page 73).

### ■ Leaves in streams reduce water quality.

The concern for tree leaves in streams is based on the concept that adding organic matter to water will cause nutrient enrichment. Although leaves are naturally in streams and provide food for many aquatic insects, storm sewers can deliver high volumes of leaf litter to nearby creeks. However, leaf pickup programs or teaching residents to start a compost pile, as well as city street sweeping are other ways to discourage excess organic matter. More importantly though, trees prevent both sediment and other pollutants including nitrogen and phosphorus from entering streams, thereby improving water quality. And most streams in natural settings are within forests!

### ■ Leaves block storm drains causing roads to flood.

Trees actually absorb a great deal of stormwater, and it is generally a lack of trees, especially in downtown areas with acres of impervious surfaces that causes storm drains to overflow.



This tree along a Charleston park got help with root conflicts as the city built a bridge over the tree's roots.

## City of Charlottesville, Virginia Gets Help for Tree Care

When the City of Charlottesville decided to increase tree planting to help expand its canopy, it faced the same problem as many cities— lack of staff for tree care. Staff were already maintaining many trees, as well as dozens of landscape islands and entryways into the city and they worried about planting more trees than they could care for. City tree plantings were larger 2+ inch caliper trees, which need extra care to get established as they have been in pots longer and could be root bound. They are also much more costly than smaller trees or seedlings.

Fortunately, the city did not need to go it alone. Volunteers stepped up to help plant and maintain seedling trees planted in parks, which saved the city money and resources, and allowed the city to expand the numbers of trees planted given the extra people power. The city planted the larger trees and citizens planted and maintained the smaller trees. They also established no-mow zones along streams and rivers in city parks to help native trees establish themselves (with a little prodding from GIC). The city now has a Tree Stewards Group and a dedicated team to look after its trees.



This adopted tree in a city park has a watering can inscribed with the message "Please do not steal. Thank you, the tree."





# Launching a Successful Tree Campaign

Tree canopy can't be expanded or conserved to any great extent without planting on private property, so a public/private partnership may well be needed.

As we noted in the first section of this guide, it takes a village to plant and care for an urban forest. And even if you are representing the city government, in many cases, tree canopy can't be expanded or conserved to any great extent without planting on private property, so a public/private partnership may well be needed.

## Getting Organized

If you already have an organized group or program, skip to the description of partners, page 106. Questions to consider when trying to get private involvement in a tree campaign include:

- ✓ Who will lead the campaign?
- ✓ Does the campaign have partners/sponsors?
- ✓ What will be the name of the campaign?
- ✓ How will planting spots be chosen?
- ✓ How will planted trees be recorded?
- ✓ How will trees be obtained for the planting campaign?

In this section we provide suggestions to answer these questions. If this part of your organizational structure has already been established, skip to the next section on funding ideas and events, pages 103-106.

**Who will lead the campaign?** Will it be the city, a tree planting group, the Garden Club, or a consortium of groups? The campaign leader needs to be able to represent all parties, coordinate events, be able to delegate to others, and enlist new parties in the effort.

**Does the campaign have partners or sponsors, and various levels of supporters?** Levels of partnership can be tied to funding (e.g., a Tree Founder donates 2,000 trees and 200 hours of labor, or a Tree Booster donates \$500 etc.). Any donation program should cover how partners and sponsors will be recognized. If someone wants to become a "partner" what is their role? All the possible donor levels, types of recognition, and partner roles and responsibilities should be laid out and agreed to ahead of time.

**What will the name of the campaign be?** Keeping Greenville Green? The 10,000 Tree Project? "20 by 40" (20% canopy by 2040)? The Appleseed Project? Use an acronym to spell something such as TREES (tree revitalize ecology, economy, society). If you are adding a number of trees into the campaign, ensure that the

number is linked to an actual, achievable, goal. The planting target can increase, or decrease, year-on-year (e.g., 1,000 trees year one, 2,000 trees year two, and so on: or a blitz the first years, then a steady planting level over the next five years).

**How will planting spots be chosen?** Hopefully, planting priorities were set during the goal-setting process outlined in Section Two of this guide. Examples of places to prioritize for planting include:

- **Business districts**, where trees can improve aesthetics, reduce heat island effects, reduce vacancies, increase sales and rental revenues, provide lunchtime shade for workers, and so on. If the district includes shopping malls or other stores with large parking areas, trees can be planted between rows of parked vehicles for shade and cooling, as well as stormwater mitigation if planting beds are recessed.
- **Neighborhoods with low canopy**, where trees can improve public health and aesthetics, increase property values, provide shade for streets, schools, play areas, bike trails and parks, increase use and enjoyment of those facilities, provide education and improve public health.
- **Along streams, rivers, lakes and reservoirs**, where trees can improve water quality, provide habitats for birds and riparian species, provide shoreline shade for fish and fishermen, provide shade for walking trails, and so on.
- **On and near cultural sites**, where they can beautify scenic roads, protect historic settings, provide garden shade for visitors, become part of a restored landscape, and so on.
- **Around schools and sports grounds**, where trees can be planted to provide shade for spectators, sound barriers between a public facility and local housing developments, and shaded streets to and from the facility.
- **Medians of entrance corridors**, where trees can beautify those entrances, as well as provide cooling effects for commuters.
- **Around city buildings**, where trees can provide shade, welcome places for visitors to sit, places to hold outdoor meetings, sites for lunch breaks, and where parking areas can be treed as well.



Staff from GIC and the James River Association prepare a tree for planting in a stream buffer at a city park.



Recall that trees are often most needed in minority and low-income neighborhoods—see Section 3 of this guide. And this may require special attention to planting tactics, community buy-in and funding. If using tree giveaways (see case examples throughout this guide), be sure to have a way to record where trees are planted and to have people sign an agreement to maintain the trees or provide volunteer help to do so. If using public funds, it may be necessary to ensure trees go to people who live inside the jurisdictional boundaries (see section on funding). See the text box on Understanding the Social History of Trees later in this section too.

**How will planted trees be recorded?**

The campaign will need a long-term target and an annual planting number to reach that target (e.g., 10,000 trees over 10 years = 1000 trees planted annually). Tree giveaways often lose track of where trees are planted, so have a system to



track tree planting locations, including the names and addresses of participants, if not also their phone numbers and e-mail addresses, for sending reminders about tree care. If staff or volunteers

are available, visit the tree after one month and annually thereafter to determine if the trees have care issues (e.g., lack of watering), pests or other challenges to address. See the text box on *Create a Google Form to capture Tree Planting Locations* on page 91 for how to create an on-line form in Excel and transfer the data to a map. You can also log the location by using paid tree tracking software, such as TreePlotter.™ There are also free apps available to track trees, such as the Healthy Cities App. Go to <https://healthytreeshealthycitiesapp.org/> for more details. The data from this app can be stored in the cloud (supported by the US Forest Service) and then exported to store in the city's GIS system, where it can be utilized to determine which areas lack new plantings and to target them for more education or tree donations. See Appendix B for additional resources.

**How will trees be obtained for the planting campaign?** Will the trees be supplied by the city? If so, are those trees available to the public? Will they be planted on public lands, private lands, or both?

In some cases, cities restrict the planting of publicly-funded trees to public property. While this may sound reasonable, cities often report that they have run out of places to plant. One city in Florida had a robust tree fund of several hundred thousand dollars (from development fees, tree removal fees and other city funding) but lacked the spaces in parks and rights of way to fully utilize those funds. Other cities have made it possible to use public funds to plant on private property by granting those funds to a local nonprofit to plant the trees.



A city can specify how many trees to plant, which species, and in which communities, while the nonprofit company carries out the work and tracks the plantings, reporting locations back to the city. See the Richmond, VA, example in Section Three for a case of a public-private collaboration to plant trees on private properties.

Tree giveaways often lose track of where trees are planted, so have a system to track tree planting locations.

City staff can provide the planting specifics, while the non-profit carries out the work and tracks the plantings.

## Become a "Tree City USA"

Tree City USA is an annual recognition program for cities and towns striving for excellence in the fundamentals of urban forest management. Administered by the Arbor Day Foundation, the program requires participating cities to:

- ✓ Have a tree care ordinance.
- ✓ Have a tree board, department or individual in charge of trees, or a combination of all three.
- ✓ Spend \$2 per capita on tree care annually.
- ✓ Host an annual Arbor Day celebration.

Cities going beyond the basic requirements can apply for Growth Awards. Tree City USA status also makes cities eligible for tree planting grants and other state grant programs.

<https://www.arborday.org/programs/treecityusa>



**TREE CITY USA®**



## Tips for Mapping Planted Trees

To ensure your tree planting campaign is meeting its targets and, more importantly, that trees are being distributed equitably within the community, it is important to have a system that tracks where the trees are being planted, particularly those on private property. If you already have an existing tree inventory system, whether through a subscription to a tree inventory software or a “do-it-yourself” Excel spreadsheet, these data can be easily collected and integrated into those systems. See the text box on *How To Create a Google Form* on the following page to capture planting locations online.



Many cities offer a planting program that allows residents to request a street tree for their neighborhood. The City of Jacksonville, FL, makes trees available through its street tree program. City residents can call 630-CITY and request to participate, or go to <https://www.coj.net/trees> to request a free tree. The city tracks the trees, using a paid subscription software.

Cities can also create their own apps to track trees using tools available through Esri. This allows them to pinpoint the

exact location of a tree, even if it is planted in the backyard of a private property. See the Summerville case example on page 96. Since most cities who manage their own GIS systems already subscribe to Esri, they can use Esri’s tools to create survey apps. For more, see: <https://doc.arcgis.com/en/survey123/desktop/create-surveys/createsurveys.htm>

Another option to capture trees is to have a postcard citizens fill out that details which species they planted and where. These data can then be entered by an intern or other city staff member and displayed on a web map, so that people can see their planted tree recorded, or peruse the data to see new plantings in their neighborhood— and if their neighbor planted only a few trees while others planted dozens, then they had better get going to keep up!

## Create a Google Form to Capture Tree Planting Locations

A Google form is another low-tech method to create and link to a newly planted tree (for more on tree inventory see Section 2 of this guide). A Google Form can be embedded on a city or organization’s website. Basic data to collect on the form include:

- The type of tree planted (species’ common name and scientific name).
- The date the tree was planted.
- The address of where the tree was planted.
- Caliper size (1-inch, 2-inch or sapling)

For greater accuracy, collect the GIS coordinates (latitude and longitude) of where the tree was planted. By collecting location information, even by something as general as a street address, urban forest managers and decision-makers will be able to see whether the campaign is reaching low canopied, low income, or communities of color neighborhoods.

To set a location, open Google Maps on your smart phone, select the area where the tree has been planted, and hold your finger on the screen. It will drop a pin and display the lat/long that can be entered into the Google Form.

The Google Form populates a Google Spreadsheet. You can download a free add-on or, under the “Tools” bar, select “Script Editor” and insert a geocoding script. This will geocode the street addresses into latitudes and longitudes, giving you an approximate location for where each tree has been planted.

Once you have the latitudes and longitudes, you can import them into a GIS form, such as Google Earth or QGIS, or into licensed software, for example Esri’s ArcGIS Online. These software programs also have online apps to collect spatial data, such as dropping pins, and moving them to the exact locations where the trees have been planted. These spatial data can be used to generate points that can be displayed on a map.

A map of tree planting locations helps communicate the campaign’s ongoing progress to the public, enabling them to track its success and where extra efforts need to be made. It is also a useful tool for program managers who are responsible for getting trees into the hands of residents who most need them. Visualizing where trees have already been planted can answer questions such as:

- Are we planting enough trees to reach our goal(s)?
- Are the new trees being equitably distributed throughout the city?
- Are some neighborhoods participating at higher rates than others?
- What is the planting rate for special districts or areas, such as the downtown, riverbanks, school grounds?
- Are the neighborhoods with low canopy planting trees?
- How do we adapt our outreach strategies to be more effective?

As residents, community groups, nonprofits, and local government enter this data, the points will need to be updated regularly and redisplayed to showcase progress to date.





## CASE STUDY: BIRMINGHAM ALABAMA

### Environmental Justice and Tree Equity:

### Birmingham's Cool Green Campaign

The City of Birmingham, AL, sits at the headwaters of a number of small creeks that drain into major rivers. The city has 99 neighborhoods and neighborhood organizations set across its 147mi<sup>2</sup> land base. As a southern city that suffered



Street tree well with bioswale and flowers.

from redlining, some residents were relegated to floodplain lands that were frequently inundated or lands that were contaminated from past industrial uses. See the city's redlined map for more background: <https://www.docstoc.org/documents/document/redlining-map-birmingham-alabama>

Still today, North Birmingham neighborhoods in particular are less treed and have the highest concentration of sites with contaminated soils. Some community members have been pushing for an urban forest program to mitigate the region's blight. The Jefferson County Urban Forest Group surveyed the five biggest parks using i-Tree and applied the Environmental Protection Agency's Enviro Atlas and health data from the University of Alabama at Birmingham (UAB) to create a story map for what they called "The Cool Green Campaign," in order to make the case for using trees to cool and clean the city, especially as higher crime rates in the

area have led some local residents people to worry that more tree plantings will lead to more criminals lurking within newly treed areas.

A link to the Cool Green story map can be found here: [https://](https://www.arcgis.com/apps/MapJournal/index.html?appid=1a79c58d04124b8c88d758a0877b7dcd)

[www.arcgis.com/apps/MapJournal/index.html?appid=1a79c58d04124b8c88d758a0877b7dcd](https://www.arcgis.com/apps/MapJournal/index.html?appid=1a79c58d04124b8c88d758a0877b7dcd)

After creating a story map showing their intent, the group's next step was to raise both funds and public interest, in order to plant trees in those high-risk and unhealthy areas. However, the recent Corona Virus Pandemic made outreach very difficult. According to the local coordinator with the CAWACO Resource Conservation & Development Council, Francesca Gross:

*Education about healthy tree canopies and removal of invasive species occurs best through personal dialogue. Printed matter, posters and mailing have limited effect on community education and engagement. The city's conservation work requires deep commitment and investment of time and resources to gain trust and create an ongoing relationship with community and city officials.*

Photo courtesy of Cool Green and UAB.



The city partnered with Vulcan Materials Company to plant 150 trees in a neighborhood that suffers from flash flooding.

Watershed education and outreach in the Village Creek Watershed included engaging students and residents in restoration of public areas. Village Creek, a tributary of the Black Warrior River, begins in the Roebuck Springs area of northeast Birmingham. The upstream portion of this watershed is primarily residential, while the downstream areas are used mainly for industry. As a result, Village Creek is listed on the Alabama's 303(d) impaired waters list for pathogens (E. coli).

During two creek cleanups, more than 300 volunteers participated in removing trash from the floodplain to improve water quality and public safety. Partners included the City of Birmingham Stormwater Management program and the non-profit Village Creek Human and Environmental Justice Society. Local corporations and environmental groups sponsored the creek cleanups and a number of litter prevention programs.

In anticipation of The World Games 2022, more companies have been volunteering to make Birmingham a better and healthier place in which to live. In December 2021, the city partnered with Vulcan Materials Company, a Birmingham-based construction materials producer, to plant 150 trees in East Thomas and Legion Field Stadium to address a neighborhood that suffers from flash flooding. Keep Birmingham Beautiful, which is part of the city's Public Works Division, also provided volunteers for litter pickups.

Going forward, more work is needed for continued community engagement. According to Gross:

*Start off with listening sessions. The community needs to be heard and listened to about what they think the problem(s) are in their neighborhoods. The issues revolve, not just around lack of amenities and services, but are deeply rooted in who has power and access to decision-making. The community needs to be at the table from the beginning.*



## CASE STUDY: KNOXVILLE, TENNESSEE

### Creating Community Arboretums: to Benefit Students (and Adults)



**1,000**

Trees planted (so far)

**9**

Number of  
Arboretums Created



Trees Knoxville found the arboretums to be very popular and have installed four on school grounds.

It's no secret that trees can make you smarter, and even better behaved, which is important for both schoolchildren and adults (Bijnens et al., 2020). Fortunately, children in Knoxville can now reap these tree benefits. Beginning in 2017, Trees Knoxville's Arboretum Program created a program called Canopy for Campuses to partner with schools to plant more trees on the school grounds, in order to provide a healthier and more enriching environment for the students.

During tree-giveaways, Trees Knoxville heard from educators, school board members and parents that they wanted a more value-focused experience for the students. They wanted students to not just plant trees but to also learn about their biology and physiology. So, Trees Knoxville began working with the schools to design and install mini arboretums. These spaces are intended to be educational and to support scientific learning and understanding to provide a synthesis between planting trees at schools and enriching students' education.

Arboretum is Latin for "a place for trees." However, not all trees that are planted on school grounds can qualify as an arboretum, since the Tennessee Urban Forestry Council has specific criteria for what constitutes one, see sidebar.

An arboretum site is certified for a three-year period and a Tennessee Certified Arboretum sign must be posted and maintained. Other recommendations from the Tennessee Urban Forestry Council include public access, trained grounds staff, tree-safe labels, and the inspection of trees planted close to highly trafficked areas.

Trees Knoxville found the arboretums to be very popular and have installed four on school grounds, with three of those receiving certification thus far (Spring 2022). They have also worked with three neighborhoods and two homeowner associations to plant arboretums on private sites. However, some homeowner sites are too small or do not want to provide public access, so an alternative Tree Sanctuary Program has been created, which requires a minimum of only 10 different species of trees.



#### Pro Tips for Creating a Community Arboretum

- Have a professional help with initial tree identification. Recruit an arborist or a local forester to assist.
- Plant at least the state's 30 trees species (consider having more diversity in case one or two species die from a pest or other causes).
- When planting at schools, include the security officer in siting decisions, so as not to interfere with lighting, cameras, or safe sight lines. Also include the groundskeeper(s) in the planting plan, to avoid landscape maintenance conflicts.
- Hang tree signs properly and never use nails to mount signage to a tree. Instead, use a screw with a spring and washer to allow for tree growth (or better yet, a ground sign to avoid disturbing the tree's bark). Ground signs will need replacement (one school's woodshop fabricated their arboretum signs).
- Select trees that are large caliper tree stock (1.5"-2" or even 3"-4") for immediate showiness.
- Enlist long-term care givers for the trees for at least the first two years (in addition to day-of-planting volunteers). Consider an "adopt-a-tree" program.
- When working with schools or other institutions, obtain a signed maintenance agreement.

For more on arboretum certifications and tree sanctuary programs see the following resources:

<http://arbnet.org/arboretum-accreditation-program>

<https://www.tufc.com/programs/tree/arboreta/>

<https://www.tufc.com/programs/tree/sanctuary/>

#### What is an Arboretum?

To qualify as an arboretum, a site must have at a minimum:

- Expert(s) in tree identification who identified and edited the tree list.
- At least thirty different species of trees on site (Level 1).
- All trees have easy-to-see and easy-to-read labels or signage displaying both the trees' scientific and common names.
- Trees that are in good health and have been evaluated and maintained (ideally by a certified arborist) to ensure the safety of staff and visitors.
- Trees that are protected from damage, such as from mowers or weedwhackers.
- Recently planted trees on an irrigation schedule.
- Mulch that is no more than 3 inches deep and does not come into contact with the trunk.
- A map that is available for all Level 2-4 arboretums.







Located in the Lowcountry SC Coastal Plain

**52,549**  
Population

**20**  
City size in mi<sup>2</sup>

**40**  
Number of years a Tree City USA

**1,000**  
City planted trees

**1,650**  
Trees distributed to the residents

**10**  
Number of events

**8**  
Tree giveaway events

**884**  
Trees given away

## CASE STUDY: SUMMERVILLE, SOUTH CAROLINA

### Flowertown Restores Its Pine Canopy

The Town of Summerville, SC participated in GIC's pilot tree campaigns project funded by South Carolina Forestry Commission's (SCFC) Urban and Community Forestry Program and the USFS.

Located in the Lowcountry of South Carolina just outside the urban ring of Charleston, Summerville was historically a spot for Charleston residents to escape their hot summers for the area's cooler pine forests. Nicknamed "Flowertown in the Pines" over a century ago, modern transportation has now put the town within commuting distance of Charleston, making it an attractive bedroom community to the larger metropolis. Growth pressures are causing loss to the town's urban tree canopy. While many places are available to add trees, these spaces tend to be located on private property, since much of the public lands are already well treed.

In order to maintain the quality and quantity of its canopy at 44%, the town needed to engage local residents to plant trees on private property. GIC and the town initiated a tree planting campaign with members of the tree board, residents, the local chamber of commerce and environmental groups. GIC mapped the urban tree canopy and open space to calculate how many trees could be added and the approximate cost for the town to plant enough trees to maintain its 44% canopy cover over the next 20 years. Summerville created a slogan "Rooted in Summerville" and identified a need for more trees to be planted on private property.



The Town of Summerville's tree giveaway draws a crowd.

Photos courtesy of City of Summerville

The tree campaign's stakeholder group was alarmed at the number of pine trees residents were pre-maturely removing, out of a fear they would fall during severe storms. The group decided to educate the public about the actual risks of trees falling during storms, especially native pine trees, and to offer free pine seedlings at the local launch of its campaign. In late 2021, the town held a tree giveaway of longleaf pine seedlings to commemorate their 40th anniversary Arbor Day. To help the town track planting locations, staff created a GIS-based tree tracking app using free tools from Esri, so residents could document their planting locations. This proved useful for town leaders to understand the gaps for neighborhoods and to focus their efforts to ensure that the canopy replanting effort was distributed evenly.

To build awareness of the many values trees provide, the town used giant price tags provided by GIC to show the values of those trees that were around the town square (see image below). The tag below explained that the value of the tree's carbon sequestered saved \$974.17 annually (based on i-Tree tool calculations).

Next steps for Summerville are to develop an urban forest management plan, for which they have received funding from the SCFC. A good urban forest management plan will help the city care for its trees long into the future.

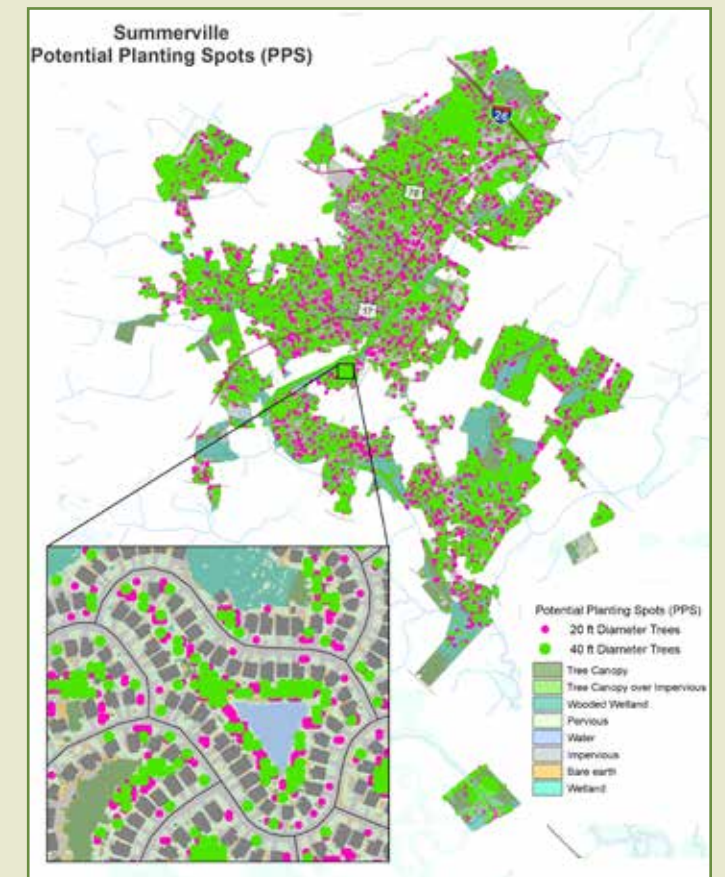


Tree "price tags" help residents understand the value of a tree's carbon sequestration.



Local residents were engaged to plant trees on private property.

Photos courtesy of City of Summerville



GIC identified many places in Summerville where trees could be planted.



## Understanding the Social History of Trees in a Community

Often, when discussing the role of non-government groups or people, we refer to them as “the public” or “the community.” But, in reality, there are many publics and many communities – both of interest and of place – and they may have very different perspectives about trees based on social, economic and cultural experiences. Past negative experiences may cause distrust of outsiders who suggest changes, so if you are planning a project from outside a community, you may need to overcome distrust issues before you even begin. This distrust may not be related to any planting campaigns; it could be a general unease towards outsiders, past disinvestment in the neighborhood, or fears that beautification leads to gentrification.

For some communities, the legacy of distrust for planning projects began with the “urban renewal” policies applied by municipalities from the 1950s to mid-1960s which attempted to disaggregate concentrated poverty or to remove “blighted communities,” especially from downtown areas. However, a building that, to an urban planner was “blighted” was, to the residents, their home or livelihood; a place that meant more than just a structure. For more about where this occurred and who was affected see <https://dsl.richmond.edu/panorama/renewal/#view=0/0/1&viz=cartogram> Redlining was another practice, based on racial discrimination, that kept people of certain races or religions from locating in predominantly white neighborhoods.

Although most of these policies were ended decades ago, many people remember what the government did to their communities, families and lives. Entire blocks of housing and commercial districts were removed almost overnight, oftentimes to erase competition from black businesses, resulting in the demolition of entire business districts of black professionals. As a result, government-initiated programs intended to “beautify” neighborhoods may still be met with distrust. So, it is important to ascertain who are the local community leaders – often the churches or other unofficial “influencers” – and get them on board at the very start of any tree-planting initiative.

Be aware that at the heart of this distrust is that tree planting will lead to gentrification since new trees, parks and other green amenities make areas more attractive to land speculators, house flippers or more affluent buyers who will drive up prices and property taxes. “Green gentrification” is a relatively new term that refers to this problem of wealth following green space improvements

or creation. This is actually an affordable housing issue, which involves wider policy decisions than just trees, and there are many ways to reassure residents they will be supported to remain in their homes. Thus, dealing with this problem should not be an argument against planting trees in low-income, racial minority communities. Instead, cities should adopt robust policies to protect existing residents and allow them to remain in their homes. For more creative ideas on alternatives and solutions to green gentrification, see [https://shelterforce.org/2020/09/08/green\\_gentrification/](https://shelterforce.org/2020/09/08/green_gentrification/)

A final fear is simply of trees themselves. Trees falling on houses is a favorite image of the local news media following storms. There is never a headline stating, “This forest buffer protected these houses from damaging winds.” More trees could, in fact, fall in older neighborhoods, where trees are aging out or dangerous trees and tree limbs that are too expensive for local residents to remove are at risk of falling. Educating residents about how to care for trees and providing financial or technical support to help residents remove risks, such as trimming off dangerous limbs, are some ways that could make residents more accepting of trees that are perceived as “risky.”

By linking trees to already identified needs, residents will often be more accepting of trees.

Raking leaves is another concern, especially for older residents. In Richmond, VA, the Bellemeade project employed youth to rake leaves for elderly residents, removing the concern about extra labor for yard maintenance. For more on this, see the GIC’s Richmond, VA, case study. Avoiding messy trees, such as those with spikey, messy fruit or long seed pods, is another way to mitigate these concerns. Lastly, start small. Many residents who fear a large tree will accept a smaller tree, especially a flowering variety, that likely will not harm them if it fell.

The key to discovering and addressing concerns that could derail a project is to first listen to residents. Find out what is important to them, their needs and fears. Determine if more green spaces can help them meet those needs and fears, such as improving safety or saving energy costs as a result of better shading of homes. By linking trees to already identified needs, residents will often be more accepting of trees. For more ideas and real-world examples, see the next section of this guide on demonstrating urban forest benefits.



## Ongoing Tree Care

The lack of long-term care is where tree-planting projects often fall short. If a city is giving away trees, it should collect recipients' location addresses and email addresses and ask them to send a photo and location for the tree, once it is planted. This makes it easy to recontact them to learn about the tree's health in years 2-5. If something has happened to the tree (e.g., it has been moved for utility work, or suffered from disease or an extreme weather event), help them plant another one.

To ensure a homeowner knows why and how to care for a tree, attach a care tag with each tree given away.

To ensure a homeowner knows why and how to care for a tree, attach a care tag with each tree given away. A care tag should provide some basic tree care tips for how to plant the tree, how often to water it, and the type of setting in which to plant it (e.g., full sun, partial sun/shade), and any other care needs. Consider an adoption certificate for the new tree parent. Include a pledge to water and care for the young tree into adulthood. This helps create a sense of ownership.

If you are a volunteer group planting in a park, make sure there is an arrangement in place for tree care. If the park department has committed to providing the care, ask that it assigns a watering crew and ensure there is a regular schedule in place. If you are providing the care, think carefully about tree placement and available labor. For example, if you are providing watering, you might want to plan for where you plant to ensure that new trees are close to a water source. You will not have time to run all over the city with hoses and buckets and travel time between watering sites adds up quickly.

Some cities and small towns do not have water trucks, but second-hand water trucks can be found on-line for around \$25,000-\$35,000. (Consider having a corporate sponsor for the water truck – offer to paint their logo on the side, if they buy it for you.) See the text box at right for low-tech, inexpensive do-it-yourself watering solutions.



Pruning branches on a new tree to ensure healthy growth.

## Do-it-yourself watering tanks

An intermediate bulk container (also called an IBC tank or IBC tote) is a square plastic tank with reinforcing aluminum bars that can be filled with water and attached to a watering hose. These can be purchased used for a few hundred dollars. Each holds 275 gallons of water, so one tank can supply fifty-five 5-gallon watering bags.

A laydown water tank is another option, often used for watering livestock in remote fields. A "halfmoon" laydown tank holds 48 gallons, and can be purchased for about \$120, while a larger 110 gallon tank will cost \$250 and up. While the smaller tanks are easier to manage, they will need to be filled more frequently. A shortened garden hose can be attached to move water from the tank the tree bags. While simple gravity pulls the water out, consider using bricks to prop up the far end of the tank, as the tank's water gets lower.

All these options can be totd on the bed of a pickup truck. A local program may also find it cheaper to rent a pickup truck to carry the tank for a few hours if watering is only needed every two weeks (or ask for a volunteer to drive their pickup truck). However, to fill these tanks from a standpipe can take a long time so, if your tree campaign is a partnership between a community group and the city, ask the fire department to fill the tanks, which can be done in minutes instead of perhaps an hour with a garden hose.

Ask the fire department to fill the water tanks for you, which can be done in minutes instead of perhaps an hour or more with a garden hose.



IBC totes (above) carry 110 to 275 gallons of water while a laydown tank (right) holds about 48 gallons. Both can be carried in the bed of a pickup truck.





Tree gators hold about 5 gallons of water.



## Self-watering bags

Newly planted trees will need to be watered regularly – weekly during a hot, dry summer. Once the tree’s roots penetrate deeper into the earth, they will be able to access moisture even when it is dry, but when establishing themselves, you will have to help out trees that are 1-2 years old, because otherwise they will struggle, and may not survive. However, do not overwater; some stress encourages new trees to push out their roots to seek water.

Overwatering a tree can be just as harmful. That is why self-watering bags are so useful. They simulate natural rain fall and facilitate steady, and not excessive water infiltration. A watering bag slowly releases water through its mesh bottom. These bags can be reused, since they are usually only needed for the first two years of a tree’s life.

The two main types of bags available are an upright bag, such as a “gator bag,” which holds about 5 gallons, or a “tree doughnut,” which is a ringed bag that holds between 15-45 gallons of water. The round low-profile bag requires less labor to keep it filled and also can protect the moisture around the tree. These lower bags can be self-watering as they take up excess rainwater and release it later.

Tree diapers or doughnuts are also self watering but they can absorb excess water during a heavy downpour and re-release that water later when the soil is dry so they do not have to be filled as often as an upright bag.

## Funding the Campaign

### How will the campaign be funded?

Before you start a campaign, you need to establish how the trees and planting program will be funded. Will this be a grant-funded project? Or city funded? Could a local business donate free trees? Can people donate trees and, if so, how many and by what method will their donations be tracked and recognized? The GIC’s budget spreadsheet, shown in Section 2 of this guide, is a tool that uses GIS analysis of plantable areas and spatially-based allocations of both large canopy and small canopy trees, in order to allocate new tree contributions to each funding partner by the percentage of canopy they hope to contribute.

To spur higher donations, allow for a recognition program, specify desired dollar amounts, and break your campaign down into specific targets.

For example, if the city plans to contribute 20% of the trees needed (a reasonable assumption, since most cities own 20% of the land), then it can use the spreadsheet to determine how many trees can be planted and over what time period. A cost-per-tree is then assigned to make it possible to determine annual costs.

Additional tabs can be used per funding partner. For example, if a community tree group has committed to plant another 20%, the spreadsheet can track those trees too. Remember that a tree purchased by a homeowner and planted in their yard is the cheapest option and the tree has a better chance for success since it can be located away from utilities and impacts from vehicles or crowds (as long as nobody mows over it).



In addition, the campaign should establish a system whereby it can account for all donations (either through the city or an established nonprofit with a reliable accounting system). Each donation should be acknowledged, and the value exchanged (what the donation will buy) should be articulated clearly (e.g., \$200 pays for one 2-inch caliper tree to be planted, watered and mulched for a year, or 300 tree seedlings to be planted, etc.). To spur higher donations, allow for a recognition program, specify desired dollar amounts, and break your campaign down into specific targets; for example, “You can tree a whole street for \$5,000” or “Plant a tree in a city park for \$150.” Provide for both large and small donations and do not make the entry price so high that it fails. For example, the City of Charleston set a donation price of \$450 per tree to meet the city’s 10,000 tree goal, but that proved too expensive and, as a result, not many trees were donated.

If accepting donations, ensure that there are options (e.g., \$50.00 buys 30 bare root stock, \$125.00 buys one large tree). Have a system in place to take on-line donations and to recognize those contributions online, with a sign by the tree or other ways. See the next section on fun tree funding ideas for creative ways to inspire and finance your planting campaign!



## Tree FUNding and Engagement

**Planting campaigns** – like any fundraising effort – should be fun. While creativity takes time, a tree funding campaign should cast a wide net. Its goal should be to catch people who would not normally attend an event or give to a tree cause. For example, if the effort only targets current tree stewards or members of the local garden club, the reach of the campaign will be very limited. The goal for outreach should be to reach beyond the usual folks to capture people who might not even think of the need, or have the desire, to plant a tree.

**Build awareness:** A campaign should include multiple avenues to learn about its efforts. Be creative. Work with local utilities and city departments to include a “Right Tree, Right Place” message to avoid overhead and underground utilities and conform to future city plans. Promote energy conservation through strategic shade tree plantings. Create signs about the values of trees and put them in local parks. Engage local schools in adding tree and forest education to local curricula and plan a planting event that includes all ages – for example, have young children grow a seedling in a pot for a year before it is planted; have a ‘family tree’ planted at a school; or have a street-on-street competition, with prizes for the street that plants the most trees.

**Motivate a desire for change:** Show that, without concerted action by everyone, the future will be less treed and more hot (negative messaging to increase concern), and also explain the difference that even one tree can make to reduce flooding, create shade and support property values (positive messaging that inspires a desire to act).

**Take action:** Make it easy to participate by sponsoring a tree, getting a free yard tree, getting a coupon to plant a tree, assigning a tree buddy to help plant the tree in a person’s yard, hosting tree give aways, tree education festivals with tree prizes, and other ways to put trees in peoples’ hands. Make the participation bar as accessible and as fun as possible. See the many case studies in this guide for inspiration!

### 3 Steps to Build a Successful Campaign:

#### 1) Build Awareness

Trees help individuals, neighborhoods, businesses, institutions, the city, etc., by... (See arguments listed in Section 1 of this guide for making the case).

#### 2) Motivate a Desire for Change

Cause a change in awareness that motivates a desire to act.

#### 3) Take Action

Plant a tree, donate to a campaign, change an ordinance, change a landscape plan.

## Plant It!, Dominion Power

Corporations are often looking for ways to market a positive image and power companies are especially interested in showing that they care about trees too. Dominion Energy’s project *Plant It!* just celebrated 15 years of success in working with schools to plant more trees. They support elementary students by providing teachers with a toolkit of educational resources and activities about the importance of trees and the essential role of pollinators in the world.

Through Project Plant It!, Dominion Energy partners with the Arbor Day Foundation to distribute pollinator seed packets and seedlings to schools. More than 600,000 free seedlings have been distributed to participants since 2007, and they keep going...

Following is a list of seven FUN ways to encourage tree plantings. There are case studies throughout this guide that cover each of these ideas. Also, see the following section on **Reaching New Constituencies** for ideas.

**1) Tree giveaways:** This is the most popular method, since the sponsor can set up in one location and have residents and businesses come to a single source to obtain their trees. Tree locations must be tracked (to count trees toward goals) and tree recipients should be provided with tree planting and care instructions. Consider co-locating the giveaway with other popular events, such as farmers markets, arts and craft events, or town fairs.

**2) Tree planting in a specific location:** While this requires more advance planning, to plan the space, ensure good soils, provide tools and safety instructions, as well as supervision for public participants, it provides more surety that trees will actually be planted properly, and in ideal locations and soil conditions. It assumes that there will be care in place to water the trees and provide periodic mulching and pruning for the first 1-2 years.

**3) Trees by request:** This allows for residents and businesses to request a tree: either street trees for municipalities or yard trees for nonprofits and other private sector sources. Some cities have established these programs, such as Norfolk, VA and Jacksonville, FL, but this approach requires more time and effort to set up the planting with the property owner (if private) and ensure the tree will be cared for over time (and not cut down when properties change hands).

**4) Trees by Adopt-A-Spot or beautification program:** In this model, areas are adopted and sponsored. This is done frequently for entrances to cities and towns or for small pocket parks. Since these programs are for public places,



Photo courtesy of the Town of Summerville

Consider holding tree giveaways within other popular events, such as farmers markets, arts and craft events, or town fairs.

tree species and care plans should be carefully considered, and you should choose trees that are beautiful, appropriate for public spaces and that require less maintenance.

**5) Trees in memory of:** Some cities, such as Auburn, AL, manage trees in memoriam programs where trees are donated in memory of a loved one and planted in a public space by the city, usually with a plaque recognizing the person for whom the donation was made. There are also larger organizations that take donations to plant in national parks or forests such as [www.alivingtribute.org/](http://www.alivingtribute.org/) or Trees in Memory from the National Arbor Day Foundation.







Breweries and wineries can name a beverage after trees, donate a percentage of proceeds, or offer coupons for free beer/wine to those who plant a tree.

**6) Tree discounts or coupons:** By partnering with a local nursery or home improvement store, a coupon can be used as a tree discount, which can drive people to obtain and plant their own trees. And it can also be a tool to track trees if, to redeem the coupon, the purchaser fills out the bottom portion (a cut-off self-mailer) that is then returned to the city or the nonprofit that is tracking tree planting locations; furthermore, the tree can also be logged to count towards the overall planting goal. This inexpensive option takes some staff time to log returned cards, but the tree is essentially free for the city, as the purchaser pays the base price. The store is happy because all the publicity advertises it and drives more customers to shop there, where they can purchase other planting supplies, such as mulch, pruning shears, tree guides, etc. A good example was carried out in Denver, where The Mile High Million Trees Campaign offered coupons for free trees. See: <http://actrees.org/files/Events/denvermillion.pdf>

**7) Sporting events:** To attract people to tree causes and gain new participants consider sponsoring a sporting event. Louisville Grows hosts a race that raises money for tree planting but also promotes their cause before and after the race. They have a 5K race to support their goal to plant 5,000 trees. They fund the event with many local sponsors such as a major wood flooring manufacturer Universal Woods, while Against the Grain Brewery provides the race packets (and a chance to have a beer too). These events showcase the goal while drawing new constituents to the cause.

## Reaching New Constituencies to Plant Trees

Most people have heard the idea of tree plantings attracting the “usual suspects”— garden clubs, scout groups, tree advocacy groups — but, to have a community-wide planting campaign, you do, in fact, need to attract the *unusual* suspects.

### **State Agency: trees = food.**

Have an event to plant food trees (fruit and nuts) and link the event to a foodie festival (e.g., have a booth with fruit pie, as well as fruit trees). Sell the food to fund the tree giveaways. Attach pie and jam recipes to the trees – it will help sell them. See the case study on Jammin' Jams on page 111 for the how-to details!

### **Private Business: trees = beer/wine.**

While trees do not make beer and wine (although there is mulberry wine and spruce tip infused beer— Yes, that is a real thing!) breweries and wineries have created beverages named after trees or campaigns and then donated a percentage of the price of each pint to planting trees (e.g., one beer = one seedling). A brewery offered coupons for free beer to those who planted a tree,

to which they had a great response. Of course, this can be transferred to any number of products. One national catalog company plants trees to replace those used to make its catalogs (see the text box below on Plow and Hearth).

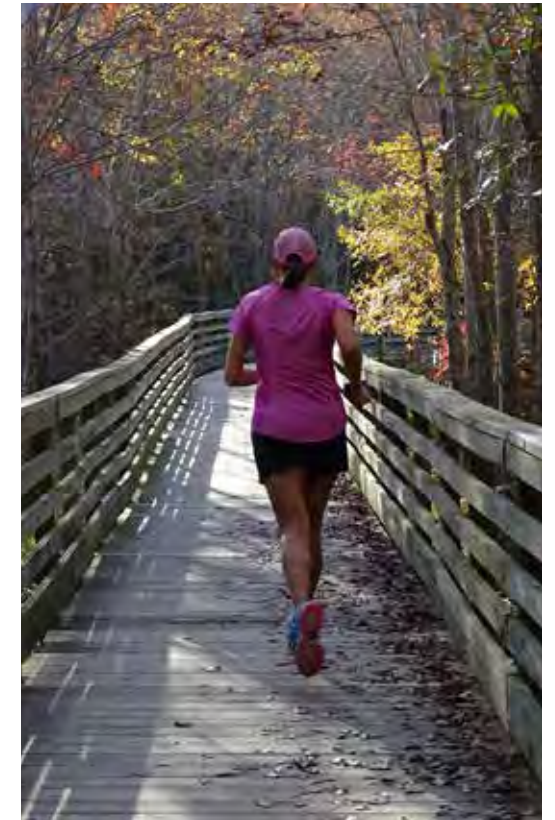
### **Public Utility: trees = energy savings!**

A well-placed shade tree, with a healthy crown, can bring a 20% cost savings in energy use. Because of this statistic, for the past decade, a Florida electric and water utility serving Jacksonville, JEA, has conducted tree planting activities through a partnership program with the nonprofit Greenscape of Jacksonville that they have called Green Releaf. Greenscape works with volunteers to plant trees at schools, parks and neighborhood organizations on public property, which can include utility easements and street medians. For more, see the full case study JEA and Greenscape of Jacksonville on page XX.

### **Recreation: trees = trails and healthy communities!**

Trees are essential to making trails that are both beautiful and shaded. This is especially important in the hot South where forested trails can also be a boon to the local economy.

The Razorback Greenway in Northwest Arkansas (see the case study on page 122) was years in the making and included, not just carving a trail across six communities in northwest Arkansas – Fayetteville, Johnson, Springdale, Lowell, Rogers and Bentonville – but also planting trees to shade the trail in urban areas, especially near a major hospital, where it provides a welcome break and healthy outlets for stressed medical staff, visitors and patients seeking exercise.



Recreational trails need trees to provide cooling shade.

## Plow and Hearth's Two For One Campaign

Plow & Hearth believes in giving back and making a difference for the environment. Its “Planting Two For One” program plants two trees for each one used in catalog production, which has become a standard for the catalog industry. Since 1991, this has resulted in 25 million trees planted in Virginia, in cooperation with Virginia Department of Forestry. The company sells pewter holiday ornaments and plants one tree for each sale through the National Forest Foundation. Their website notes “Each seedling planted helps restore natural habitats lost to forest fires and the effects of encroaching civilization.” <https://www.plowhearth.com/trees>





## CASE STUDY: JACKSONVILLE, FLORIDA & JEA Utilities as Partners in Managing the Urban Forest



Where:  
Jacksonville and  
surrounding  
communities in  
Northeast Florida

**500**  
Tree planted annually

**10**  
Number of years  
of the Green Releaf  
program

**478,000**  
Number of electric  
customers served by  
JEA

Trees and power lines can co-exist, if both are properly managed and maintained. The vast majority of tree-related power outages arise from trees that are dead, declining or poorly maintained. Proper planning and responsive stewardship can mitigate the chance of conflict, error, damage and tree mortality, while at the same time providing crucial benefits to the community, such as shade, reduced energy costs, stormwater uptake and more.

As the largest non-profit, community-owned utility in the United States, JEA also has a strong commitment to community tree care and has a partnership with Greenscape of Jacksonville, to manage the Green Releaf program. Greenscape helps volunteers plant trees at schools, parks and in utility easements and street medians. JEA emphasizes the importance of planting and conserving large shade trees, as part of their energy conservation messaging through Green Releaf. The utility arborists and urban foresters emphasize the conservation of existing mature trees that are already providing cost-savings for homeowners. For example, a well-placed tree with a healthy crown can bring a 20% cost savings through energy conservation.



Photo courtesy of JEA

JEA plants across the community from schools to streets.

### Planting Trees to Save Energy

For homeowners, nonprofits, or local governments interested in planting trees for energy savings, follow these best practices and planting tips from JEA and the U.S. Department of Energy:

- Plant with the local climate in mind. See: <https://www.energy.gov/energysaver/design/landscaping-energy-efficient-homes>
- Plant broad leaf trees to maximize summertime cooling.
- Use evergreen and semi-evergreen trees to provide shade year-round and serve as windbreaks in winter.
- Ensure trees have enough space to grow to their mature size, thus maximizing shade and energy conservation benefits.
- Plant trees on the southern and southwestern sides of buildings for maximum shade.
- Plant trees on the northern and northwestern sides of building for windbreaks to deflect cold winter winds away from buildings.
- Consult with a certified arborist, utility service provider or professional tree care specialist regarding tree selection, planting, long-term care, and avoiding conflicts with overhead and underground utilities. Follow the “Right Tree, Right Place” mantra.

### How to Partner With Your Local Utility

1. Find out if your utility is already a member of Tree Line USA®. (<https://www.arborday.org/programs/treelineusa/directory.cfm>). Since members must meet a set of five established criteria, the partnership groundwork is ready to implement.
2. Collaborate and leverage existing planting campaigns or tree-related initiatives already in progress.
3. Contact and engage a utility forester, utility arborist or vegetative management specialist to act as advocates and facilitate partnerships from the utility's end.
4. Rather than simply asking for funding, be prepared to show how a tree education and planting program can bring value to utility services and the utility's customers (e.g., avoid utility conflicts with “right tree, right place”).

For more tips see [See https://www.jea.com/environment/Tree\\_Planting/](https://www.jea.com/environment/Tree_Planting/)



Photo courtesy of JEA



JEA educates residents about avoiding planting overly large trees under power lines. Trees that grow up under power lines are subject to pruning that results in a V shaped tree, which is less stable.





Use simple graphics to show homeowners where to plant trees. This graphic is available free from GIC.



Avoid planting large trees under power lines. Smaller trees, such as crab apples (*Malus*) or crepe myrtles (*Lagerstroemia*), can be planted and not interfere with overhead wires.

## CASE STUDY: SAN ANTONIO, TEXAS

### Jammin' Jams

## Linking trees to food and fun in Texas and beyond!

Too often, tree giveaways only reach the most receptive members of the public, which often translates to trees being planted in already well-treed neighborhoods. To expand into areas of the city that lack trees, urban foresters in Texas found ways to engage with residents in a manner that resonates with local interests. For example, many people enjoy fruit trees; others enjoy spring blossoms; and others want shade against the heat. Addressing such needs can be especially important to residents who live in areas where food insecurity or high energy bills are significant issues. Fruit trees also have cultural appeal in areas where fruit has been grown as food (e.g., Florida, Louisiana, South Carolina, Georgia etc.) Fruit tree planting can expand interest in other types of tree plantings, such as for shade or wildlife.

As the second most populous city in Texas, San Antonio comprises a diverse mix of residents. The city's Climate Action Plan and Office of Sustainability established a 40% tree canopy cover by 2040 to increase cover by 10%. Today, the city holds hundreds of tree giveaways, often in conjunction with community festivals or parades to maximize outreach efforts. One particular tree giveaway event, Jammin' Jams, has been going on since 2009 at a local farmers' market. The event

Program sponsor with the city: Alamo Forest Partnership

3,000 participants in 2021

1,500 trees given away in 2021

15,000 fruit and nut trees planted over 10 years

15 equivalent of acreage of orchard planted with fruit and nut trees planted over 10 years

Photo courtesy of City of San Antonio



Fruit trees ready for a new home.



## CASE STUDY: SAN ANTONIO, TEXAS: Jammin' Jams (continued)

As the second most populous city in Texas, San Antonio comprises a diverse mix of residents. The city's Climate Action Plan and Office of Sustainability established a 40% tree canopy cover by 2040 to increase cover by 10%.

draws thousands of participants, giving away more than 1,000 trees in a matter of hours. Initially, to draw the interest of the public, organizers held jam making workshops as a way to engage and educate. The desire to make jam attracted people who might not otherwise have had interest in trees or participated in traditional tree planting volunteer work parties. Combining people's desire for cooking, home crafting or do-it-yourself culture with trees, provided a value-added incentive for adopting trees.

The annual event grew from a small staff booth at the farmers' market with just 100 trees given away. Once organizers began adding jam making to the event and tied it to the use of the fruit trees for adoption, this annual event became incredibly popular and the city brought high-quality, larger 3-5-gallon sized trees. By 2013, the event attracted more than a thousand people and trees went much faster than in years prior. As crowd sizes increased dramatically, jam making sessions had to cease as staff were consumed with crowd management. But the word was out – trees equal jam!

This program has since been replicated in the City of Norfolk, Virginia. The event's logistics and flow are very similar, but in Virginia, the jam making is still a central component of the event and draws new participants each time; and the city has established an orchard itself that is open to the public.



Photo courtesy of City of San Antonio

People line up well ahead of Jammin' Jams and volunteers have crowd control down to a science.

### Pro Tips

- Find a location that can expand in future years, even in the first year of a giveaway. This gives flexibility as the event grows into something bigger, with more people attending. Keep in mind places for storage, staging of equipment and trees, and management of lines of people.
- High-quality trees given away were a big driving factor for the success of the event. Organizers posted to social media a few weeks before the event, but after many successful years, the event had its own following. The location at Pearl's Farmers Market was also a big factor in the success.
- Engage with partners who are familiar with crowds and events. In Texas, the Bexar County Extension staff helped lay out and design the flow of the event. This was critical for expanding the number of participants, especially as the number of people attending reached into the thousands. In 2019, around 75 volunteers were on site supporting and managing the event for success.



Flyers for events are also in Spanish.



San Antonio's Tree Adoption mascot makes it fun for kids.

Photo courtesy of San Antonio Parks and Recreation



## CASE STUDY: SOUTH CENTRAL FLORIDA

### Trees to Trunks

#### Drive-through tree giveaways, with a side of shade.



Founded by Mark Cassini and Matt Shipley in 2016 as a positive, proactive, community-centered approach to the ecological and human risks associated with climate change, Community Greening (CG) mobilizes nonprofits, residents, corporations and city governments to plant trees where there is a low tree canopy. Strong ties in the local community, combined with ongoing professional development in environmental equity issues, helps ensure that challenges are identified by residents and solved collaboratively. They offer programming to increase the tree canopy including tree plantings at parks and schools; urban orchards; residential areas; and tree giveaways. Community Greening also employs a Youth Tree Team of local Palm Beach County high school students; many of the teens live in and around the neighborhoods in which Community Greening works.

Even with all their creative programs, finding efficient ways to get trees into the hands of the community can be challenging, even in

**100**  
cars showed  
up for the event

**1,000**  
trees given away

**200**  
trees given away  
to date

#### Sponsors and Partners

City of Boynton Beach,  
Community Foundation,  
and Palm Healthcare.



Community Greening pivoted to continue to give away trees safely during the Covid pandemic.

Photo courtesy of Community Greening

the best of times. Throw in a global pandemic and the challenge has been even harder. Innovative solutions by grassroots organizations working with the public was a must once social distancing became the new normal. Community Greening pivoted for their tree giveaways during the pandemic with an event called “Trees to Trunks.”

In the early spring of 2020 into 2021, the global pandemic completely altered the way governments, businesses and communities lived and worked. Community Greening’s tree giveaway events involved people crowded together, mingling in a festive atmosphere, with food trucks and music. With safety a chief concern during the Pandemic, innovative ways to deliver programming and services were required. The CG staff attended a Florida Tree Conference, where they learned how the City of DeLand, FL, typically distributed trees at events by loading them into the trunks of people’s cars; a safer way to give away trees during the pandemic.

Overall, the Trees to Trunks event was very successful. Set up took two hours and Community Greening staff and a small handful of volunteers were able to distribute 200 trees into a hundred cars in a little over an hour. Each car was able to receive up to two 3-gallon trees from a list of seven different species of fruit trees. Normally, they provide a mix of fruit trees and native shade trees at their events, but with the ongoing pandemic and concerns of food insecurity in the community, they decided to just offer fruit trees.

The CG staff have found that 3-gallon trees are the best size to use at a tree giveaway. The tree is large enough when planted to be visually satisfying and less likely to be mowed over or damaged, and still small enough for people to fit in a car.

Factsheets were distributed to participants on each species, along with a waterproof tag attached



Community Greening had the traffic control system well in hand for the large event.

Photo courtesy of Community Greening

to the tree with information from the Arbor Day Foundation on how to properly plant and care for the tree. The factsheets were a great way to provide information and educate the public in advance and solved the problem of curious tree adopters holding up the front of the line with their many questions. Reducing time spent in line by providing answers to anticipated questions improves everyone’s experience.

Community Greening coordinated with the Boynton Beach Police Department on traffic control for the event. At one point, they had 500 cars in line. The police department sent one officer to support traffic management and helped design the flow of the event. A must for anyone looking to replicate this giveaway model is to have the entrance to the event located on a low-traffic side-street, in which a long line of cars can snake their way through a neighborhood and cause the least amount of traffic disruption. The exit can be located on a busier thoroughfare, since cars will be leaving one at a time. Another option is to use a large parking lot of a mall, (with permission), during a quiet shopping day, with traffic cones and signage to indicate direction of flow for tree pickup.



## CASE STUDY: SOUTH CENTRAL FLORIDA: **Trees to Trunks** (continued)

### Pro Tips

- Post the start time, but not an end time for this type of event. Instead, phrase it as “until trees run out” so as to avoid cars showing up long after all the trees had been given away.
- Give out tickets to the cars who will be receiving trees, then turn away the other cars, so they will not have to wait only to be disappointed.
- Ensure a fun event, such as having music. CG had a DJ playing music and interacting with people in their cars, interspersed with quips, such as “Honk your horn if you’re getting a mango tree!”

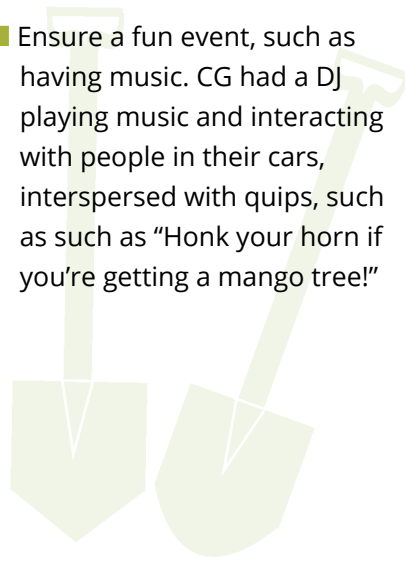


Photo courtesy of Community Greening

Outreach through CG’s social media network, posting on Instagram and Facebook and word of mouth were key to getting the word out. The City of Boynton Beach also promoted the event through their website and social media. In addition, Palm Healthcare supported the event through its “Healthier Boynton” initiative. Participants got to select which kind of tree they wanted through rank choice voting. CG also collected participants’ addresses and entered this into the “Treeplotter,” software to see where trees are distributed and to see if their outreach goals are met to report to funders. Currently, CG does not have the staff capacity to follow up on how well trees were planted or cared for by recipients; however, they expressed the hope to interest a college student intern to take this on in the future. CG is exploring the recordation of tree planting locations through social media by using tags distributed with the trees. CG encourages recipients to take a photo and post it using specific social media handles, along with the tree tag. While posting success has been moderate so far, it builds enthusiasm for the tree planting campaign.

The event worked well, relative to a small number of staff and volunteers, who were split into two 5-member teams that could tackle two cars at a time. Each person had a specific task they stuck to for each car: one person retrieved the tag from the trunk, which listed the tree species, and called it out to two people standing by who brought the trees over and loaded the trunk; a fourth person handed out factsheets, water bottles, and face masks to each car. This style of tree giveaway would be ideal for an area with enough space and an organization or community group with a small volunteer base looking to give away trees efficiently.

Although forced into the Trees in Trunks methods by the pandemic, CG staff loved doing this style of tree giveaway because it was a streamlined and efficient way to distribute trees, so they plan to continue with this model in the future. Once the pandemic ends, CG staff hope to return to some of the more personal community engagement offered at their more traditional, festival-style tree giveaways which build support when everybody can mix and mingle.



Photo courtesy of Community Greening



Photo courtesy of Community Greening





## CASE STUDY: GREENVILLE, SOUTH CAROLINA

# Trees Upstate and Plant GVL

### "Plant, Promote and Protect" Trees

Located in the upstate Piedmont region of northwestern SC, both Greenville City and County are seeing tree losses as they continue to grow and develop. Fortunately, both communities have partnered with the regional nonprofit group TreesUpstate to stem their tree losses and replant their landscapes. Forming public-private partnerships such as this are essential to meeting challenges for protecting forest cover.

TreesUpstate (TU) was founded in 2005 in response to sprawl-patterned development in Greenville County. Residents had become increasingly concerned as forests converted to housing, highways and malls. While growth will happen, Greenville County residents thought it could be done better— and without losing so many trees. Residents realized they needed to plant back trees to account for on-going losses of canopy cover.

Spartanburg County, which was planting a lot of trees at the time, provided the inspiration to form TreesUpstate, as did Trees Atlanta. TreesUpstate took care to form a board comprised of long-standing Greenville families that were deeply rooted in the community. Meanwhile, the executive director of Trees Atlanta provided a mentorship role to TreesUpstate, helping it grow its board of directors, and provide a leadership role for tree advocacy and stewardship. According to TU's current director, Joelle Teachey, "We realized that it's a 'both/and' situation; it's not trees versus the economy. There is a huge economic value to a healthy urban tree canopy."

In 2005, TreesUpstate began by planting trees in one gateway (interstate planting) and one school

"It's not trees versus the economy. There is a huge economic value to a healthy urban tree canopy."



Photo courtesy of TreesUpstate

**36%**  
City of Greenville Canopy Cover

**"40 by 40"**  
Tree GVL New Campaign Goal:  
40% Canopy by 2040.

annually. In 2008, it shifted its focus to community tree planting. TreesUpstate eventually stopped plantings at interstates due to the high costs and inherent uncertainty of planting in rights-of-ways as roads were realigned or widened. School sites proved challenged when grounds staff were not prepared to perform on-going tree maintenance such as watering and pruning. They created a new strategic plan in 2010, shifting their primary focus to legacy, large canopy tree plantings intended to last a lifetime, and to a NeighborWoods initiative to focus on neighborhood plantings. The strategic plan also included a shift from the idea of "we plant" to "you plant."

Realizing that trees are a social equity issue, and that lower income communities lack the means to plant, TreesUpstate partnered with the Greenville County Redevelopment Authority (GCRA) to reach GCRA neighborhood groups. Its mission became to "Plant, Promote and Protect" Trees. These partnerships have proved an effective way to reach community members to plant and care for trees. According to Teachey, a key tip is to ensure the new tree owner has a sense of pride in and stewardship for their tree by celebrating each tree planting. "We make community tree plantings in neighborhoods being revitalized a big deal," she says.

A public tree planting campaign and tree giveaways were seen as ways to maximize the number of trees planted. Its original public tree planting goal was to plant 10,000 trees in 10 years, but it actually managed to plant 11,000 trees within 5 years. So, TU reset its campaign target to 25,000 trees in 10 years. They also partnered with Duke Energy to focus on the energy-saving benefits of trees. As a result, since its founding in 2005, the campaign has planted and given away over 16,000 trees, offsetting 176 million miles of car emissions.

Interest in tree giveaways has increased dramatically, with all trees offered taken, and often with events ending in half the allotted time. This is greatly helped by the fact that the organization has a staff person dedicated to promotions through social media. In addition to using an on-line map to track its planted trees, it also tracks tree give-away planting locations to record where donated trees end up.



The NeighborWoods initiative shifted from the idea of "we plant" to "you plant" and worked to ensure that each new tree owner had a sense of pride and stewardship for their new tree.

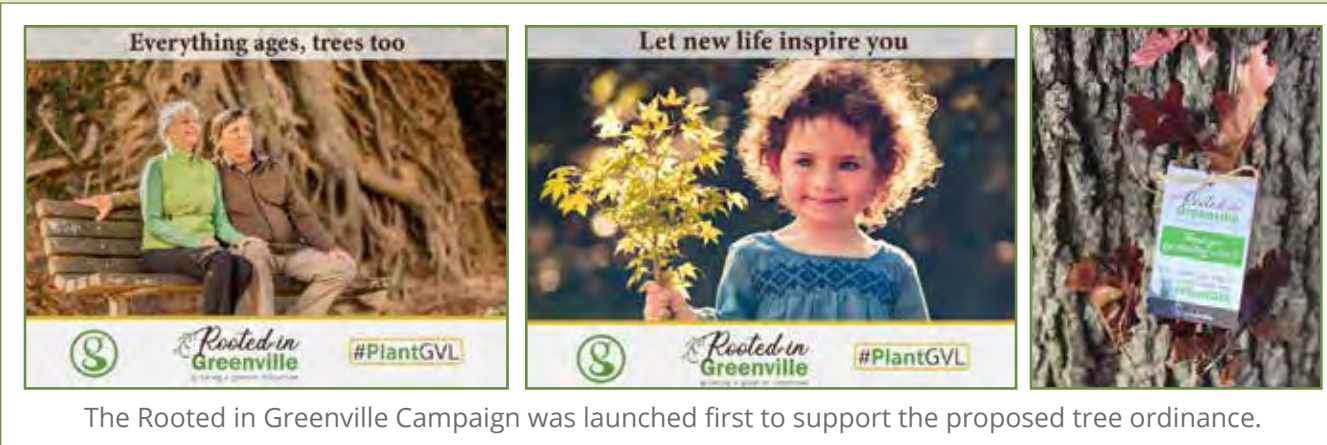


TreesUpstate partnered with the Greenville County Redevelopment Authority (GCRA) to get trees planted in lower income neighborhoods.

Photos courtesy of TreesUpstate



CASE STUDY: GREENVILLE, SC: TREES UPSTATE AND PLANT GVL (continued)



The Rooted in Greenville Campaign was launched first to support the proposed tree ordinance.

Photos courtesy of City of Greenville

In 2019, TreesUpstate launched a new initiative with the City of Greenville, the Green Infrastructure Center (GIC) and the South Carolina Forestry Commission to create a new canopy map and goal for a long-term planting campaign for the city. This coincided with the city's plan to create a new tree protection ordinance and an associated campaign titled "Rooted in Greenville," which helped promote an updated tree ordinance that was passed by city council in 2021.

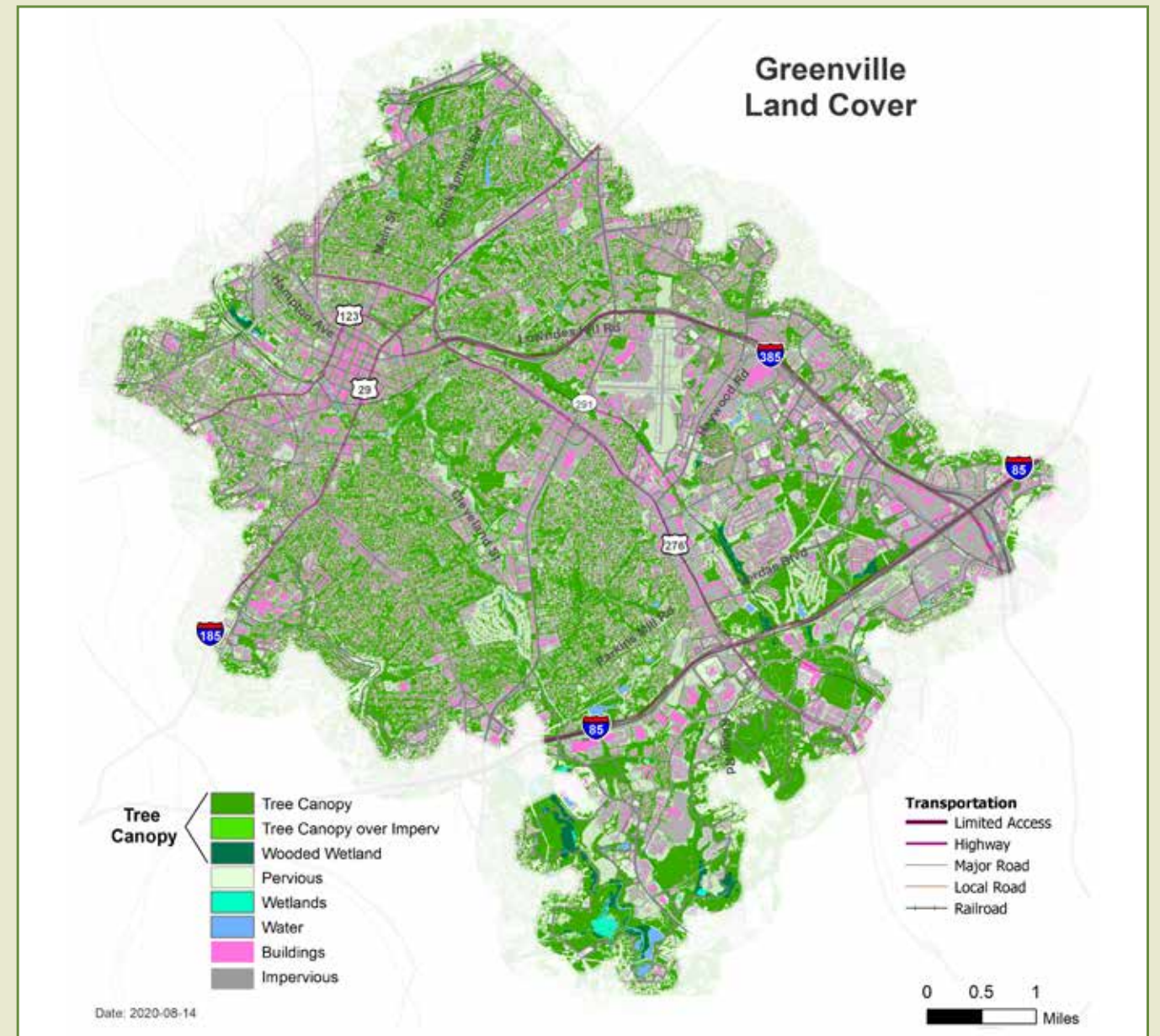
The city agreed to increase tree canopy from 36% to 40% by 2040 or "40 by 40."

The updated tree ordinance improves standards of tree care, protection of heritage trees and replacement of total tree diameter for removed trees. The city was very intentional in merging the idea of replanting the city with the new ordinance to better protect city trees. According to the city's landscape architect Edward Kinney:

*We've lost over 33 million square feet of canopy since we started taking recorded photos in 2001...and there's really no reason for us to assume that the decline wouldn't continue the way that it has for the past ten or 20 years, unless we do something to substantially halt its decline.<sup>8</sup>*

Tree canopy was mapped by GIC and showed trees covered 36% of the city. GIC facilitated the process for the city and TU to set a canopy goal based on the new maps. They agreed to increase tree canopy to 40 percent by 2040 or "40 by 40." To meet the new goal, the city has committed to planting 1,000 trees per year with TreesUpstate having committed to plant and giveaway more than 3,000 trees annually. With a tree campaign goal of "40 by 40," a joint slogan "Plant GVL" and joint fundraising by the city and TreesUpstate, social media and education efforts begun, the campaign is well on its way to achieving a long-term increase in canopy coverage and a healthy urban forest for the future.

<sup>8</sup> "Keeping Greenville Green: City Council Passes First Reading of Tree Ordinance Aimed at Replenishing Canopy," Anne Maxwell, Jan. 13, 2021, Channel 7 news; at: <https://www.wspa.com/news/top-stories/keeping-greenville-green-city-council-passes-first-reading-of-tree-ordinance-aimed-at-replenishing-canopy/>



Tree canopy was mapped by GIC and showed trees covered 36% of the city.



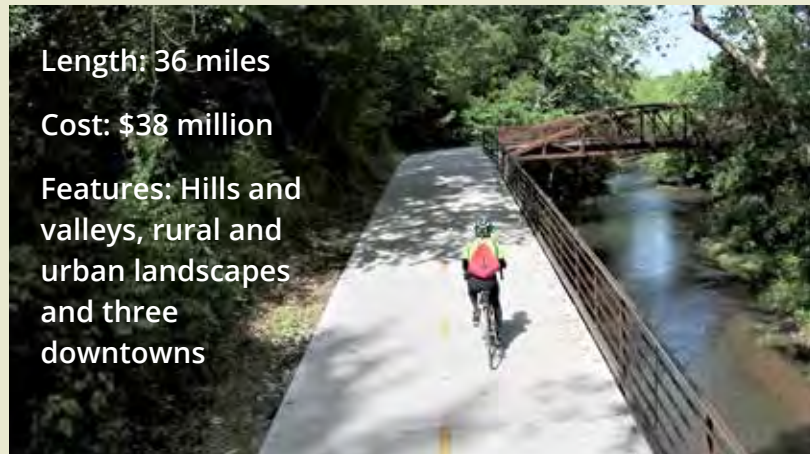
## CASE STUDY: NORTHWEST ARKANSAS

# Getting Fit on the Razorback Greenway

### Over hills, through valleys and three downtowns

Years in the making, the Razorback Greenway in Northwest Arkansas carved a greenway trail across six communities: Fayetteville, Johnson, Springdale, Lowell, Rogers and Bentonville. In total, the Razorback Regional Greenway cost approximately \$38 million. The majority of funds needed to build it came from a federal transportation grant and a matching grant and a major gift from the Walton Family Foundation. The Northwest Arkansas Regional Planning Commission and Northwest Arkansas cities also dedicated significant resources to bring the project to fruition, while the Arkansas' Urban and Community Forester provided technical support.

Trees were critical to the greenway's success, as they provided shade, beauty and habitat. People walked a long ways on this greenway because trees made the landscape more interesting and inviting. This backs up findings by researcher Kathy Wolf that people walk farther in well treed landscapes (2007). Furthermore, since the trail runs through the downtown districts of Fayetteville, Bentonville and Springdale, it provides direct access to various civic, entertainment and retail destinations; 6 downtowns, 3 hospitals, 23 schools, the University of Arkansas, the corporate headquarters of Walmart, JB Hunt Transport Services and Tyson Foods, along with multiple arts and entertainment venues, and numerous historic sites, parks and neighborhoods.



**Length: 36 miles**

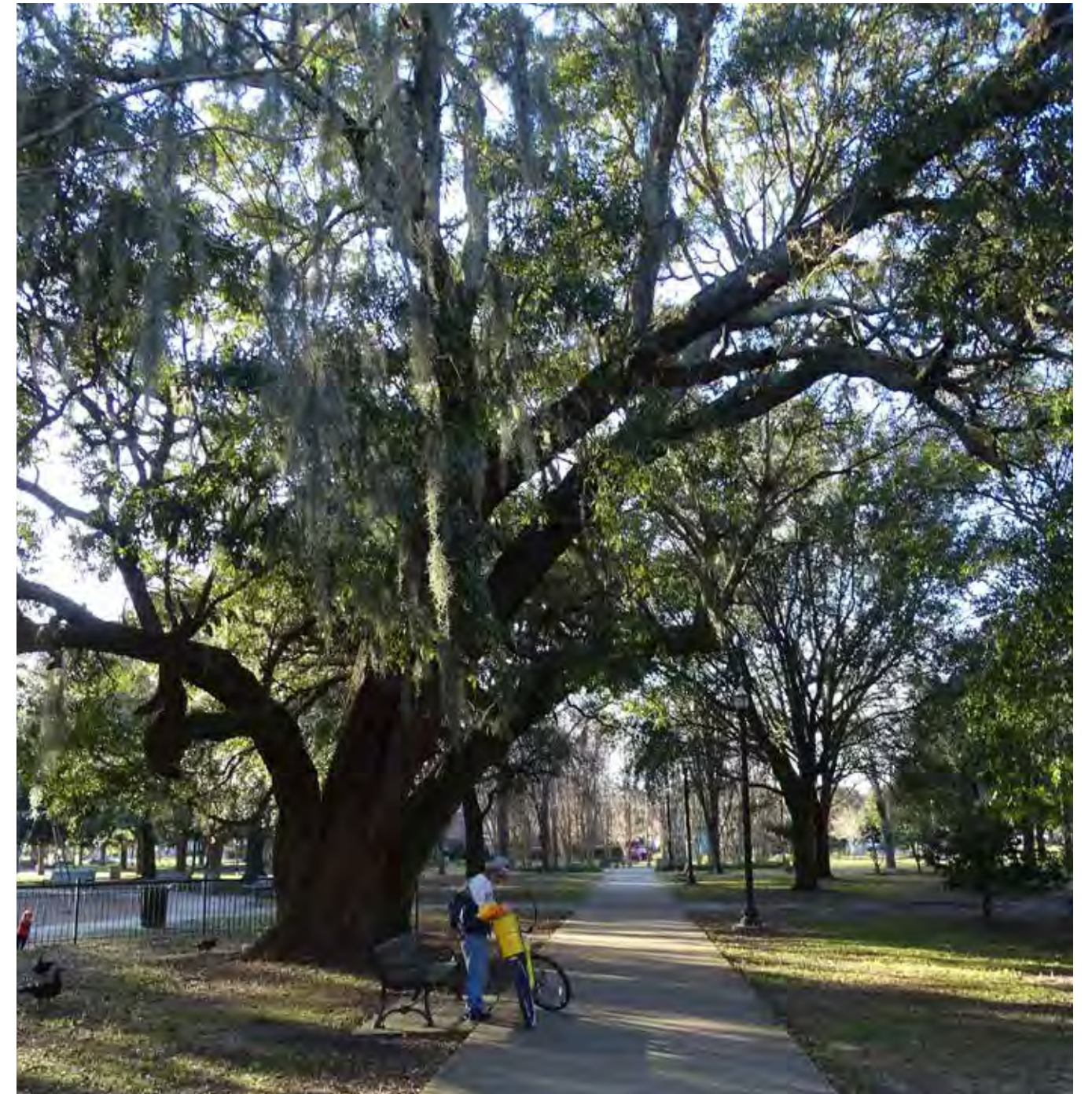
**Cost: \$38 million**

**Features: Hills and valleys, rural and urban landscapes and three downtowns**

While trees were especially critical along the more urban sections of the trail, the clayey urban soils created special concerns for planting trees, and it was decided to add amendments from American Biochar to them. In 2018, 450 trees along the 36 miles of trail were planted, which continue to thrive with the help of the biochar mix. Indeed, these trees show enhanced root growth and are less susceptible to stress from drought, salt damage, lack of nutrients and soil compaction.

## Section Summary

In this section, we focused on tree campaigns and how to make them both engaging and successful as well as tips to make tree giveaways more inviting and effective. In the next and final section of this guide, we offer tips on how to document the benefits of urban trees based on urban canopy data. Calculating benefits can be important in making the case for continued funding of planting campaigns from both the public and private sectors.





# 5. Demonstrating the Benefits and Maintaining the Urban Forest

In Section 1, we provided multiple statistics about the benefit of trees. This section shows how to document those benefits using data from your own forest. There are many ways to demonstrate the benefits that urban forests provide. As described in earlier sections, generic statistics can be used to make the case for urban forest benefits, but specific numbers for benefits based on actual canopy cover are far more compelling.



## Quantifying Benefits and Sharing Them

Canopy can be estimated using statistical analysis programs such as i-Tree Canopy, and then i-Tree tools can be used to estimate the environmental values they provide, such as carbon sequestration, stormwater mitigation or the capture of fine particulates. However, we recommended that you utilize a mapped tree canopy to determine the benefits its trees provide, as it will be location specific and can be used strategically to make plans for where to conserve or plant trees to maximize benefits.

A statistically derived (non-mapped) canopy figure can only generate statistics for benefits citywide – but as we showed in Section 4, the tree canopy can vary considerably across a city. An effective strategy to make the case for tree planting is to understand where disparities exist. For example, while a citywide canopy could be at 44%, a particular neighborhood could have a canopy as low as 10 or 12% and receive far less benefits than better treed neighborhoods.

Canopy maps allow you to break out the data by neighborhood, census block, watershed, downtown or other geographical unit used for planning. It may well be the case that a low-income neighborhood has less canopy cover and thus less benefits, such as clean air and other positive health outcomes, than a higher-income neighborhood. It's important to discern these differences and create planting or replanting plans that include equitable outcomes for your community. Following are examples for how specific tree benefits can be calculated and messaged.

## Clean air

For a simple statistic, a useful quote is, "According to American Forests, an average healthy mature tree can absorb 10 pounds of air pollutants, while providing 260 pounds of oxygen annually." However, you can derive more specific benefits for your city or town's trees if you have a map of your tree canopy in GIS. Use spatial maps of canopy cover to determine the acres of trees for a specific neighborhood, or for the entire city. The pollution abatement values used by i-Tree can be multiplied by acres of trees, using the values in the chart below to determine how much pollution current or new tree cover can mitigate. For example, to determine the value of ozone removal for a neighborhood with 50 acres of tree canopy, multiply 50 by the removal rate of 48.212 pounds of ozone mitigated per acre. This equals 2,410.6 pounds per year, at a dollar value of \$129,892.



Air Quality Multipliers (Urban Rates)

Pollutant (abbrev.)	Benefit Description	Removal Rate (lbs/acres/year)
CO	Carbon monoxide removed annually	1.13
NO <sub>2</sub>	Nitrogen dioxide removed annually	6.241
O <sub>3</sub>	Ozone removed annually	48.212
PM10	Particulate matter greater than 2.5 microns and less than 10 microns removed annually	13.683
PM2.5	Particulate matter less than 2.5 microns removed annually	2.463
SO <sub>2</sub>	Sulfur dioxide removed annually	3.068
CO <sub>2</sub> seq	Carbon dioxide sequestered annually in trees	10,010.27
CO <sub>2</sub> stor	Carbon dioxide stored in trees (note: this benefit is not an annual rate)	251,395.36





The city of Charleston has 32,896 acres of trees, which remove 454,951 pounds of large particulates and 81,022 pounds of fine particulates from the air each year.



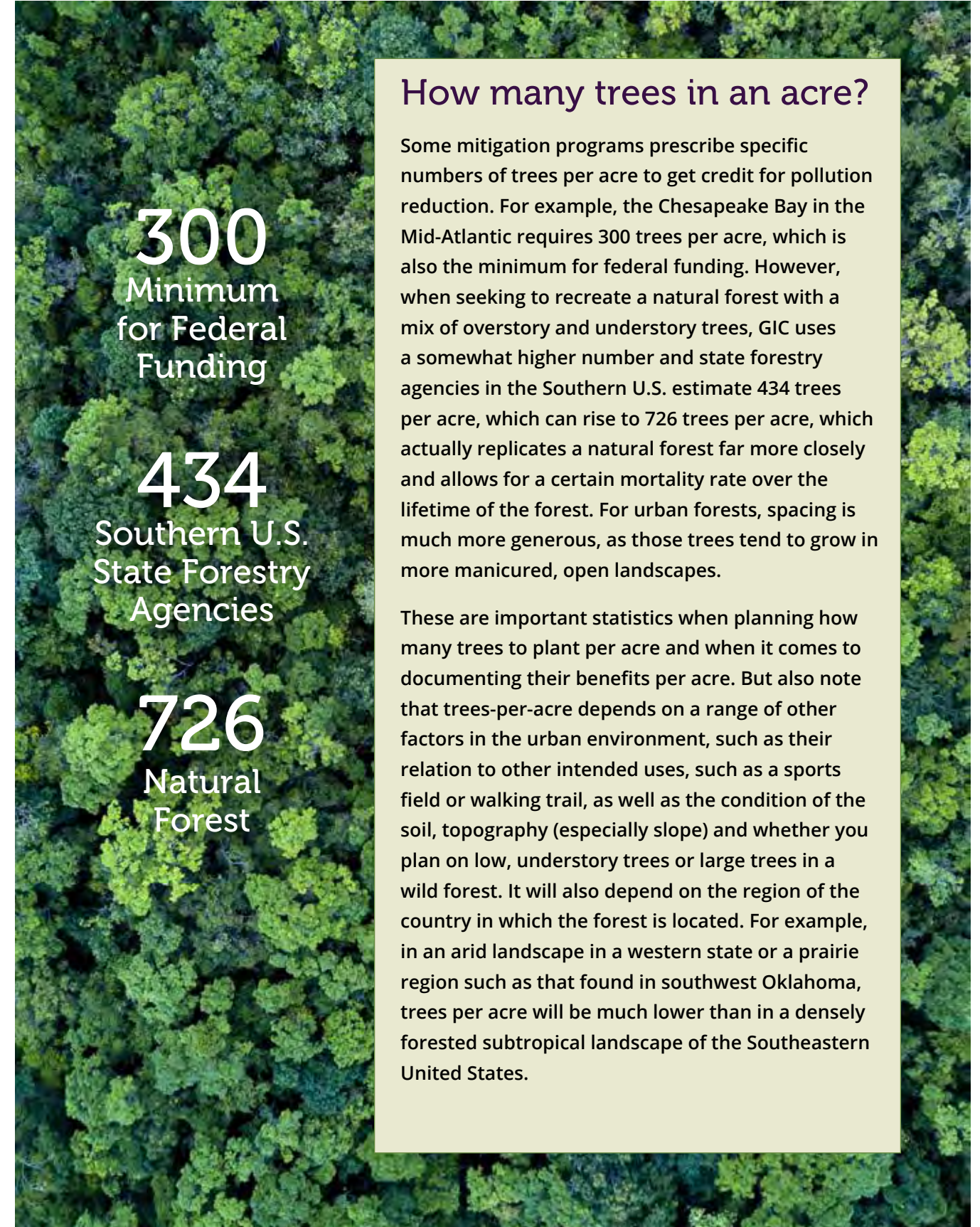
Note that, although tools such as i-Tree Eco will calculate these values for you, using your own spatial maps to determine this will allow you to make a case such as this:

*Planting an additional 20 acres of trees in the neighborhood will remove 273,660 pound of large particulates and 49.26 pounds of fine particulates. If planting a large enough area, this can be determined as a monetary value using the numbers of tons per year, or the appropriate fraction thereof. Since there are 2000 pounds in a ton, in the above example that's 273.66 pounds of large particulates, or about a 1/7 of a ton. If you divide 6,268 by 7, that equals around a \$900 value.*

Remember, this is a per year value, so, over the life of the 20-acre woodland of, say, 100 years, this equates to a value of about \$90,000. While 20 acres of trees is a lot, consider that there are many neighborhoods with vacant and abandoned lots that could offer many plantable acres. A new community park could be created, along with new trees in existing yards and at businesses, which could easily total 20 acres of trees.

Making the case for a large city is even more impressive when it comes to the benefits trees provide. Take Charleston, SC, for example, which has 32,896 acres of trees. The benefits they provide, simply in terms of cleaner air, amount to 13.83 pounds per acre removal of large particulates. When that is multiplied by 32,896 acres, it means 454,951 pounds of those particulates are removed from the air per year. For fine particulates, the totals are 2.463 pounds per acre, or 81,022 pounds per year.

If your city has adopted a climate goal (check your comprehensive plan/resiliency/sustainability plans), then it may want to report on the pounds of carbon dioxide sequestered in trees, which would be 10,010.27 pounds per acre per year, or 329,297,842 pounds CO<sub>2</sub> removed annually. If the city planted another 50 acres that would be 500,215.50 pounds of additional carbon sequestered!



### How many trees in an acre?

Some mitigation programs prescribe specific numbers of trees per acre to get credit for pollution reduction. For example, the Chesapeake Bay in the Mid-Atlantic requires 300 trees per acre, which is also the minimum for federal funding. However, when seeking to recreate a natural forest with a mix of overstory and understory trees, GIC uses a somewhat higher number and state forestry agencies in the Southern U.S. estimate 434 trees per acre, which can rise to 726 trees per acre, which actually replicates a natural forest far more closely and allows for a certain mortality rate over the lifetime of the forest. For urban forests, spacing is much more generous, as those trees tend to grow in more manicured, open landscapes.

These are important statistics when planning how many trees to plant per acre and when it comes to documenting their benefits per acre. But also note that trees-per-acre depends on a range of other factors in the urban environment, such as their relation to other intended uses, such as a sports field or walking trail, as well as the condition of the soil, topography (especially slope) and whether you plan on low, understory trees or large trees in a wild forest. It will also depend on the region of the country in which the forest is located. For example, in an arid landscape in a western state or a prairie region such as that found in southwest Oklahoma, trees per acre will be much lower than in a densely forested subtropical landscape of the Southeastern United States.



## CASE STUDY: LOUISVILLE, KENTUCKY

# Trees for Health

## Prescribing Tree Medicine



### Location

Outer Bluegrass region  
of Kentucky

**618,733**  
city population

**5,000**  
trees planted to date

**8,000**  
five year goal for trees  
planted

### Sponsors & Partners

Louisville Grows,  
The Nature Conservancy,  
University of Louisville, The  
National Institutes  
for Health.

Louisville, Kentucky is using trees to improve environmental health through a project called “Green Heart” that examines air quality problems and evaluates how trees can alleviate health impacts. The study is a first-of-its kind drug trial, where trees are the actual medicine. The Green Heart Study includes the National Institutes of Health (NIH), the University of Louisville, the Nature Conservancy and Louisville Grows. A neighborhood in the center of Louisville was chosen to assist for its poor air quality, racial diversity and its low-to-medium incomes. Interstate 65 runs through the center of the neighborhood, which is also close to the airport.

The study is concerned with fine particulate matter (2.5 microns and smaller) that originates from combustion engines, such as cars, trucks and airplanes. The University of Louisville is utilizing NIH funding to monitor air quality and collecting health surveys from residents. The Nature Conservancy is funding Louisville Grows, a grassroots tree advocacy group, to plant the trees. So far, the project has found that people with cancer can survive longer if they live in greener places, and residents in greener communities have lower levels of depression and stress, which is also key to the prevention and mitigation of cancer.



Image courtesy of Louisville Grows

Planting trees in tiers helps to push pollutants upward away from residences.

The five-year project plans to plant 6000-8000 trees in total. So far, Louisville Grows has planted over 5,000 trees, with plans to complete several more planting projects within the next few years. Trees are planted as buffers in the rights-of-way along the interstate’s noise barrier walls (see image at left) with around half the trees planted on private property. Planted buffers are approximately 16-18 feet wide by 100 feet long and utilize an angled buffer design, with evergreen trees planted against the highway barrier walls, scaling down to lower shrubs closer to the roadway. This angled buffer design helps push air pollutants higher into the atmosphere and reduces the likelihood an air eddy that will flow pollutants back down into the neighborhood side of the sound barrier wall. Evergreens, magnolias and arbor vitae are planted at the back, with smaller junipers and other shorter evergreens next, and then shrubs closest to the road. Although evergreen species make up just 5% of the city’s tree canopy, they were chosen for their ability to capture fine airborne particulates. Louisville Grows is working with the state transportation department to permit even taller buffers that utilize broadleaf species, along with evergreens such as the eastern white pine. Most of the 1-2” caliper trees were planted in dense plantings, so the cost was considerable. For example, at one buffer planting site, Louisville Grows installed 23 mature trees at a cost of \$15,000.

Neighborhood outreach is a key aspect to obtain buy-in from residents. Door-to-door outreach efforts were hampered initially by pandemic restrictions, though they have since eased. Staff from Louisville Grows have also attended community meetings to sign up participants, along with site visits to make sure yards are “tree ready.” Volunteers have been easiest to obtain for planting buffers, with a peak of over 200 volunteers planting 270 trees in a little less than six hours in one neighborhood section.

Residents have volunteered to have their health monitored before, during and after the project, in order to compare improvements in outcomes, such as respiratory health. This groundbreaking study will provide proof-of-concept that trees really do improve our health— and that it’s never too late to get started. For more on the city’s current canopy statistics, see <https://treeslouisville.org/wp-content/uploads/2022/02/2022-UTC-Fact-Sheet-FINAL.pdf>

## Louisville Grows 5-step Tree Campaign

This program identified five key steps in building a tree planting campaign:

1. Identify the neighborhood based on initial community interest and data from the city tree map.
2. Partner with community organizations and key stakeholders.
3. Canvas the neighborhood to identify “treerecipients.”
4. Give “Citizen Forester” training for community representatives.
5. Organize planting days with local volunteers to boost community engagement.



Image courtesy of Louisville Grows





## Stormwater and Flooding

Many cities are concerned with urban flooding. One mature tree can intercept thousands of gallons of stormwater annually, which can be quantified for individual trees, sites or cities. This argument can be made as a reason to conserve or add canopy, whether through the city's stormwater division or either the resilience or sustainability officer. For stormwater uptake, this can vary considerably by tree, but i-Tree MyTree has a fun and easy calculator tool for an individual tree. See: <https://mytree.itreetools.org/#/>



Furthermore, the Center for Watershed Protection has tools to calculate the volume of stormwater benefits per tree, at: <https://www.cwp.org/making-urban-trees-count/>. GIC also offers tools that can calculate stormwater volume and water quality benefits provided by trees, by acre. This tool is best applied at the watershed scale and requires a map of treed areas and plantable open spaces. See Section 2 of this guide on tree map types for more details.



For more on the methods and calculator tools, see this webpage [http://www.gicinc.org/trees\\_stormwater.htm](http://www.gicinc.org/trees_stormwater.htm). For planting campaigns, consider this slogan to make the case for absorbing water:

**“Plant Trees for Flood Relief!”**



When cities are highly impervious, even an afternoon thunderstorm can cause severe flooding.



### Trees to Offset Stormwater (TSW) Tool

Under a grant from the USFS, GIC developed a Trees and Stormwater (TSW) spreadsheet tool for cities to determine:

- 1) **How much stormwater trees take up during various storm events.**
- 2) **How much pollution— nitrogen, phosphorus or sediment— trees capture.**
- 3) **How much more water and pollution would runoff if trees were lost.**
- 4) **How much more water and pollution would be captured by new tree plantings.**

The TSW model utilizes TR-55 curve numbers (CN) developed by the Natural Resources Conservation Service (NRCS) to generate expected runoff amounts for different land covers and soils. This curve number method is used by stormwater engineers to determine how much stormwater needs to be captured to mitigate land use changes and which best management practices could be applied to capture and treat the runoff from proposed developments.

Tree canopy is key for capturing stormwater because trees reduce the proportion of precipitation that becomes stream and surface flow, also known as water yield. Utilizing a highly detailed land cover map can account for the variety of conditions in which trees are found (e.g., trees over pavement versus trees over a lawn or in a forest). Researchers

Hynicka and Divers (2016) modified the water yield equation in the NRCS model by adding a canopy interception term (Ci) to account for the role that canopy plays in capturing stormwater, resulting in:

$$R = \frac{(P - C_i - I_a)^2}{(P - C_i - I_a) + S}$$

Where R is runoff, P is precipitation, Ia is the initial abstraction, which is the fraction of the storm depth, after which runoff begins, and S is the potential maximum retention after runoff begins for the subject land cover (S = 1000/CN - 10).

Adding data to run the TSW model requires knowledge of how to use Geographic Information Systems (GIS) mapping to determine tree cover and understory conditions. There are many firms that can create a land cover map for a city, as can staff at GIC. Data required include a recent high-resolution land cover map that shows all the different land cover surfaces and data for soils and impervious surfaces, such as roads and sidewalks, which are available from the local government. Adding in additional impervious data allows the analyst to “see” the impervious areas underneath trees. See Section 2 of this guide for more details on tree canopy mapping.



King tides can cause flooding even on a sunny day.





A 10 percent loss of tree canopy in Charleston would result in an increased runoff during a 24-hr storm of 231.7 million gallons—the equivalent of 351 Olympic swimming pools!

GIC's TSW tool allows a city to model the effects of adding or losing trees on stormwater capture versus runoff. The model can be used to run "what-if" scenarios, specifically either losses of tree canopy from development or increases in tree canopy from tree planting programs. For example, applying the TSW model to the demonstration City of Charleston, SC, a 10 percent loss of tree canopy, along with the resultant new impervious areas, would result in an increased runoff for a 24-hr storm of an additional 231.7 million gallons (351 Olympic swimming pools). The calculator tool showed that increasing the tree canopy from 58% to 60% would result in a decrease in stormwater runoff (or increase in capture) of 1,569 million gallons of water across the city.

A key finding from this work is that removal of mature trees and existing urban forest canopy generates the greatest impacts of increased flooding and runoff pollution.

## Urban Heating

This report covered the problems and benefits of trees in reducing heat stress and surface temperatures in Section 4 of this guide. There are several on-line urban heat calculators that depict hot days (above 100°F) for the present, the past and the future for every city and town in the U.S. Try this one: <https://www.nytimes.com/interactive/2018/08/30/climate/how-much-hotter-is-your-hometown.html>

Note that, although these models show projected futures, they do not model urban heat abatement from future tree plantings. An estimate could be derived, however, by collecting actual data for urban temperatures in shaded and unshaded areas of a city, and then document the difference that trees make in urban cooling. This would be a great project for a school or a university intern. One could then predict that if X future areas were shaded, they would be Y degrees cooler.

Use an outdoor thermometer and take measurements both under the canopy and in a nearby unshaded part of the street. Compare them. Differences of 7°-12° Fahrenheit between shaded and unshaded areas are typical for urban areas. If you have mapped the entire urban canopy, you could hypothesize how much greater an area could be cooled with tree plantings. So, if you are planning a planting project to cover X areas of open space, you could predict the decline in surface temperatures based on planting. The methods for conducting a more definitive and scientific study of urban heat island effects are found on EPA's website <https://www.epa.gov/heatislands/measuring-heat-islands>

As noted in Section 3, GIC developed guidance for using satellite imagery to identify areas that are excessively hot and for pairing those data with

### KEY MESSAGE —

**Trees are free health care—  
they cool the city and  
reduce heat health risks!**



Trees can reduce residential cooling costs by 30 percent or more.

Charleston, South Carolina, USA\* Urban Tree Canopy Stormwater Model version 1.0.2017

The Green Infrastructure Urban Tree Canopy Stormwater Model estimates stormwater runoff yields for current and potential land cover. The methodology is based upon the NRCS TR-55 method for small urban watersheds. It is used to provide better estimates using GIC's high-resolution land cover and modeling of potential canopy area.

TOTALS		#VALUE!	13.8%	1,645.7	231.7	1,576.7	#VALUE!	Variables				Variable			
		Statistics by Drainage Basin (current settings)		m/1000 gal/yr		%		Event	% UTC loss	% FOS Loss	% Imperv	PCA	PPA	% of Land	% of PPA
Area	Current Tree Cover	Current Impervious Cover	Tree H <sub>2</sub> O Capture	Increased H <sub>2</sub> O w/10% tree loss	Added H <sub>2</sub> O Capture w/10% PPA	Tree Cover Goal	Park on Vacant	Field and Wetlands	Converted Land	Canopy Added	Enter % to be planted				
1	030502010708-Atlantic Ocean	50.2%	16.7%	45.01	0.001	0.30	1%	1 yr / 24 hour	10%	10%	40%	0.0%	50.0%	11.0%	10%
2	Bohicket Creek	65.4%	11.0%	4.8	2.06	0.31	6%	1 yr / 24 hour	10%	10%	40%	71.7%	6.4%	1.2%	10%
3	Folly Creek	62.0%	11.2%	0.2	0.20	0.02	4%	1 yr / 24 hour	10%	10%	40%	95.4%	3.2%	1.6%	10%
4	French Quarter Creek	77.0%	1.7%	0.3	0.00	0.00	7%	1 yr / 24 hour	10%	10%	40%	77.0%	0.4%	0.2%	10%
5	Good Creek	60.1%	17.8%	0.3	0.20	0.01	4%	1 yr / 24 hour	10%	10%	40%	57.1%	17.0%	8.5%	10%
6	Guerin Creek	73.1%	0.0%	1.1	0.00	0.00	9%	1 yr / 24 hour	10%	10%	40%	97.2%	0.1%	0.0%	10%
7	Lower Ashley River	68.7%	11.0%	28.8	0.00	1.90	1%	1 yr / 24 hour	10%	10%	40%	12.0%	3.0%	1.2%	10%
8	Lower Cooper River	61.0%	10.9%	14.7	2.12	1.94	4%	1 yr / 24 hour	10%	10%	40%	51.5%	12.5%	4.0%	10%
9	Lower Wando River	72.3%	0.2%	77.7	19.88	0.88	7%	1 yr / 24 hour	10%	10%	40%	78.8%	4.0%	2.0%	10%
10	Middle Ashley River	75.0%	0.1%	1.1	1.13	0.01	6%	1 yr / 24 hour	10%	10%	40%	81.0%	3.0%	0.0%	10%
11	Rantowles Creek	76.1%	0.5%	70.36	0.74	71.09	7%	1 yr / 24 hour	10%	10%	40%	78.0%	3.0%	1.7%	10%
12	Stono River	69.7%	9.0%	14.01	1.10	13.84	5%	1 yr / 24 hour	10%	10%	40%	30.0%	3.0%	1.1%	10%
13	Stono River-Atlantic Intracoastal	58.0%	14.0%	1,068.23	102.89	1,029.05	7%	1 yr / 24 hour	10%	10%	40%	72.0%	4.0%	1.0%	10%
14	Upper Cooper River	51.0%	0.4%	147.04	64.23	148.29	8%	1 yr / 24 hour	10%	10%	40%	66.1%	3.4%	1.7%	10%
15	Wadswa River-Atlantic Intracoastal	21.0%	0.0%	5.0%	0.00	1.17	0%	1 yr / 24 hour	10%	10%	40%	84.7%	3.8%	1.4%	10%

The TSW calculator tool allows an urban area to evaluate the water uptake of its existing canopy and model impacts that would occur from changes, whether positive (adding trees) or negative (removing trees). In addition, the TSW data can be applied as a layer over other maps, depicting where to retain trees for stormwater or where to plant them for the greatest uptake.

For more, see [http://www.gicinc.org/trees\\_stormwater.htm](http://www.gicinc.org/trees_stormwater.htm)





Trees could be planted here to replace this stump.

census information to highlight places where social equity is a concern in relation to race, income and urban heating. This approach can measure how evenly distributed canopy is across a city and the degree of “tree inequity” that exists. Maps of plantable areas can then inform you as to where trees need to be added to reverse inequitable impacts or the poor tree planning of the past.

We emphasize the importance of understanding the wider causes of such canopy problems. For example, a current lack of trees might be due to a past storm, after which tree replanting was overlooked as a key recovery strategy. It might also be true that current attitudes or lack of awareness in existing communities are driving disinvestment in the future canopy.

GIC has developed a GIS-based tool for siting tree plantings in the most advantageous spots to reduce impacts of summer heat on residences. Whatever the reasons for past or current tree inequities in canopy coverage or care, data can speak loudly to make a convincing case that change is needed. Contact GIC for assistance in developing tools for your community.

## Making an Effective Case

In any city, there are many competing demands for time and money. Trees are sometimes seen merely as landscaping or for beautification – but not as essential. However, trees are essential for public health, safety, biodiversity, erosion prevention, stormwater uptake and much more. In Section 1, we included examples of the types of arguments to make by stakeholder type, as well as additional statistics that can make environmental, economic and social arguments, so refer back to Section 1 of this guide for pithy facts that can be provided to news media and elected officials. Here, we discuss possible ways to make a compelling case for more trees. As a reminder, there are many benefits that trees provide:

- Reducing flooding by capturing runoff.
- Cleaning urban streams and lakes by filtering pollutants.
- Cooling urban temperatures for livability.
- Improving health by facilitating walking, running or biking and reducing heat island effects.
- Increasing economic stability by improving property values of neighborhoods and business districts.
- Place making and livability that leads to mental wellbeing and community cohesion.
- Providing habitat for birds, beneficial insects, wildlife and pollinators.
- Improving air quality and water quality.
- Reducing energy use.

In short, trees are a sound return on investment—they cost relatively little to plant and care for, compared to what they return to you. Many citizens and city arborists have contacted us expressing



frustration that their city does not plan for its trees or is not expending the time and funds necessary to care for existing trees, or to replace them as they age out. Similarly, many cities lack standards to ensure that planted trees survive. The SC Forest Toolkit written by GIC includes many of the important codes and policies needed for a thriving and sustainable urban forest. See Appendix B for links to these resources.

### KEY MESSAGE —

**Trees pay you back for planting them—  
with re-opened storefronts, stable neighborhoods and safer communities.**

### KEY MESSAGE —

**Trees foster walking and health—  
tree care is community care!**

When trying to make an effective case for trees, realize that all cities and towns are in a state of conflict within their budgets, wherein debates are often framed in terms of “priorities” – with funding for police or schools, courthouses, or roads being “higher priorities,” which means that trees are left out or minimized because the budget pie is only so large. This attitude is exacerbated when trees are only seen as “beautification” (in the same boat as landscaped islands or entry plantings) or as a “luxury,” and not as an essential part of the city’s infrastructure. So, it is important to frame the argument in terms of the wider economic benefits trees offer to the city, in terms of raising house values, and thus property taxes, increasing tourism and spending in shops, and thus sales taxes, and reducing infrastructure costs, such as stormwater drains. If you argue that trees are infrastructure that will reduce costs and increase revenues to the city in the long run, and trees should be included in city budgets for that reason, you may find your arguments gain a more receptive audience.

Similarly, many cities and towns have health campaigns, but do they argue only for more walking paths and sidewalks but not the essential trees to provide both shade and safety? By making the case that trees belong as part of existing or upcoming strategies you will be more effective in making the case for trees. Tackle the most pressing issues in your community, using tree as part of the solution.



Let's take a few examples.

Many U.S. cities are concerned about urban flooding because of overstressed storm drains and the problems of flooded roads and standing water after storms. Use GIC's stormwater calculator and stats that show how urban forests can soak up soak up tens of millions of gallons of stormwater annually. Compare the cost of planting an acre of tree seedlings to a new stormwater pond along with its associated pipes and expensive maintenance. Trees can reduce the problem of stormwater runoff while a constructed pond, with all its pipes and maintenance costs, is far more expensive, in the long run, than an acre of strategically planted trees. One answer is to add tree planting to the city's stormwater program, so that it becomes part of a large, more strategic budget that has a built-in level



These trees planted in a bioswale will help to soak up more stormwater and are also infrastructure for this Florida city.

**KEY MESSAGE —**

**Trees are the straws  
of the city—  
soaking up  
stormwater and  
reducing flooding.**



of priority – use GIC's TSW calculator to make the case, or CWP's individual tree calculator, mentioned earlier in this section of the guide. You may also need water storage solutions such as capturing stormwater volume in cisterns beside buildings or under parking lots that can be used to help water those trees later when its dry.

Most cities have a plan to revitalize a downtown or have an established an economic opportunity zone, which is attractive to builders because the IRS provides credits for investing in these zones (see <https://www.irs.gov/credits-deductions/businesses/opportunity-zones>). However, these investments don't require re-greening, so consider establishing minimum tree standards for redevelopment projects in these zones. Often, developers will say that they cannot afford to add "landscaping" for affordable housing or low-cost office parks, however, trees and shrubs are a very small cost of any development project and can be used as an incentive to grant other benefits to developers, such as narrower sidewalks or additional stories on a building, in exchange for adding more vegetation. In addition, properties with trees and open spaces within developments hold their value and are worth more over time than properties without trees or neighborhoods without parks.

## Belmont, The Little Neighborhood That Could, Charlottesville, VA

Unfortunately, some people lack the imagination to see what a blighted area could become, given some careful planning. In the Belmont Neighborhood of Charlottesville, VA, an older downtown area that had once been the walkable business district for a blue-collar neighborhood had turned, by the 1980s, into a place with closed and boarded-up shops. Only a handful of businesses remained, such as a small convenience shop, a towing business, a tire shop and a plumbing company. Cars sped through down the main street and people didn't walk to the once charming and bustling community shopping area, but only saw it as an eyesore to hurry through. A group of citizens serving on the Community Development Block Group— a HUD Program to recover urban areas— determined that they could reinvest in the neighborhood and make the area attractive once again, using CDBG funds to plant trees, add treed medians and bump outs to slow traffic and make pedestrians feel safe and welcomed.<sup>9</sup> Once the cars were "traffic calmed," cyclists felt safe to use the newly added bike lane, and stores once used only for storage were now desirable real estate and reopened as shops, offices for architects and artists, and restaurants serving tapas and farm-to-table menus. Shopping in downtown Belmont, once thought to be a joke, now became a reality. Key city officials were engaged, including the city's traffic engineer.

Efforts to add bump-out islands of trees were first seen as "impossible" by the fire department but, rather than meekly accepting a hard "No" from the city's Fire Department, the neighborhood



Streets were narrowed with new tree islands and bump outs with trees were added to sidewalks to shield pedestrians and slow traffic.

established a series of mock street islands using traffic cones, then asked the Fire Department to bring their largest hook and ladder truck to take the turns around them onto side streets while moving at their fastest safe speed. This resulted in agreement for a compromise turn radius that allowed both safe passage for emergency vehicles and pedestrians and the treed bump-outs and islands.

In addition to new tree islands and bump outs, street trees removed 30 years before as part of a lane widening

project were replanted, using the CDBG HUD funds. Today, the community continues to thrive. Had this project been framed merely as a tree planting project, it would not have had the support and the funding; but, tying it to revitalizing the business district, improving pedestrian safety, and so on, did attract grants. And it was found that using trees and plantings for revitalization was both popular and successful! Linking tree planting to established urban programs, such as CBBG or opportunity zones, can help cities make the link between environmental health, trees, and economic success.



Tying tree planting with revitalizing the business district, and improving pedestrian safety, attracted financial grants.

<sup>9</sup> The CDBG program also provided downpayment assistance for home ownership, rehabilitation of homes for low-income homeowners, and low interest loans to restore or start a business in the district.





## Job creation

Communities have hired an arborist because they realized the importance of having an in-house position to ensure a healthy urban forest.

Often, a popular topic for cities is job creation. Although the global pandemic of 2020—2022 depressed the job market, employers have since found it very difficult to obtain workers and the “great resignation” became the catchphrase of the day. However, it might also be the “great relocation.” Many workers not only switched jobs, but they also moved, often to places that were greener. Working at home, as well as Covid-forced isolations, made many people want to get outside more and to find places to recreate that were local and did not require a drive. Now more than ever, being able to offer residents and workers a greener city and greener neighborhoods is key to attracting employers and keeping workers happy.



Landscaping staff can become certified arborists, giving employees opportunities for advancement.

Linking the urban forest to jobs is a very important consideration when it comes to economic growth. The more a city places an emphasis on its trees, requires permits and expert consultations for tree removals and engages in tree inventory work, the more it will preserve and restore the canopy it has, and the more it will encourage people to live and work in the city. This will also open up opportunities directly tied to nurseries, landscaping and arboriculture, creating more demand for trees and related products, such as mulch, pots, fertilizer, or pruning shears, generally stimulating the home gardening market.

In addition, a city might consider having some of its landscaping crew certified as arborists, which would give staff meaningful training opportunities while building job satisfaction and advancement. The International Society of Arboriculture offers such training and certification. It also offers certification in Tree Risk Assessment, which can help a city

### KEY MESSAGE —

**Trees grow wood, food and JOBS!**

### KEY MESSAGE —

**Tree jobs for youth can create the next generation of skilled workers who care about their community.**

*Grow trees, grow jobs!*

ensure that damaged and dead tree limbs are dealt with ahead of storms and before extensive damage occurs, reducing the risk of lawsuits and ensuring that the canopy of a city remains green and healthy.

Making time for – and funding – professional certifications ensures that the required skills are built in house. However, one note of caution was voiced by an urban forester from Charleston who lamented that, when people develop skills, they tend to leave city jobs for the private sector. The solution to this is, of course, to pay your skilled people above minimum wage so that the city retains them over the long term. The more a city is engaged in care of its trees and the training of its employees, the more valuable, satisfying and important the job of the city arborist will become, so advocate for him or her to earn a living wage.

We discussed tree boards earlier in this guide—remember that they can be a key advocacy force for the urban forester. After working with GIC on canopy goals, communities have hired an arborist because they realized the importance of having an in-house position to ensure a healthy urban forest.

Community tree planting groups can also take on the above advice as well. Finding arborists of the future requires encouraging youth to enter the field of urban forestry. Community Greening, serving south central Florida, runs a Youth Tree Team that employs local teens to “improve their



Community Greening runs a youth program where teens get their first work experience planting trees in public spaces.

neighborhood, learn about green jobs and teach them about the environment. The teens get their first work experience by maintaining trees and public green spaces, conducting community outreach and attending “green collar” enrichment activities. Community Greening also ensures that its own staff are enriched by engaging them in workshops and conferences in state and nationally, where they can learn new skills and stay motivated.





Successful post-storm cleanup of damaged trees requires pre-contracting to enlist the most skilled companies before the storm begins.



These upland tree species are being killed by frequent storm inundation. With a continuously rising water level, the coastal city of Norfolk, VA, is planting different trees, with many now planted in upland areas to replace those that will be lost as a result of sea level rise.

## Storm and Climate Planning

Most communities can get behind the need to plan for storms. However, many emergency plans leave out planning for tree damage. Take a look at your community's emergency plan for your county, city, town or region. These plans may address road clearing or debris transport and storage, but they may make little or no mention of trees. Addressing trees can require a specialized approach with skilled and trained workers. If the city hopes to be reimbursed for trees lost to weather events or to engage in replanting, there are strict rules that FEMA requires localities to follow.

Cities often struggle to recover from storm damages— both in the short- and long-term. The faster a city can recover and re-open, the lower the economic and social damages will be to the community. Usually, once a storm hits, cities and towns are challenged to obtain the resources they need to restore critical functions. This frequently requires enlisting contractors, who are in short supply during and after storms, thus delaying recovery time. And, if the wrong contractors are hired, or FEMA processes are not followed, the city may have to absorb far more costs when FEMA denies reimbursements due to improper procedures.

Proper debris monitoring is a critical element for FEMA reimbursement. According to audits done by the Office of the Inspector General (OIG), without proper debris monitoring, debris clean ups are susceptible to fraud and overcharges by disreputable contractors. This is another reason that a community should be prepared to handle trees after storms, especially by having pre-contracts in place for skilled and

authorized personnel to remove and manage tree debris safely and effectively, as well as to get reimbursed for removals and for the cost of new trees to replant following storms. To learn more about planning for trees, both before and after storms, see GIC's Resiliency webpage at <http://www.gicinc.org/resiliency.htm>

In addition to storm planning, the need to prepare for climate change may be a pressing issue, especially if it means more frequent and heavier storms for your region, or the threat of sea-level rise. However, there are other, longer-range effects for which you should prepare. Inventories of trees can help you determine if you have a tree composition that is more "resilient" to climate

### KEY MESSAGE —

**Planning for a resilient city requires a climate-ready canopy!**



change effects whether from storms or droughts. Being a resilient city means that you are both prepared and ready to adapt so that critical functions can continue.

As mentioned in Section 2, tree inventories can be conducted ahead of storms to identify trees that are at risk because of rot, disease or poor form, such as a bifurcated trunk. Inventories for risks should be conducted by a Tree Risk Assessment Qualification (TRAQ) arborist. Inventories can also identify an overabundance of trees subject to current or future problems, such as the American elm (Dutch elm disease), ash (emerald ash borer) or Bradford pear (wind susceptibility). If your community lies near the coast or in a hurricane-prone area, you should also consider selecting and planting more salt-tolerant trees, trees that can act as wind buffers or hold sand dunes in place, and trees that don't mind their roots being waterlogged. Similarly, areas subjected to fire need to avoid planting non-native trees that are more likely to ignite, or which don't recover well after fires.

Conducting inventories and funding tree care or removals as warranted can make sure there is less damage during a storm and reduce the resultant damage or recovery costs. If you are a coastal community threatened by sea level rise, it would be prudent to evaluate places that will be subject to inundation and estimate the resultant loss of trees that would not withstand such inundation. Evaluating those places now and planting water- and salt-tolerant trees in inundation zones is as important as planting new trees in upland areas to replace those that will be lost. Also, ensure that rising water and inland marsh migration does not result in a loss of coastal forest buffers. To learn more about forest resiliency, see GIC's studies of coastal forest resiliency at [http://www.gicinc.org/res\\_coastal\\_forests.htm](http://www.gicinc.org/res_coastal_forests.htm)



A tree inventory and tree risk assessment can help cities manage their urban forest.



New tree planting is happening with a focus on species that can survive long into the future.



## Better Parks and Neighborhoods

We've discussed arguments for cities, but since most lands are in private ownership, most trees are privately owned too. Encouraging residents to plant and care for trees is essential to ensure a healthy and extensive urban forest. There are many arguments you can use to encourage private participation, such as: trees increase the economic value of homes; trees reduce energy bills; trees clean the air of pollutants; trees provide shade for outdoor activities, such as barbecues (and tree forts); fruit trees provide food; and so on— see the graphic on page 10 that depicts tree values based on research by Kathy Wolf. People often react much more strongly when family values and stewardship are engaged.

As noted, in the Tree Campaign for Greenville, SC, the message of "Plant the Next Generation" was used to make the case that, just as we grow our families with children, we also should grow our trees' children as well. Older neighborhoods with older trees often lack the next generation of trees because of mowing and paving that prevents seeds from growing into trees. Leafy green neighborhoods may well comprise mostly older trees that are aging out. Staff from GIC have explained to local officials that, "We have the older grandparent trees in this neighborhood, but where are the grandchildren trees?" This message resonated, since people could understand that, as old trees age, there needs to be a next generation coming along to replace them. The city responded by developing a

"We have the older grandparent trees in this neighborhood, but where are the grandchildren trees?"



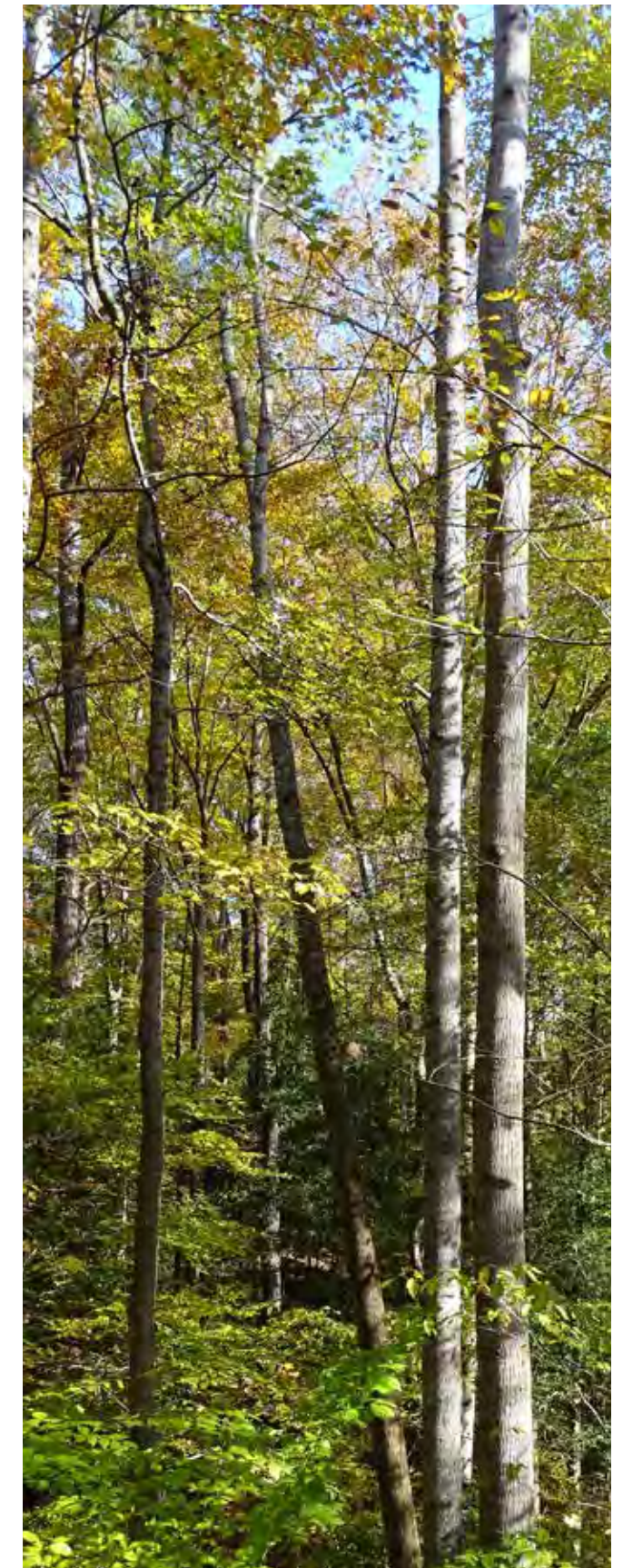
Photo courtesy of City of Greenville



Photo courtesy of City of Greenville

number of social media ads on this topic, including the examples shown here.

We also know that people want to visit parks that are well landscaped and feel safe. Cities and towns often lament the fact that they don't have the funds to extensively landscape all their open spaces. One barrier to planting more trees was overcome in Charlottesville, VA, by compromising with the Park Department's staff. They agreed to establish "no-mow zones" to allow a forested buffer to establish itself along streams, especially since it meant less area they needed to mow. Department staff were also amenable to planting more trees in other areas of the parks, but their budget did not allow for purchasing as many trees as were desired because the city's policy was to plant larger (more expensive) trees that establish quicker (and were less likely to be accidentally mowed over). A compromise was reached to plant smaller, bare root trees that would be cared for by adoptive parents. By having adoptive parents, each tree could be cared for more easily and cheaply, which allowed more trees to be planted. This also engaged the community as tree stewards, including residents who did not have room in their own backyards to plant trees. (See "City of Charlottesville, Virginia Gets Help for Tree Care" on page 84 of this Guide.)





It is also important to identify the barriers people perceive that prevent them from planting or caring for trees, such as fear of trees falling on their house, or a dislike of raking leaves.

### Consider a focus group for your community!

If you are not sure which messages— preventing flooding, reducing heat, improving property values, increasing safety and beauty, green jobs, cleaner air, etc. —will resonate with community members, host a focus group to test them out and see which ones are the most compelling. Invite representatives (around 20 people from various neighborhoods and backgrounds) and present different messages to them. Provide them with survey cards to record their reactions and then hold a group discussion. Which messages (if any) are the least compelling and most compelling? Ask them what would motivate them to take action (e.g., plant a tree or volunteer for tree maintenance). Also, consider targeting different groups with different messages aimed at their interests and the diverse ways to reach them, e.g., messages that “Trees Help Water Quality” could be targeted to boaters and fishermen, while “Trees Reduce Flooding” messages could be targeted to homeowners, engineering departments and city officials.

It is also important to identify the barriers people perceive that prevent them from planting or caring for trees, such as fear of trees falling on their house, a dislike of raking leaves, a lack of knowledge about costs and expenses, or difficult access to tree nurseries or sources of native trees. Not all of these barriers can be overcome, but they can inform how a tree campaign is designed. For example, some residents who are reluctant to plant a large shade tree may be willing to plant a smaller flowering tree that is less intimidating.



Some communities have also offered technical assistance or funding for low-income residents to have dangerous limbs or trees removed, which can overcome fears that a storm-damaged tree will be a costly problem to remove. And, even once perceived problems are understood, overcoming those barriers may still take time, so patience is required. If trees are hard to buy for inner city residents, either because they are for sale in the suburbs and the residents lack suitable transportation, hold tree giveaways or pop-up tree shops, or have a coordinator arrange ahead to bring trees to people and have volunteers plant them, as many tree groups do. For more, see the tree pop-up shop examples from Trees Knoxville on page 94.

Tree campaigns can also be used to build advocacy for strengthening tree ordinances, as the City of Greenville, NC, did with its “Rooted In Greenville” campaign. The city had been struggling to build support for its new tree ordinance, so they began the campaign to build public support for trees before proposing additional regulations to protect trees in new developments. After the campaign— which involved slogans, ads, social media and tree giveaways— the public resoundingly supported the new regulations. While the campaign took over a year to conduct, the results were stronger provisions for tree retention, rather than having the regulations continue to be stalled. And new developments— now with more trees, thanks to new city codes— will gain value, encouraging new residents to buy into these communities.

It is also important to acknowledge that people get their information in myriad ways. Community engagement takes time. If the city is the entity launching a campaign, then it may need to engage more diverse partners to get the word out, such as churches, neighborhood associations, sports clubs, youth groups, garden clubs and school clubs, such as boys and girls clubs. Information should be provided in the most useful formats, such as newsletter-ready articles, door hangers, public service announcements, and the like.

Perhaps one of the more fun campaigns mentioned earlier offered a free pint of beer for every planted tree. While a tree certainly costs more than a craft beer, it was an effective campaign because it brought in an element of fun and new stakeholders who might not have paid attention otherwise.

The key is to think outside the box. For example, how about a poetry contest around trees aimed at 5th graders? This could engage both youth and their parents, along with media stories and posting the winning poems at bus stops, city hall, the library and in schools. Another idea might be a competition to paint a picture or photograph your favorite tree. All sorts of art projects can be done with leaves. Or people can be asked to “Design Your Own Park”, with the winners getting free trees. Your campaign may vary by neighborhoods, such as outreach to the garden club in one community and the youth groups in another.

Community engagement takes time. If the city is the entity launching a campaign, then it may need to engage more diverse partners to get the word out, such as churches, neighborhood associations, sports clubs, youth groups, garden clubs and school clubs, such as boys and girls clubs.



# Planning for the Future

## Benchmarking – keys to success

Not all campaigns come out as intended— both positively or negatively. Establish a way to learn which messages and methods are getting through. The most common one is asking people at events, tree giveaways, or website visits, “How did you hear about this?” If a campaign is not reaching the right people or you note that all responses come from just one neighborhood, re-evaluate what is working and re-think your approach. If your community does not have in-house marketing and media staff, consider hiring outside help or partner with local groups who already know how to reach their communities. The key is to stop using messages and approaches that don’t work— and find ones that do! In short, any campaign should have a way to gauge effectiveness, whether its tracking clicks on a website, recording calls to a hotline or participation in plantings.

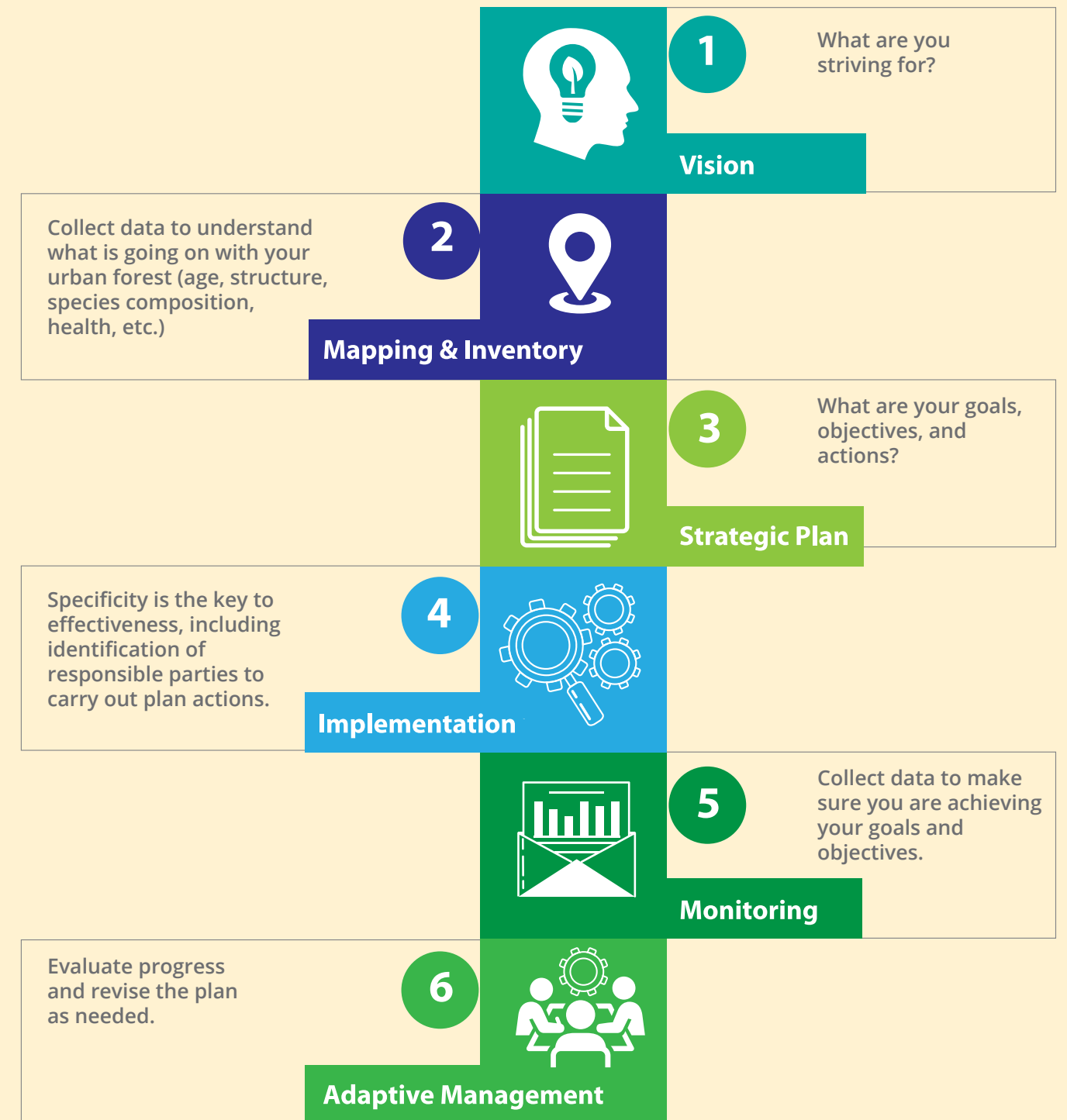


Set a benchmark for what success would look like for your group— 100 trees planted, 200, 10,000— and the desired outcome. Is it to plant more trees, or is it to educate the public in tree care, or to increase awareness of the social, health and economic benefits of trees? Or is it to take action? There could be different messages timed for different time periods with, first, a preliminary messaging campaign that built awareness, and then a second campaign that spurred people to action.

Tracking whether your messaging actually led to action is key, if that is the intended outcome. In the case of the “Rooted in Greenville” campaign, the city’s chief aim was to gain awareness of, and support for, a new tree protection ordinance

and to lay the groundwork for the upcoming tree planning campaign. It then launched the second campaign, “Plant GVL 40 x 40” to spur action— enough tree plantings to achieve 40 percent canopy cover by 2040. The measure of success will ultimately be determined by re-mapping the canopy every five years to see if the city is gaining or losing tree cover, in addition to meeting specific goals for trees planted annually by the city and partner groups including TreesUpstate. Once the campaign is well underway, an urban forest management plan could be the next step. See the graphic at right for the steps to crafting a plan.

## Basic Framework for an Urban Forest Management Plan





## Reviving the Group

If your group is suffering from a lack of interest or has more “talkers” than “doers,” consider whether it makes sense to add new membership or to start a new program that appeals to a different audience. Established groups often lament that they need more young people, or more families, and so on, but they should be asking themselves, “What can we do to appeal to young people or families?” “Are we partnering with schools, holding tree plantings that include fun appreciation events, such as concerts or picnics? Community Greening hired a DJ to spin music at tree planting events and giveaways, which made them fun and attracted a vibrant crowd.

Ensure that your group has long-term staying power because it is engaging, multi-generational, fun and effective.

If your group is, like your trees, aging out, consider a youth branch, neighborhood chapters or new ways to invite new members. Consider the timing of meetings— are they held during work hours when many people are not available? Are your members getting tired, exhausted, running out of ideas? Sub-tasking is one way to ensure that your group’s leadership does not burn out by overwhelming the person(s) in charge. Are there childcare issues that could be addressed by providing care at the event? Are there multi-lingual options you could adopt, with translators at meetings or events? For example, TreesUpstate from Greenville SC recently translated many of their materials into Spanish to ensure that key stakeholders could understand and engage with tree planting activities. Websites also can be multi-lingual and some offer options for other language versions on their home pages.

A great way to increase engagement is by giving people more responsibility. The national conference of the Izaak Walton League also hosts a parallel youth conference. The two conferences come together throughout the week and the young people are encouraged to review and add to the adult conservation policies.



Photo courtesy of Izaak Walton League



Photo courtesy of Community Greening.

DJSoNyce spins records for a community planting event at Community Greening in Florida.

Another way to broaden engagement is to consider if there is a constituency that can tackle a particular program aspect. For example, in one campaign, a group, of women gardeners formed an “ivy swat team” that went out and about, hunting down harmful ivy growing on urban trees. They do one thing well and they do it over and over again. Since your community most likely has a garden club or garden movement, consider forming your own Ivy Eradication Brigade – dedicated neighbors armed with clippers to rescue endangered trees! Also provide simple posters, such as this one <http://treestewards.org/wp-content/uploads/2012/03/take-ivy-off-trees.pdf>, that show why ivy is bad and how to remove it successfully. Make it fun, with a contest for the most trees treated and with Instagram or Facebook posts showing your successes.

The end result is to ensure that your group has long-term staying power because it is engaging, multi-generational, fun and effective. For more, see the earlier case study of how TreesUpstate built its organization and better integrated its work with one of the communities it served.

### Key questions to ask about your group's effectiveness

- Who makes up my community? (hint: use the 2020 census update).
- How are we reaching those constituents? Can we attend or co-sponsor their events and talk about trees?
- What are the community's wider needs and interests? Can we find a link that addresses those issues as well?



A public sign can ensure that trees planted in rights of way are recognized as public projects.



Root-bound trees find it very hard to break out of their old limits and to send out strong new roots

## Ensuring long-term stewardship

Finally, consider how tree planting projects are cared for over the long term. One way is to ensure that trees planted in rights of way are recognized as public projects. One tree planting project almost disappeared when, a few years after installation, a bike advocacy group identified the treed median as their favored place for new bike trails and recommended removing the trees. Public outcry from the Tree Board stopped the plan and alternate bike routes were sought. Remember that city councils change, arborists change jobs and neighborhoods change leadership, so tree commitments can be forgotten.

Ensure there is signage and written commitments for care plans and stewardship. A public sign identifying the project helps too. In the conflict just mentioned, the community has since added signage to the planted median to explain that these trees were intentionally placed there. If your group is planting trees in a park, ensure there is a maintenance agreement in place (or an agreement that your group can provide care and watering). Pruning will likely be needed on young trees at 1-2 years, depending on their size when planted and the types of trees.

Considerations for maintenance needs are also important when selecting trees. For example, the American sycamore is a very tough street tree, but it needs aggressive pruning in its first several years to ensure a safe and contained form as a street tree. Since some trees need more care, choose species wisely, based on you and your city's capacity to care for them.

## Planting

Trees that come in 3 or 5-gallon pots are often root-bound; their roots have not been able to spread out properly and so have become a tangled ball. You should not plant the roots in such a state. Carefully unwind them, not breaking any large roots, and ease them outwards, then extend the larger roots as you place the tree into the ground and build the soil around them. Root-bound trees find it very hard to break out of their old limits and to send out strong new roots, so making this effort during planting is essential— and do not plant them in the canvas bag or wire mesh they might have come in.

## Watering

Plastic upright bags are often used to allow for water to seep slowly into the ground overtime. The 5- or 10-gallon upright bag or horizontal doughnut shaped bag is filled and then left for a few weeks, as water seeps through the mesh, simulating natural rainfall. Some of the horizontal doughnut-shaped bags are designed to absorb and then later release excess moisture and do not need filling unless there is a severe drought. Both upright and ringed water bags also protect the tree from accidental weed whacking and suppress weeds around the base of a newly planted tree.

## Mulching and Mowing

Mulch should be placed around the base of the tree but ensure there is a space of several inches between it and the trunk. Mulch should never be piled up against the tree because excess moisture against the trunk can lead to rot and disease. Improper mulching, hitting watering bags with lawn mowers or weedwhackers are just some of the many insults inflicted on newly planted trees. Even if they are well cared for, too many encounters with a sloppy mower can lead to wounding and early mortality so train grounds crews in caring for new trees. In some landscapes, such as along streams and wetlands or within park areas, it is best to establish no mow zones. Allowing for native shrubs and grasses to grow up within the planted area will reduce erosion and equipment conflicts.

Most programs, such as master gardeners and master naturalists, require volunteer projects to be designed with a long-term care plan included. In addition to a short-term plan for watering, mulching and pruning, trees tend to contract diseases or have other problems such as pest infestations, sun scald, vandalism and wind damage, so invite a certified arborist to visit the trees a few times a year



In this study, a dying tree (left) which has a gator bag was not watered often enough and began to die. A tree diaper was added (round bag at base of the tree) which soaks up rainwater and re-releases it during dry periods, and it allowed this urban tree to return to health (right).



Piling mulch high up against the tree trunk— also called volcano mulching— harms the tree by creating an overly moist environment against the trunk.





A no-mow zone was established once to allow newly planted trees to create a more natural buffer and avoid mower damages.

Tree projects need to begin with every chance for success, so sending back diseased or root-bound trees ensures that what is planted will more likely survive.

to evaluate tree health. If one tree is diseased and proximate to trees of the same species, you should treat or remove the diseased tree before it infects the others. This is also why a diversity of tree species should be chosen, to avoid losing an entire planting project. This has happened to many tree buffers that were historically planted entirely in green ash. It is a marvelous riparian tree, but the recent infestation by the emerald ash borer has destroyed many of these projects entirely. If the riparian corridors had been planted with a variety of species, and not only ash trees, they would also still be thriving.

Since none of us have crystal balls, future diseases, storms and pests cannot be known in advance— or only after it is too late. One way to account for that is to, first, assume less than a 100% survival rate, but plan for only the 60-80% survival of newly planted trees; and second, hold back some of your tree budget (say, 20%) for replacement trees.

### Purchase Healthy Trees

If trees died because they arrived diseased, don't be afraid to refuse delivery or send them back. Most nurseries that value your business will accept returns. The authors of this guide asked for and received a refund on several dozen dogwood trees that became diseased within a few months of planting; they likely arrived sick and only later showed signs of their distress. Similarly, a hackberry tree arrived severely rootbound and it was immediately returned for a full refund. Tree projects need to begin with every chance for success, so sending back diseased or root-bound trees ensures that what is planted will more likely survive. If a nursery is continually supplying poor stock, find another provider. It's also advisable (if nearby) to visit the nursery ahead of ordering, to check the quality of their stock and to ask colleagues or other nearby tree groups whether they get their trees there. Nurseries that don't provide good product end up with a poor reputation; letting them know that you know and expect better might help them to improve.

### Follow Up and Monitor

Plan for a date to review tree planting projects six months and one year out and make any needed replacements. In a GIC planting project, pretty cherry trees were stolen near the new park entrance. Hopefully, they were replanted in someone's yard nearby and thus still contributed to the canopy goal. Since there was a contingency budget, they were quickly replanted, and those new trees were not taken.

Another tip that is useful to prevent vandalism is to engage the local neighbors in the planting process, so that the community has ownership in the project. Engage with neighbors when selecting your trees from a list with pictures; and offer them some trees for their yards too, so that everyone benefits and contributes.

Walter Hood, an urban planner and landscape designer from the San Francisco Bay Area, engaged local gang members in his tree planting project. He noticed them hanging around near the project site and invited them over to help plant. They ensured that nobody messed with the trees they had planted, since they considered themselves protectors of their "hood," of which the trees were now a part.



Staff from South Carolina's Urban and Community Forestry Program teach local government officials how to gauge tree health.



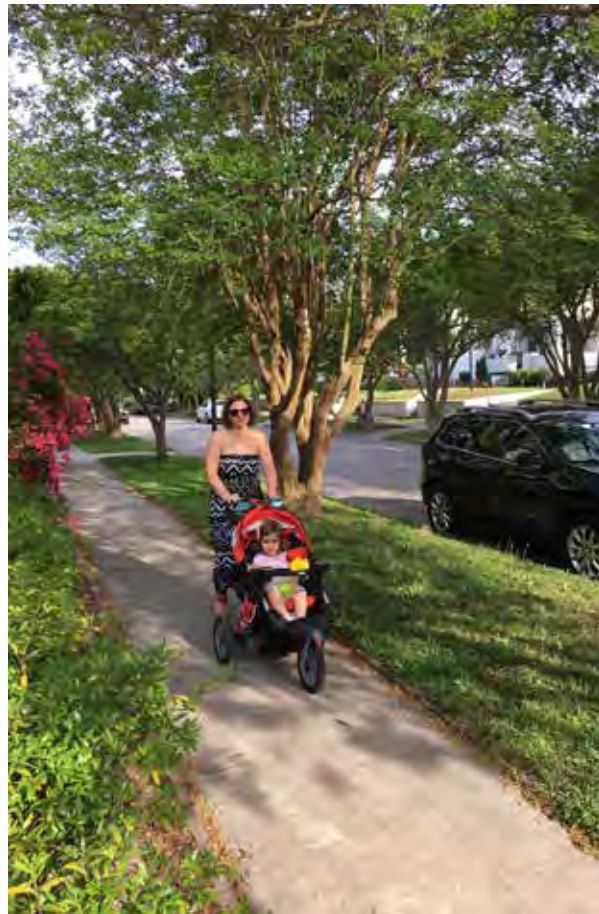
Also learn from your mistakes! Some trees don't do well in some areas. Perhaps the soil is wetter than assumed, the site is windier than realized or has more active uses that weren't accounted for, such as overflow parking or informal sports that encroach into the planted areas. Sometimes, the municipality decides to put a building on your planting site. While that is regrettable and perhaps cannot be helped, ask for a mitigation project to relocate or plant replacement trees. If the trees are established, ask for a per caliper replacement, since it will take years for a 2-inch diameter oak to replace the value of a 20-inch oak.

In summary, ensure that tree planting projects have a plan for proper planting, short-term watering, mulching, and pruning, along with periodic inspection by an arborist and the regular replacement of dead or dying trees. Ensure that any grounds crew are trained to avoid harming the trees, provide tree care if needed and ensure a contingency budget for unexpected events such as a storm or vandalism. If trees are planted in private yards, ensure the landowner has signed on to do such tasks as watering and pruning and consider whether they might need some help. Setting an





Sometimes a little TLC can help a sickly tree become healthy.



expectation that large, donated trees will be revisited to make sure they are healthy can motivate people to take care of them. And just like with a public site, consider a contingency budget for landowner “accidents” with the mower, bad parking, kids and other mayhem that goes on in people’s yards. The key is to get trees to live to a healthy age.

Finally, those who plant the trees might not be the same people as those who care for them. So, make sure that whoever has signed up (or been volunteered) for the task has both the knowledge and resources that they need. Use the analogy that, just as a car or bike needs a tune up to keep it running well, so does a planting project.

Don’t forget that with outdoor work, anything from flooding to fires can destroy a project. A wry joke among the authors of this guide has been to ask, “When is the next major flood of record coming?” and to answer, “Let’s look on the calendar to see when our streamside tree planting is scheduled!” So, as it is often said, hope for the best, but plan for the worst. Also, realize that sometimes trees that look scrappy or stressed often recover with some additional “TLC.” The authors have found that, in some cases, a marginal tree that looks like a “goner” will revive and surprise you— not in every case, but often enough to say, “Let’s let this tree keep going another six months and then, if it doesn’t recover, we can replace it.”

We’re glad we waited on quite a few questionable trees...

## Community Outcomes

In conclusion, a good urban tree program will always be evolving. You will be continually working on it. There is mapping your canopy and establishing achievable goals; educating the community about the importance of trees; engaging everyone in regular tree plantings; ensuring those plantings are distributed equitably to all communities; distributing press releases and

advertisements; writing reports, or purchasing trees, posting tree conservation posters, labels, guides, etc.; active involvement in writing city policy documents, such as the comprehensive plan, zoning ordinances or even the emergency operations plan to include tree planning and restoration; working to preserve trees; advocating for tree planting in developments; on-going support for funding the tree programs; engaging the community; and so on.

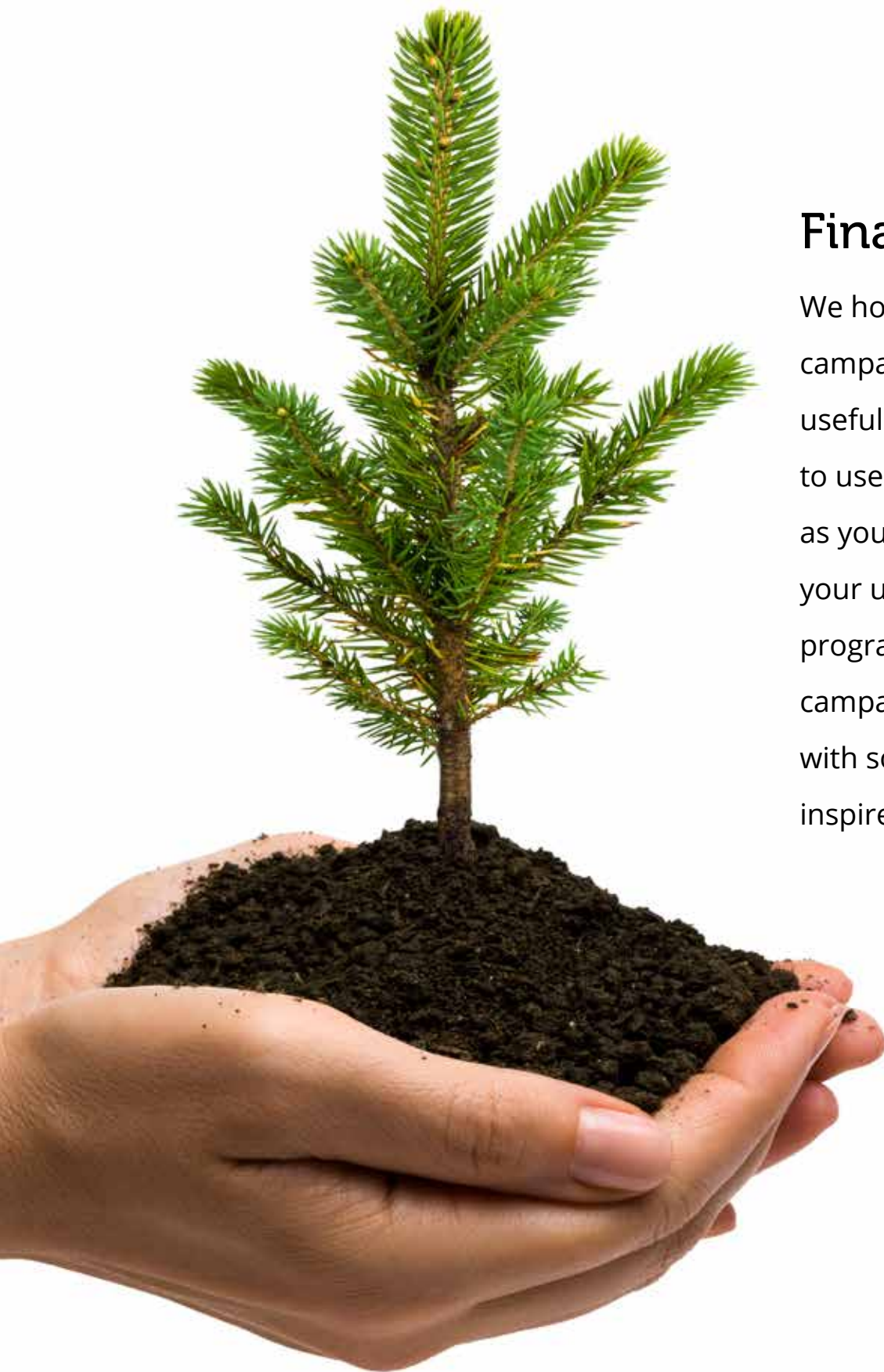
Implementing a robust tree planting and care focus for a city, town, county or region takes both time and dedication. Urban tree programs often suffer funding cuts during economic downturns. However, compared to many other government programs, tree programs cost relatively little and pay big dividends in return by protecting, and even improving, property values, the local tax base and public health, while reducing energy costs, flooding and runoff, and the heat island effect. Trees also support shopping centers and the central business district, increase shade, encourage people to relax and remain in the area, beautify our landscapes, preserve our mental health, and much, much more. By calculating social and ecological values (using programs such as i-Tree), mapping tree cover and publishing and promoting tree values, trees can be seen as integral to the success of any community. And, just as we fund community health and wellness, so should we fund our trees and urban forests that support wellbeing. Documenting and promoting these values will ensure that tree programs are not cut, but rather seen as vital to community wealth and wellbeing, and as a legacy for future generations. And, you are not alone in your efforts! Taking better care of your urban forest is also important to our nation. The US Forest Service's Ten-Year Urban Forestry Action Plan for our community forests lists the many reasons and goals for sustaining healthy urban forests. <https://urbanforestplan.org/>

## Signs of Success

A robust effort by local governments, conservation groups, tree advocacy groups, neighborhood groups and landowners should result in the following, along with specific benchmarks for success:

- Numbers of trees requested and given away.
- A canopy goal that is continually being evaluated through new canopy mapping and benchmarks for achieving canopy goals, such as trees planted per year and net trees retained (planted trees minus trees lost or removed).
- Continued funding of tree planting, conservation and education efforts— dedicated sources within the municipal budget.
- Robust engagement by the public and voluntary planting of trees on private property.
- A decline in complaints— unless there are more complaints because of increased awareness of the need to keep trees healthy!
- An increase in requests for consultations, such as what trees to plant, which are salt tolerant, how to evaluate tree damage, how to create an urban forest management plan, etc.
- Development plans that include tree conservation areas, retention of significant trees, new plantings included on site plans, and increased survival of planted trees.
- Increased tree literacy, which can be measured by surveys, types of public enquiries, etc.
- Applications to serve on the local tree board or a new tree advocacy or boosters group formed to engage a broader sector beyond the limited seats on a tree board.
- A multitude of ways that trees are included in policymaking for such issues as: stormwater management, reducing urban heating, climate change planning, energy conservation, storm preparation, community health and wellness, etc.





## Finally...

We hope this tree campaign guide has been useful. Please continue to use it as a reference as you grow and develop your urban forest programs and planting campaigns. We leave you with some final quotes to inspire your journey...

**“Someone’s sitting in the shade today—  
because someone planted a tree a long time ago.”**

— *Warren Buffett*  
speaking on the need to think long term when investing.

**“The best time to plant a tree was 20 years ago.  
The second-best time is now.”**

— *Chinese proverb*

**“People who will not sustain trees will soon  
live in a world that will not sustain people.”**

— *Bryce Nelson*

**“Acts of creation are ordinarily reserved for gods  
and poets, but humbler folk may circumvent this  
restriction, if they know how. To plant a pine,  
for example, one need be neither god nor poet;  
one needs only own a good shovel.”**

— *Aldo Leopold, American Author,*  
in *Pines Above the Snow, A Sand County Almanac.*





# APPENDIXES

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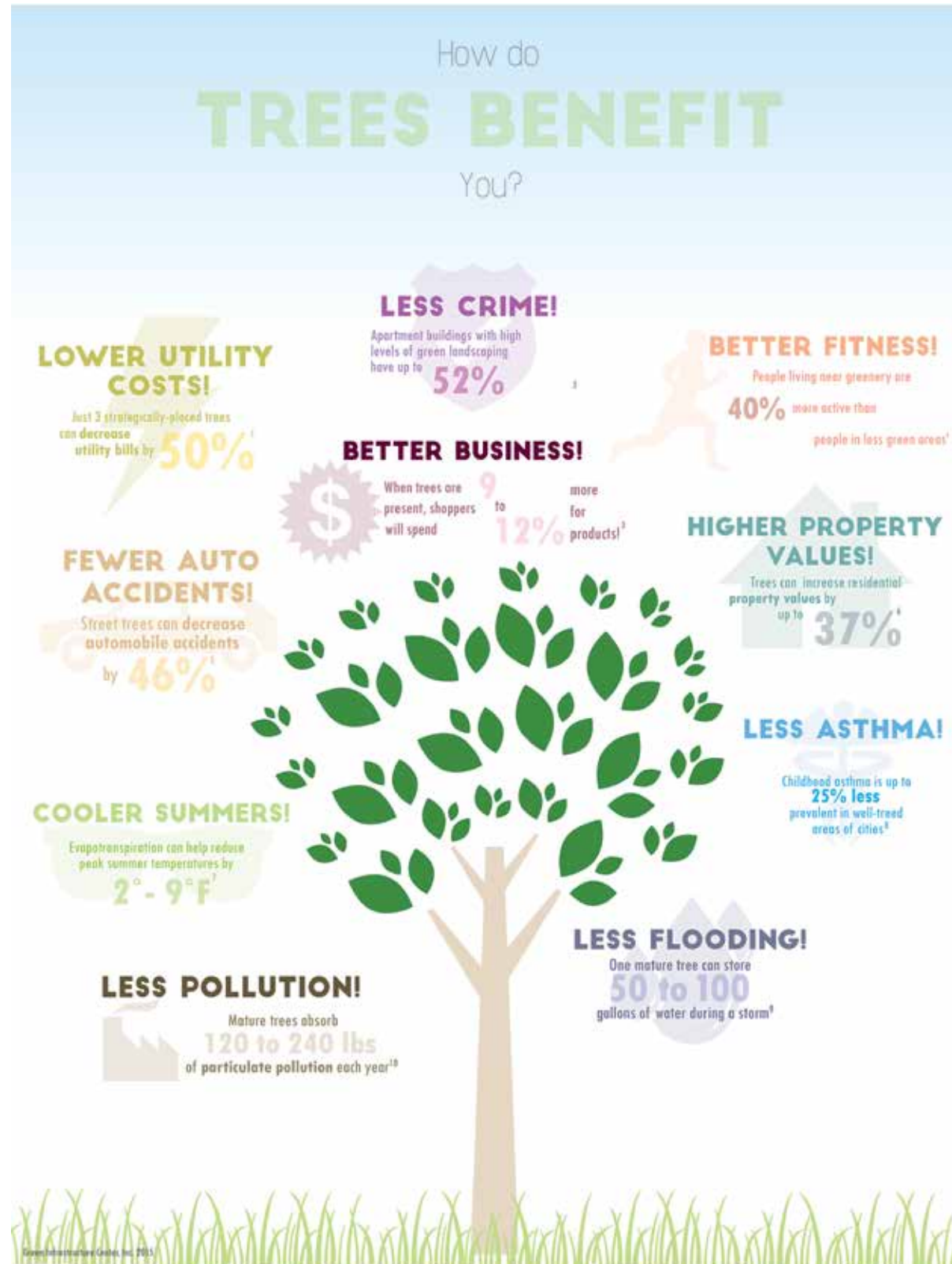


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Contact GIC to obtain a free, ready-to-print poster of this graphic.





## APPENDIX B. Useful Tools Referenced

### Tree Mapping Tools

- **Alliance for Community Trees:** a consortium of groups sharing knowledge and skills for urban trees <https://www.arboday.org/programs/alliance-for-community-trees/>
- **i-Tree:** series of tools to calculate ecosystem services found at iTree: <https://www.itreetools.org/>
- **Healthy Cities App:** (free tool for tracking tree planting): <https://healthytreeshealthycitiesapp.org/>
- **Open Tree Map** (paid subscription to track tree planting): <https://www.opentreemap.org/>
- **Tree Plotter** (paid subscription to track tree planting): <https://planitgeo.com/treeplotter/>

### Other Resources:

- **A Tree Owners Manual:** A guide to planting and caring for trees by the USDA Forest Service. [https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb5368392.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5368392.pdf)
- **Green Blue Urban Design Guide** (structural tree supports): <https://www.greenblue.com/wp-content/uploads/2016/05/GBU-Design-Guide.pdf>
- **Multiple references and tools:** <https://www.vibrantcitieslab.com/toolkit/>
- **Research on Forest Issues in the Southern United States:** <https://urbanforestrysouth.org/>
- **Tree City USA:** <https://www.arboday.org/programs/treecityusa>

### Visualization and Messaging Tools:

- **Classify how green a neighborhood is:** <https://www.naturequant.com/naturescore/>
- **American Forests Social Equity Tool:** <https://www.americanforests.org/tools-research-reports-and-guides/tree-equity-score/>
- **Visualize adding trees and green to urban spaces using augmented reality with WildStreets:** <https://www.wildstreets.org/>

### Green Infrastructure Center Books and Guides

The nonprofit Green Infrastructure Center (GIC) authored this guide and many others. The GIC works across the United States offering technical support to communities who want to plan for, protect or restore their natural and cultural resources. Most of GIC's guides are available for free download. The GIC also offers support for tree canopy mapping and planning, goal setting and strategic plans, resiliency plans and storm readiness planning. To learn more about GIC and to access other free tools, see the following resources and GIC projects page: <http://www.gicinc.org/projects.htm>

- **An Analysis of Forest Cover and Benefits: Boynton Beach Tree Canopy Report:** Example of Urban Tree Assessment, GIC conducts many city assessments for clients. This is an example for Boynton Beach FL: GIC's Tree Canopy Assessment for Boynton Beach, Florida, together with a strategy plan and recommendations for action. Visit: <http://www.gicinc.org/PDFs/BoyntonBeachCanopy.pdf>
- **Green Infrastructure Planning Guides for states and the U.S.** see: <http://www.gicinc.org/book.htm>
- **Using Trees for Stormwater Management** see: [http://www.gicinc.org/trees\\_stormwater.htm](http://www.gicinc.org/trees_stormwater.htm)
- **Planners Forest Toolkit:** GIC's guide to all the policies and codes that communities should have in place to ensure a healthy urban forest. Also includes arguments to convince local leaders to take action. Although written for South Carolina it can be applied anywhere in the United States. June 2021. [http://www.gicinc.org/PDFs/Planners\\_ForestToolkit\\_2021.pdf](http://www.gicinc.org/PDFs/Planners_ForestToolkit_2021.pdf)
- **Forest Connectivity Design Guide:** Get GIC's design guide for conserving forests and other habitats, even when developing! The guide, Forest Connectivity in the Developing Landscape: A Design Guide for Conservation Developments was written for the Carolinas, but design ideas can be applied anywhere. The guide includes case studies for two GIC-designed sites. Sept. 2019 Contact GIC for print copies or visit [http://www.gicinc.org/PDFs/DesignGuide\\_final.pdf](http://www.gicinc.org/PDFs/DesignGuide_final.pdf)
- **GIC Guides and Resources to Plan for the Storms and Preparing the Urban Forest for Recovery:** [http://www.gicinc.org/storm\\_mit.htm](http://www.gicinc.org/storm_mit.htm)
- **The Community Forest Storm Mitigation Planning Workbook.** This guide can help your community prepare for storm damages, develop strategies to manage debris and recover faster from disasters that impact the urban forest. Based on existing state guides, this national version includes the latest FEMA guidance and is designed as a workbook for community use. 2021. Visit [http://www.gicinc.org/PDFs/Comm\\_Forest\\_Storm\\_Mitigation\\_Workbook\\_National\\_Final.pdf](http://www.gicinc.org/PDFs/Comm_Forest_Storm_Mitigation_Workbook_National_Final.pdf)



# APPENDIX C. Request for Urban Tree Proposals

## Canopy Maps, Tree Inventory, Urban Forest Management Plans – Key Elements to Include

Many cities do not have the technical and professional specifications for what to include in a Request for Proposals (RFP) for canopy mapping, tree inventories or management plans. In addition to all the usual legal language to include in a bidding document as required by a city or town, the following elements should be included in a bid request. There are three types of bidding information provided: canopy data, tree inventory and urban forest management plans. A canopy map should be completed first. A tree inventory is based on where such data are most needed as a city may not be able to afford to inventory every street. An urban forest management plan should utilize the canopy and street tree data to create a data-informed plan. A plan created without data on the extent and condition of the urban forest will be lacking important elements for decision making on what to prioritize as well as how much actions may cost (e.g. trees need to be planted or maintained on x, y, z streets, or the need for maintenance of x trees will cost y dollars. For a digital copy of this file to customize, contact GIC.

### I. Tree Canopy Cover Data and Maps

#### Scope of Work

The consultant will conduct the classification of citywide land cover using the most recent leaf-on aerial imagery from the National Aerial Imagery Project (NAIP) (4-bands) available for [City/Town] at a resolution of 1 meter or less. Specifically, imagery will be classified into all landcover classes including tree canopy, other vegetation (turf, shrubs), impervious surfaces, bare soil/sand, building and non-building impervious surfaces, wetlands, and water. The city will provide the consultant with base GIS data to aid in the analysis (data for roads, streets, sidewalks, and rights of way, parcels, publicly owned properties such as parks and schools, and underground/overhead utilities is available).

Land cover classes will be calculated by percent and also by specific requested areas of analysis for urban tree canopy (up to 5 spatial analyses, e.g., trees citywide, in parks, historic districts, census blocks/tracts, downtown).

Misidentification of shrubs versus trees is a common error in classification of vegetation and application of LiDAR and other object recognition tools should be used to help to prevent this mistake. Consultant to obtain and utilize the most recent LiDAR data to differentiate smaller shrubs from trees (e.g., under and over 10 feet). (Note that recent— within the last 5 years— LiDAR may not be available for your area so check before including this provision.)

The consultant will also prepare a QA/QC report for derived data to achieve at least 95% overall mapping accuracy. Consultant to report on how accuracy was determined (e.g., confusion matrix, field verification etc.).

The consultant will provide at minimum the following information based on the data collection in the form of data, maps and narrative:

1. Calculation of acres and percent of land area in covered by tree canopy citywide and at least three other geographies (e.g., land use, neighborhood, right of way, census block groups, parks). When calculating percentage of tree canopy cover as a percentage of land cover do not include surface water in the denominator. [Optional if relevant: provide guidance as to whether wooded wetlands or mangroves should be included as part of canopy cover.]
2. Identification and mapping of areas that are suitable for tree planting = Potential Planting Areas (PPA). Consultant should detail how unsuitable areas (sports fields, utility conflicts) will be accounted for and removed from the PPA. Areas suitable for planting may also be categorized in terms of priority areas related to benefits of trees such as urban heat island, stormwater flooding, or other benefits.
3. Quantification of ecosystem services of the city's tree canopy, which may include but are not limited to, stormwater management, air quality, carbon sequestration, and urban heat island mitigation. At the completion of this task, the consultant will present results to government staff. Tools in the i-Tree suite <https://www.itreetools.org/> can be used for some of these calculations.
4. Recommendations for a percentage tree canopy goal based on the current tree canopy percentage and the PPA determined.
5. The Consultant will present a draft of the canopy data and maps to [City/Town] staff to review and staff comments will be addressed before the final maps and report are complete.

#### Deliverables: REPORT and DATA:

- 1) Tree canopy assessment report [XX pages] including findings and methods to also include maps of tree canopy, potential planting areas, identified priority areas by canopy cover (e.g., parks), and documentation of ecosystem services calculations. The report will be formatted for printing for the city website. [Optional: Specify [X] # of printed copies to be provided by consultant].
- 2) PPTX presentation of results in slide deck to be used for community education [15-20 slides] including maps and canopy assessment results.
- 3) A GIS file and geodatabase of the tree canopy and land cover provided to be included in the city's GIS system. GIS files must include tree canopy data in both raw raster and vector formats, as well as pre-made map documents from (1) above that include all relevant files created for the project.
- 4) [Optional: Add community education event, workshop or survey on tree values to engage the community in understanding canopy assessment and supporting canopy protection or expansion.]



## APPENDIX C. Request for Urban Tree Proposals *(continued)*

### II. Tree Inventory [GIS Data and Report]:

#### Scope of Work

Conduct a street tree inventory in selected street rights-of-way, street tree easements, parks, public facilities grounds, and other public property for approximately [XX] trees [Or by increments of each 1000 trees]. Include cost per tree in bid and for additional increments of 1000. Contractor may use a GPS-based data collection system and must provide the data output to the [City/Town] in Microsoft Excel, Access, or Esri shapefile formats. Locations to be inventoried include:

**[Specify exact locations for inventory, e.g., street rights of way, parks, schools and estimated # of trees, certain streets or neighborhoods]**

#### DATA COLLECTION\*:

Tree inventory data fields must include, but are not limited to:

1. Location – street address, GPS coordinates to decimeter precision (4 inches), assign record # to tree (e.g., 1, 2, 3)
2. Image of Tree (photo)
3. Tree Common Name
4. Tree Latin Name (Genus, species) unless unknown (e.g., crabapple)
5. Trunk Diameter at Breast Height (DBH at 4.5' above grade)
6. Tree Height (Estimated in feet)
7. Trunk Spread (Visual estimated in feet)
8. Stems – number of stems below DBH
9. Tree Health Condition (Overall) – good, fair, poor, dead as follows:

*Good*- normal for the species including shoot growth, wound wood development, foliar color and density, and absence of dieback or damaging pests

*Fair*- deficiency in one category such as below normal shoot growth, wound wood development, foliar color and density, or presence of dieback or a damaging pests or disease

*Poor*- below normal or deficiency in two or more categories such as shoot growth, wound wood development, foliar color and density, or presence of dieback or damaging pests

*Very Poor*- major deficiency in two or more categories such as shoot growth, wound wood development, foliar color and density, or presence of dieback or damaging pests

*Dead*- no living tissues

10. Tree Structure: Condition of mechanical or structural portions of the tree, expressed as:

*Good*- absence of any significant mechanical defects although minor defects such as low amounts of decay that are unlikely to fail under normal weather conditions may be present

*Fair*- minor structural defect(s) is present that may fail under storm conditions, or several minor mechanical defects can be found

**Poor**- one or more significant structural defect is present that may fail under normal weather conditions

*Very Poor*-several significant structural defects are present that may fail under normal weather conditions

*Most significant defect present and severity*; Roots, Root Crown, Trunk, Trunk/Scaffold Union, Scaffolds, Branches

11. Observations – general observations warranting recognition

12. Primary Maintenance Needed

- Overhead utilities- presence of primary or secondary electrical distribution wires or telephone or street lighting
- Site Type –Planting Area – Most limiting dimension of planting area in feet
- Other – for trees note if requires further inspection.  
Note trees that need full Tree Risk Assessment note need for this.  
Check if location is within the ROW

13. Growing Space Type: type of location the tree is growing in such as lawn area, natural area, border tree, tree lawn, or tree pit.

14. Quality Control -- All data, as itemized below, to be reviewed digitally for errors and errors corrected. Contractor will report the findings and corrections at the completion of each step.

- Field quality review of 2% of all data points collected in the first week of data collection with particular emphasis on trees identified for removal
- Field quality review of 1% of all data points collected each week after the first week of data collection with particular emphasis on trees identified for removal
- Cross data collector review (other reviewer than the original data collector) for all data collection personal.
- Office review of 100 % of data for data mismatch errors, for example, appropriate tree health or structural condition rating for "Removal" maintenance classification; appropriate street for side street versus on street classification, appropriate diameter size for "Train" maintenance classification, and all other similar data reviews that can be completed in the office.
- Field resolution of data errors identified.
- 100% correct species identification; no unknowns in data set.
- Visually review and correct mapped tree data for accuracy of locations.



## APPENDIX C. Request for Urban Tree Proposals *(continued)*

### II. Tree Inventory [GIS Data and Report]: *(continued)*

\* If interested in performing a Tree Risk Assessment: Require GPS location of each inventoried tree, performance of work by ISA Tree Risk Assessment Qualified (TRAQ) professional and collection and recording of tree risk data as specified by ISA in their Tree Risk Assessment Manual and Form. For more see <https://www.isa-arbor.com/education/onlineresources/basicreeriskassessmentform>

#### Deliverables: DATA and REPORT:

The consultant will provide a map and database of all collected tree data.

The consultant shall provide an inventory report summarizing the methodologies, urban forest management statistics outlined as follows.

- 1 Inventory Methodologies
2. Quality Control Summary (methods and results)
3. Management Statistics
  - a. Species Distribution
  - b. Diameter Distribution
  - c. Health Distribution
  - d. Work Need
  - e. Tree Species Exceeding 10% of the Total Population
    - i. Diameter Distribution
    - ii. Health Distribution
    - iii. Trees Flagged for Additional Risk Assessment
    - iv. Work Needs/Recommendations

### III. Urban Forest Management Plan

**Urban Forest Management Plan:** The contractor will support the [City/Town] in developing a comprehensive urban forest management plan. The plan shall be based on inventory data and discuss major trends, such as species composition and tree conditions, as identified in the inventory. Tree characteristics that affect management, such as species diversity, condition, and maintenance requirements, should also be discussed. Provide a multi-year budget and management recommendations. Additional content may include, but are not limited to:

1. Trends – species diversity, size distribution, condition, primary maintenance needs, etc.
2. Ecosystem Benefits – using consultants’ calculations or by generating report through i-Tree tools
3. Current Canopy Cover (by percentage if known)
4. 5- and 10-year strategies for maintenance schedules.
5. Annual, 5-year and 10-year budgets for maintenance activities.
6. Assessment of current personnel, equipment and capacities to meet management needs
7. Potential pest and disease management needs
8. General recommendations including relevant goals for forest cover (use existing city or town goals but ensure they are based on actual canopy maps and plantable open space).
9. Applicable charts and graphs
10. Appendices

#### Project Pricing

<b>COST TABLE</b> (may also break this out into subcomponents)	
<b>I. Tree Canopy Cover Data, Maps and Report</b>	
Total Cost for Tree Canopy Assessment	\$
<b>II. GIS Based Tree Inventory</b>	
Data Collection Cost per tree	\$
Cost per each increment of 1,000	\$
Total Data Collection Cost for [# trees, e.g., 2000]	\$
Total Cost for Inventory	\$
<b>III. Urban Forest Management Plan Development</b>	
Urban Forest Management Plan Cost	\$



## APPENDIX C. Request for Urban Tree Proposals *(continued)*

### Ownership

All data created for this project becomes the property of [City/Town] and must be turned over at the project's completion. This includes all processed data, images, maps and analyses produced in final format. The firm may utilize these products to showcase their performance or in portfolios, but they do not retain the rights to reproduce or share these data without prior permission from [City/Town].

### References and Qualifications\*

Provide at least three (3) references with contact information and detail the firm's relevant prior work. References should relate to similar work performed and demonstrate the firm's qualifications to perform the Scope of Services. If available, provide links to digital work samples.

Relevant qualifications for all staff to be included in the project along with roles must be specified. For example, if the principal is a certified arborist, the qualifications should specify their role in the project (project manager, field data collection etc.).

\*For tree inventory work add: Bidder shall be able to recognize the native trees of [Your State] as well as a wide variety of ornamental trees. Bidder shall be an ISA Certified Arborist for at least 3 years. Bidder shall be proficient in using tree inventory software. Must provide Documentation of ISA Certified Arborist Number. If also performing a Tree Risk Assessment add "and Tree Risk Assessment Qualified for at least 1 year."





