Urban Tree Canopy Assessment
of Lake Charles, Louisiana

October 2022

An Analysis of Forest Cover and Benefits

Prepared by the
Green Infrastructure Center Inc.

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Lake Charles, Loui

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opy and associated benefits for Lake Charles, Louisiana. The tree canopy
Community Forests. The Green Infrastructure Center Inc. (GIC) was hired
e Charles. GIC evaluated the city's tree canopy extent, plantable areas,
the environmental benefits provided by the city's trees.

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Lake Charles' tree canopy was severely damaged during four federally-declared natural disasters in 2020 and 2021, resulting in extensive tree losses.

Why Map Urban Canopy?

Trees are declining throughout the southern United States. Causes for this decline arise from multiple sources including land conversion for development, storm damage, hurricanes, and lack of tree replacement as older trees die. Many communities in Louisiana have now mapped their tree canopies and are looking for ways to protect or expand their urban forests. Data about the City of Lake Charles' trees are needed to track trends, assess losses or set goals to retain or restore canopy. The City of Lake Charles now has baseline data to set canopy goals, monitor canopy protection progress, measure environmental benefits of city trees and prioritize strategic restoration of canopy locations.

Trees are the city's 'green infrastructure.' Just as we manage our grey infrastructure (roads, sidewalks, bridges and pipes), we also need to manage our 'green infrastructure' (trees and other vegetation). The city's green infrastructure provides many values that support a vibrant, safe and healthful city. Trees add to the city's historic coastal character, and they enhance its livability by filtering storm water and reducing runoff, cleaning the air, providing oxygen, shading, and natural beauty and enhanced property values. As the City of Lake Charles recovers from natural disasters and continues to grow, it should also manage and expand the urban forest. This will help the city meet its goal to be "a regionally vibrant cultural center with plenty of access to outdoor amenities."

Hurricane Laura damaged many homes and properties.

Key Stats

Parish: **Calcasieu**

2021 Population Estimate: **81,097 people**

Total City Area: **51.1 sq. miles**

Land: **44.7 sq. miles; 17,856 acres**

Acres of lakes/ponds: **1,912**

Acres of swamp & marsh: **910**

Miles of stream/canals: **103**

Acres of tree canopy: **2,951**

Gray vs Green

Image at left shows Lake Charles' gray infrastructure including buildings and roads. Classified high-resolution satellite imagery (at right) adds Lake Charles' green infrastructure data layer (trees and other vegetation). The green infrastructure provides cleaner air, water, energy savings and natural beauty.

Summary Outcomes

Canopy

Lake Charles has a tree canopy of 10.6%. This relatively low canopy resulted from damages by several devastating hurricanes during the fall of 2020 which resulted in a 5% canopy loss (33% of the existing canopy). Fortunately, the City of Lake Charles has room to add significantly more tree cover that would provide many benefits to the city for shade, air quality, urban cooling and habitat and natural beauty. These benefits trees provide for Lake Charles' citizens are called 'ecosystem services' or benefits nature provides relatively for free. In fact, the city could achieve a far greater canopy coverage that is higher than the pre-storm coverage of 15% and thus provide even more benefits to the Lake Charles' community.

Air Quality

Trees play a critical ro
cleaning the air of par
which can harm huma
such as sulfur dioxide
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they capture rainfall
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allons of water per
.63 inches), the city's
means less flooding
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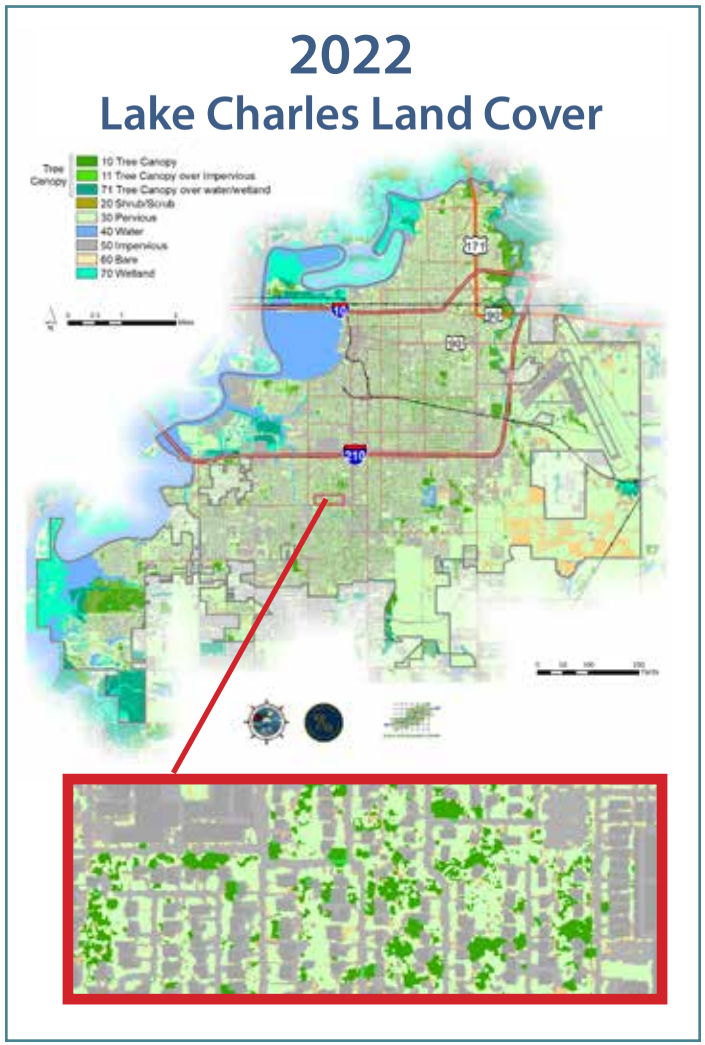
and continues to grow and develop, it will be important to maintain existing coverage and to plant replacement trees to overcome losses. Based on analysis of change in canopy over two years (2019-22) the city lost 33% of its tree canopy to several natural disasters; equal to about 100,000 trees lost. If this trend were to continue, without further investment and planting efforts, the city's canopy could disappear in a relatively short amount of time. Although a complete loss is unlikely since residents will continue to replant, the city needs to *increase the rate of planting to prepare for and to recover from natural disasters*.

Lake Charles has adopted a citywide goal to increase tree canopy to pre-Laura (2020) levels of 15% to be achieved over the next ten years. This requires planting more than 103,700 trees in total or 10,370 trees annually across the city. The city can reassess progress and adapt its canopy goal over time to achieve a higher overall canopy coverage.

Cover



anopy in the last few years due to storms. There is opportunity to recover lost canopy
es equate to better air quality, shade and energy savings, more stormwater uptake and

of 81,097 persons. The city is racially and ethnically diverse with 43.9% non-Hispanic Whites, 47.9% Black/African Americans, and 3.4% Latino residents[1].

Lake Charles (French: Lac Charles) is a brackish water body located alongside the Calcasieu River in Southwest Louisiana, United States, situated almost entirely within the Lake Charles city limits. The border adjoins 5.8 miles of Lake Charles' shoreline and 1.43 miles of the Calcasieu Riverfront. Lake Charles' mission is to be "united for progress prosperity" and its vision is to be "a vibrant art, cultural and dining scene with parks scattered throughout the city and easy access to shimmering Lake Charles, via the beautiful Lakefront Promenade." With 198.5 acres of municipal parks, beach and conservation lands, the city is rich in natural amenities that contribute to its high-quality lifestyle.

The Canopy Assessment

This report describes the city's current canopy coverage, the canopy assessment method, an analysis of the canopy's environmental benefits and city strategies to sustain and expand the urban forest. Products created include:

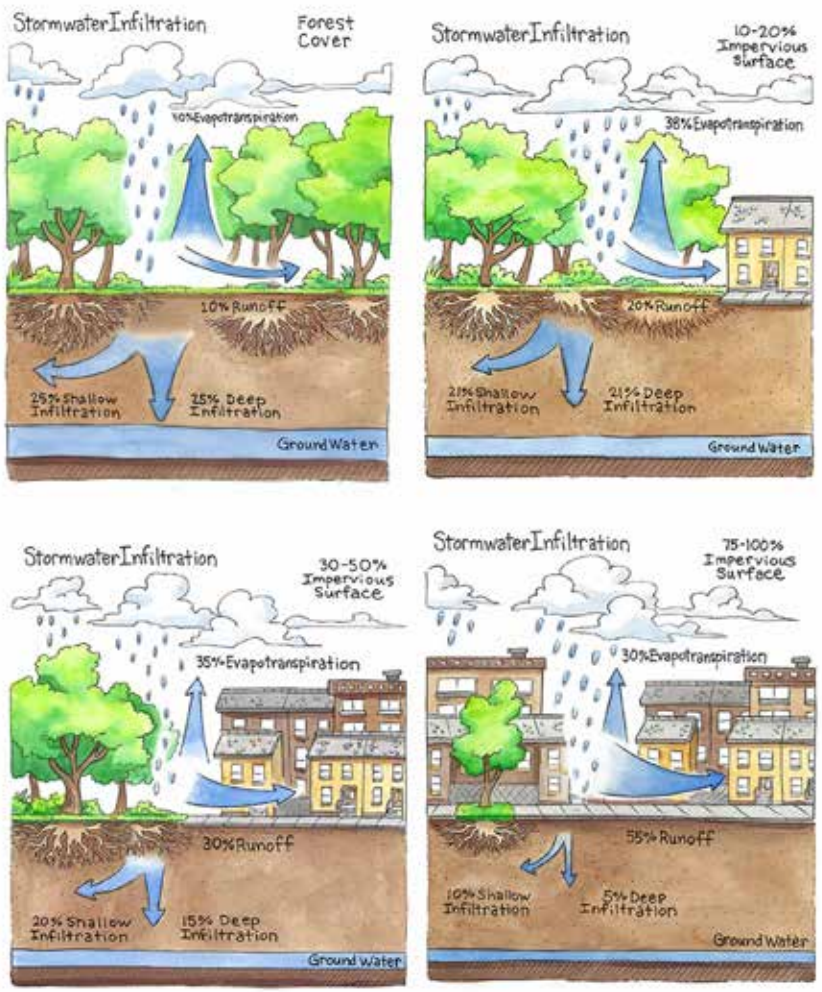
- Analysis of the current extent of the urban forest through high resolution tree canopy mapping
- Possible Planting Area analysis to determine where additional trees could be planted
- Calculation of the environmental benefits and pollution removal by city trees
- Analysis of city's codes, ordinances and practices for their ability to conserve or protect the urban forest
- A public survey concerning where the city should prioritize tree planting efforts and the top strategies for increasing tree canopy
- Tree canopy community outreach and educational materials

The city can utilize the tree canopy to maximize environmental and social benefits including:

- Community health and vibrancy.
- Aesthetic values and natural beauty.
- Decreased urban heat island and reduced heating and cooling costs.
- Abundant bird and wildlife habitat.
- Expanded walkability and multimodal transit support.
- Revenue from tourism and retail sales.

Lake Charles has many o

Runoff increases as land is developed.



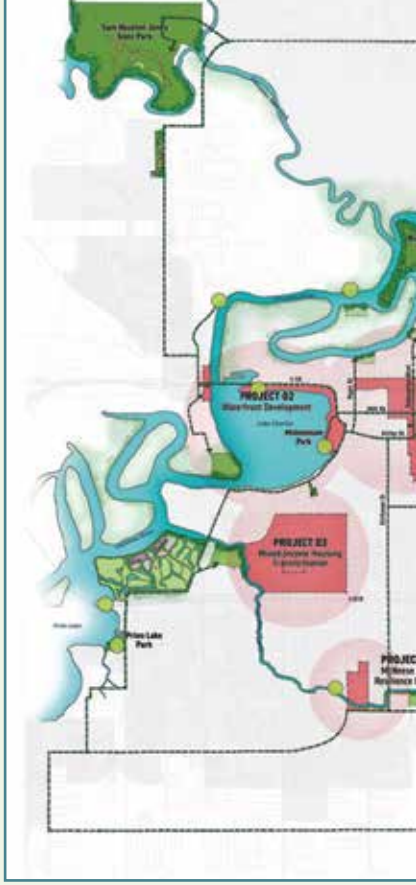
Data Source: Federal Stream Corridor Restoration Handbook (1998)

Planting trees strategically along the coulees can reduce nonpoint source

and forests is buffering against storms and losses from flooding. According to the U.S. Environmental Protection Agency (EPA), excessive stormwater runoff accounts for more than half of the pollution in the nation's surface waters and causes increased flooding and property damages, as well as public safety hazards. The EPA recommends a number of ways to use trees to manage stormwater in the book Stormwater to Street Trees.

Excessive stormwater runoff accounts for more than half of the pollution in the nation's surface waters.

Retaining trees and forests along coasts also provides a wind break and helps to evaporate and reduce standing water. In addition, utilizing trees as 'green infrastructure' can provide a basis for reimbursement from FEMA if trees are damaged during storms. To qualify, trees must be inventoried and specifically utilized for stormwater management, erosion and sediment control, buffers or other green infrastructure functions.



The Bayou Green Greenbelt is a prop
that will connect residents to public

Lake Charles participates in the National Flood Insurance Program's Community Rating System (CRS). The CRS is a voluntary incentive system that allows local governments to earn flood insurance premium discounts for policyholders in the community. Local governments receive points for actions or policies that reduce flooding and flood damage; these points earn premium discounts as high as 45%. The City of Lake Charles is currently rated as Class 9 in the CRS program, saving residents and businesses within its special flood hazard areas on average about $200,000 per year.

Additionally, communities can earn credit for adopted management plans that protect the critical natural functions of floodplains and native species, while implementing habitat restoration projects. CRS requirements include an inventory of all species in the plan's geographic purview, action items for protecting one or more of the identified species of interest,

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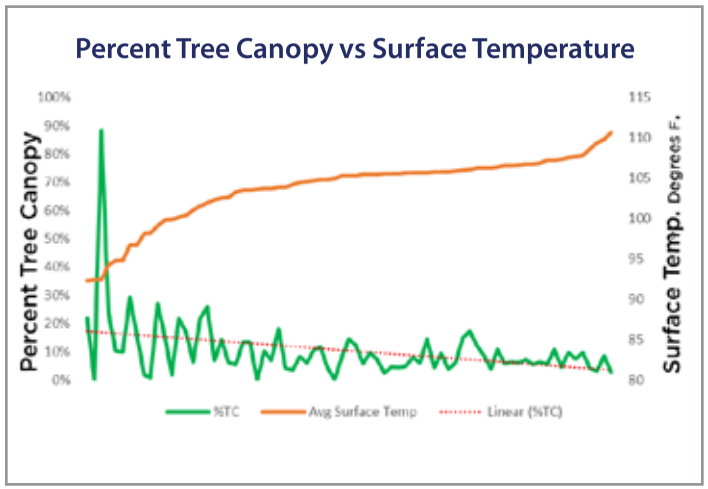
There are many spaces in existing parking lots where trees can be planted or replaced.

Air Quality and Surface Heating

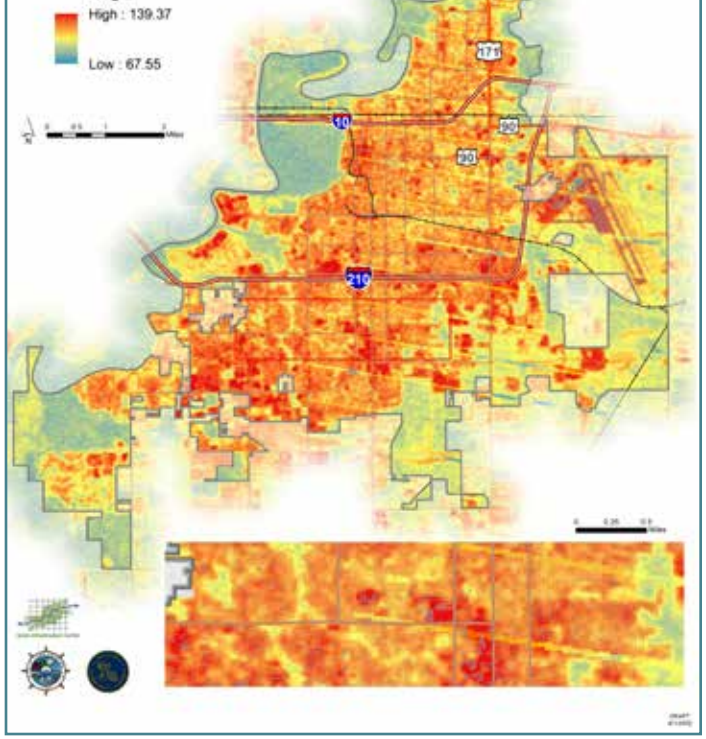
Trees Cool the City

During Louisiana's hot summers greater shade is always appreciated. Excessive heat can lead to heat stress which especially affects infants and children up to four years of age, those 65+ years of age and older, those with underlying medical issues, and those on some medications (Centers for Disease Control 2020).

Tree cover shades streets, sidewalks, parking lots, and homes, making southern urban locations cooler, and more pleasant for walking or biking. Multiple studies have found significant cooling (2-7 degrees Fahrenheit) and energy savings from having shade trees in cities (McPherson et al 1997, Hashed et al 2001). Shaded pavement also has a longer lifespan, so maintenance costs associated with roadways and sidewalks are less (McPherson and Muchnick, 2005).



Higher surface temperatures are positively correlated



Trees Clean the Air

In addition to cooling surfaces, trees absorb volatile organic compounds and particulate matter from the air, improving air quality, and thereby reducing asthma rates. Trees play a critical role in not only providing oxygen but also cleaning the air of particulate matter and ground level ozone (O_3), which can harm human health. Trees also sequester greenhouse gases such as sulfur dioxide and carbon dioxide. As these gasses are trapped by trees, the severity of climate change is reduced. Trees also store carbon and prevent its release, further helping to ameliorate possible climate change impacts. Even at the neighborhood level, trees reduce pollutants. Trees clean the air and well treed neighborhoods suffer less respiratory illnesses, such as asthma. (Rao et al, 2014),

More trees could be planted on North Enterprise Boulevard

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Trees Improve

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Well treed area

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

Trees Increase Property Values and Sales

Developments that include green space or natural areas in their plans sell homes faster and for higher profits than those that take the more traditional approach of building over an entire area without providing for community green space (Benedict and McMahon 2006).

A study by the National Association of Realtors found that 57% of voters surveyed were more likely to purchase a home near green space and 50% were more willing to pay 10% more for a home located near a park or other protected area.

57% of home buyers were more likely to purchase a home near green space, while 50% of home buyers were willing to pay 10% more for a home located near a park or other protected area.

Lake Charles now has baseline data to monitor canopy increases from plantings, measure the stormwater and water quality benefits of its urban forest, and can prioritize restoration of canopy where it is most needed. Currently the city's canopy coverage is 10.6%, but it could be expanded.

The city's near-term canopy trend is downward. Over three years (2019-22), the city lost 33% of its relative tree canopy. This equates to nearly 100,000 trees lost (net) or around 58,000 small trees and 41,000 large shade trees. If this trend were to continue, the city's canopy could disappear in a few decades. While this is unlikely, new actions are needed to stem the losses and grow the canopy.

To change the loss trajectory, the city needs to actively plant trees to replace those lost to natural mortality (old age), storms, development, pests, and neglect or poor care. As older trees die (or before they die), younger trees need to be planted to restore the older canopy. While the city has been planting trees, more trees need to be planted by both the public and private sectors at greater numbers to achieve the goal of a 5% citywide canopy increase. The data from this report can inform the city's tree canopy recovery strategy and planting plan and can be shared with the public to encourage them to plant trees. This strategy can also be used to secure grants and donations to help fund the recovery effort.

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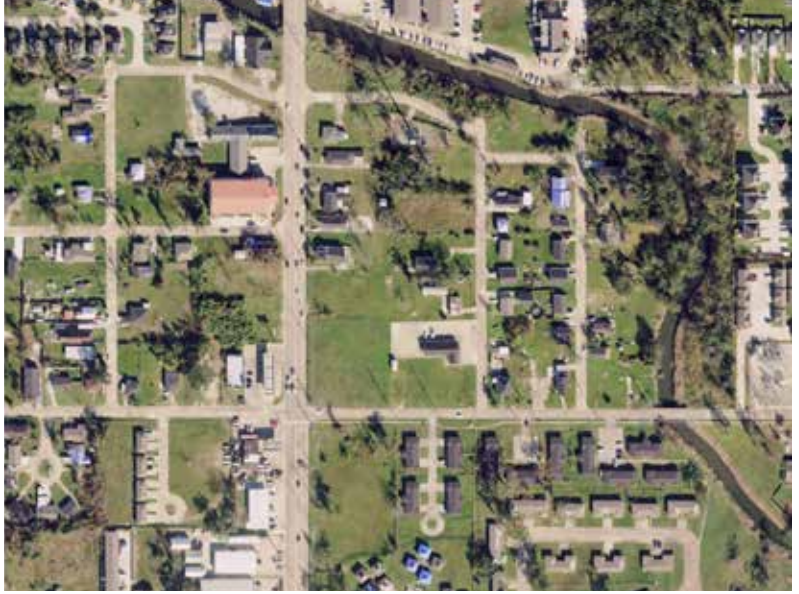
odel scenarios for future tree coverage, and quantify their ecosystem services, a highly detailed
l future planting areas were developed (see Appendix A for details). In addition to urban forest
r other purposes such as analyzing urban cooling, walkability, street tree plantings, inform area

Map of Potential Planting Areas (PPA)



NAIP Image 2022

Potential Planting Areas (PPA)

In urban areas, realistic goals for expanding urban canopy depend on an accurate assessment of plantable open acreage. A Potential Planting Area (PPA) map estimates areas that may be feasible to plant trees. The PPA is created by selecting the land cover features that have space available for planting trees and accounts for the overlap of canopy (e.g., canopy that is intermingled or a large canopy tree that partially covers an understory tree). Of the nine land cover classes, only pervious/turf were considered for PPA. However, some paved areas could be removed or reduced, soils conditioned, and then used to plant new canopy.

Eligible planting areas are limited based on their proximity to features that might either interfere with a tree's natural growth (such as buildings) or places a tree might affect the feature itself, such as power lines, sidewalks or roads. Playing fields, cemeteries and other known land uses that would not be appropriate for tree cover, such as golf courses and airports were also avoided in calculating plantable areas. The resulting PPA represent the maximum potential places trees can be planted and grow to full size. The GIC recommends no more than half the available PPA is realistic to plant, since many uses such as tomato gardens or sunbathing by the pool require full sun.

Potential Planting Spots (PPS)

Potential Planting Spots (PPS) are created from the PPA. A GIS modeling process is applied to select spots where a tree can be planted depending on the desired size. For this analysis, expected sizes of 20 ft. and 40 ft. diameter for individual mature tree canopy were used with priority given to 40 ft. diameter trees (larger trees have more benefits).

Potential Canopy Area (PCA)

The Potential Canopy Area (PCA) is created from the PPS. Once possible planting spots are selected, a buffer around each point that represents a tree's mature canopy is created. For this analysis, that buffer radius is either 10 ft. or 20 ft., which represents a 20 ft. or 40 ft. diameter

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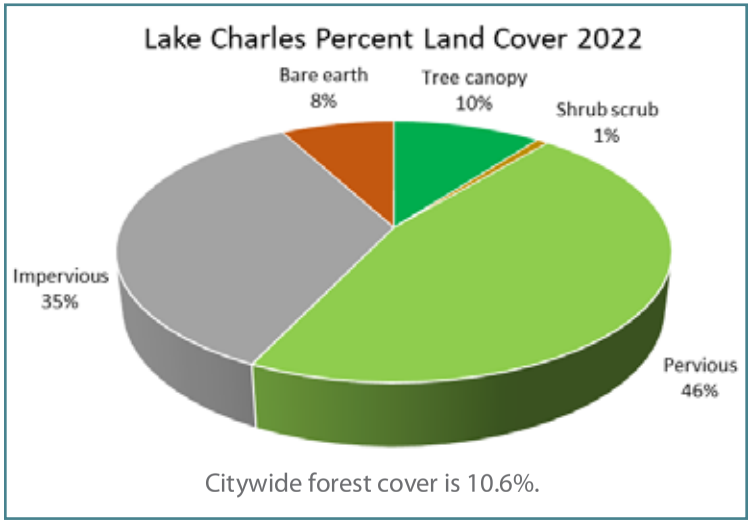
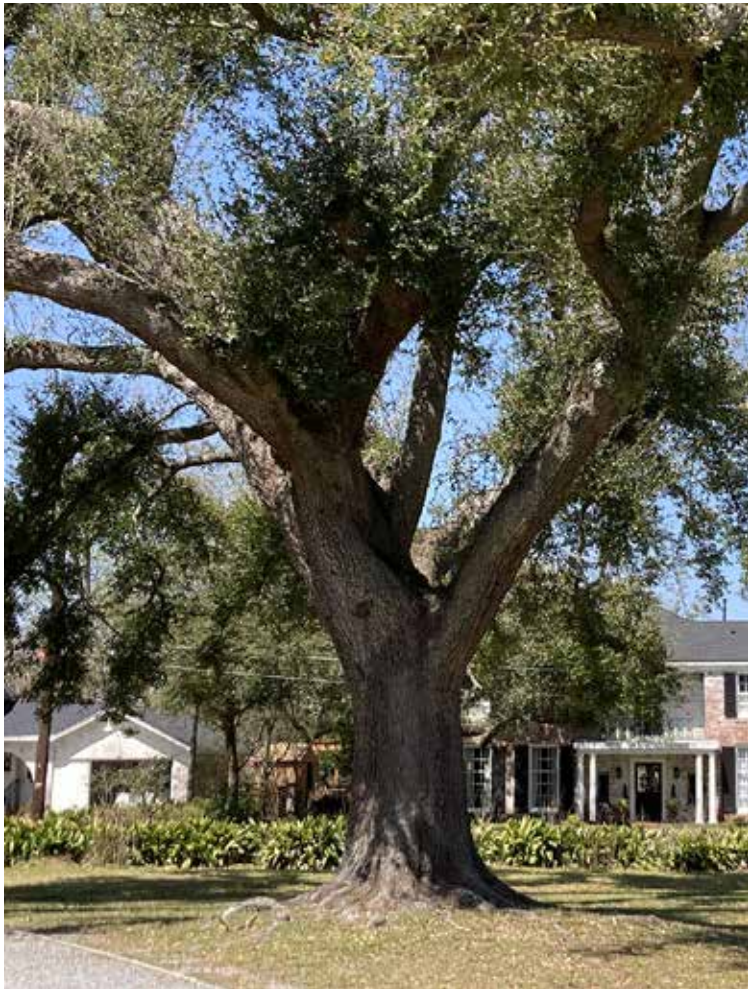
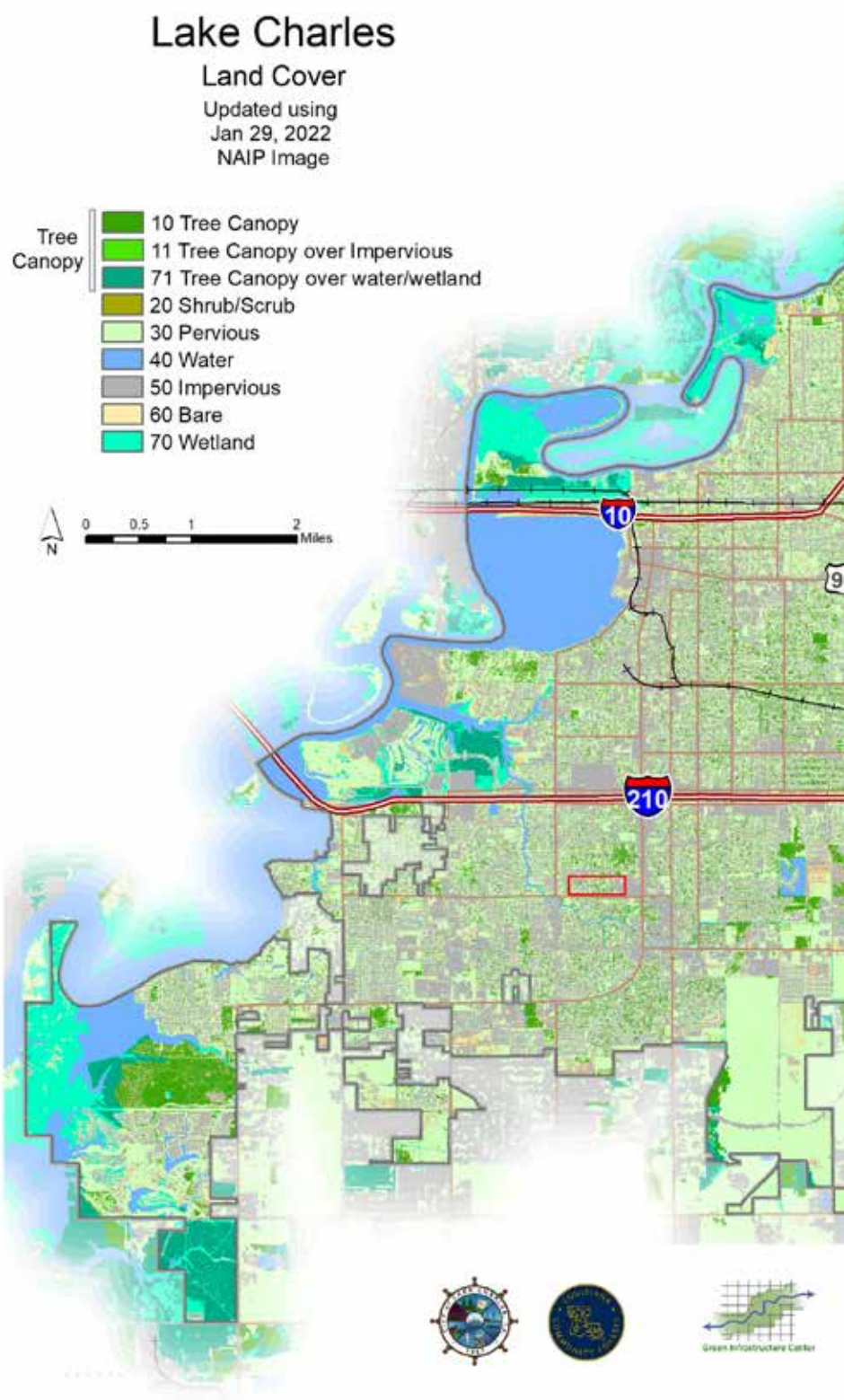
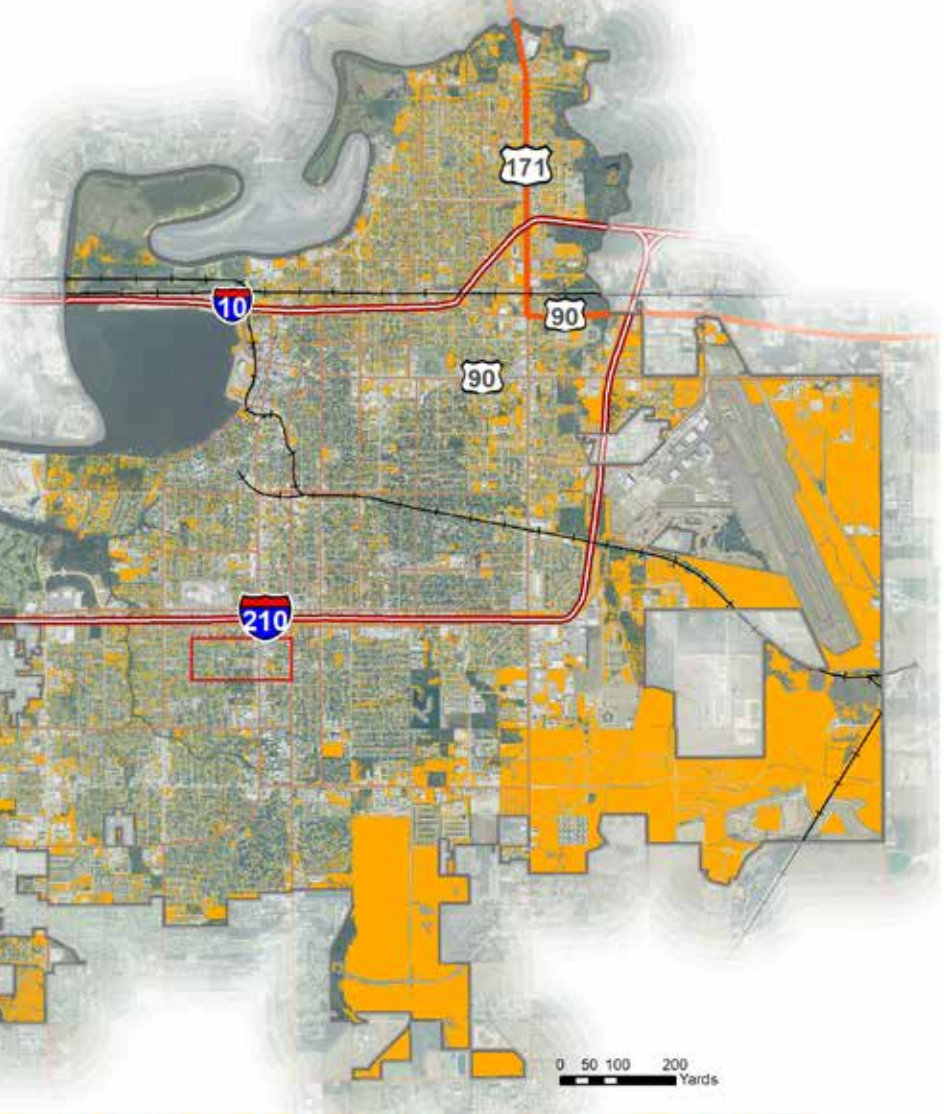


Citywide forest cover is 10.6%.

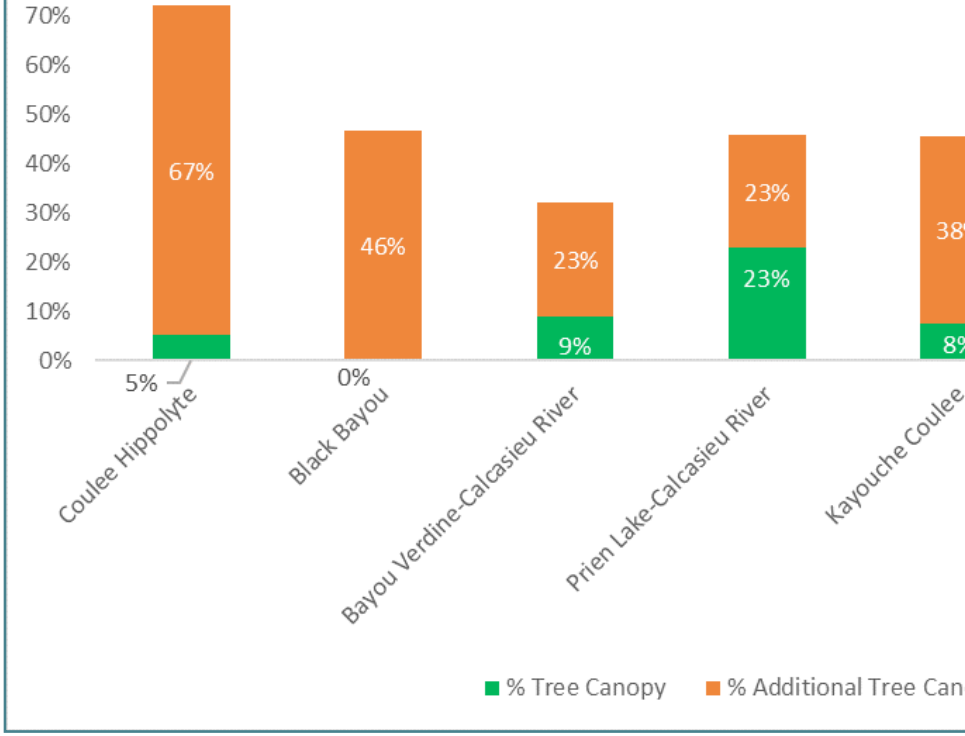




This map shows the tree canopy of the city which covers

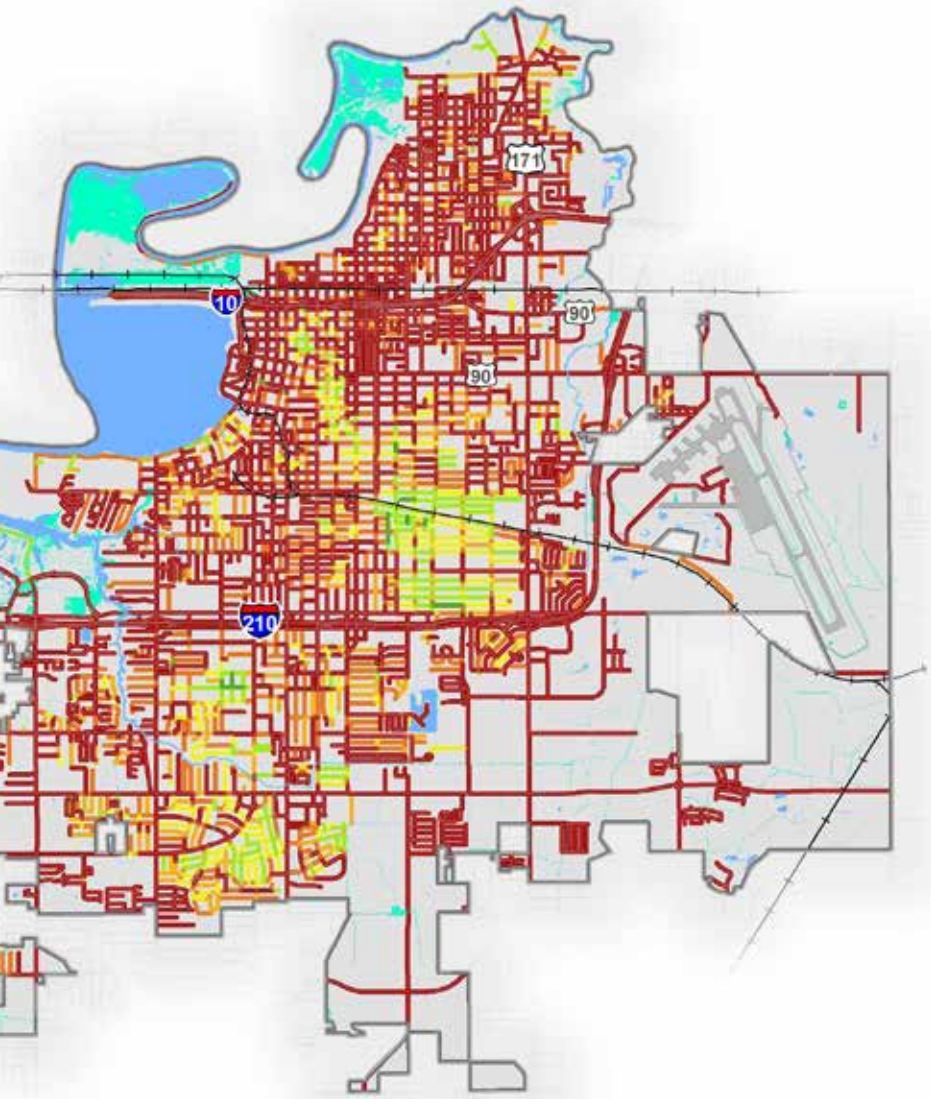


) shown in orange depicts areas where it may be possible to plant trees.
o be confirmed in the field and may be on private or public lands.



Map of Street Tree Coverage

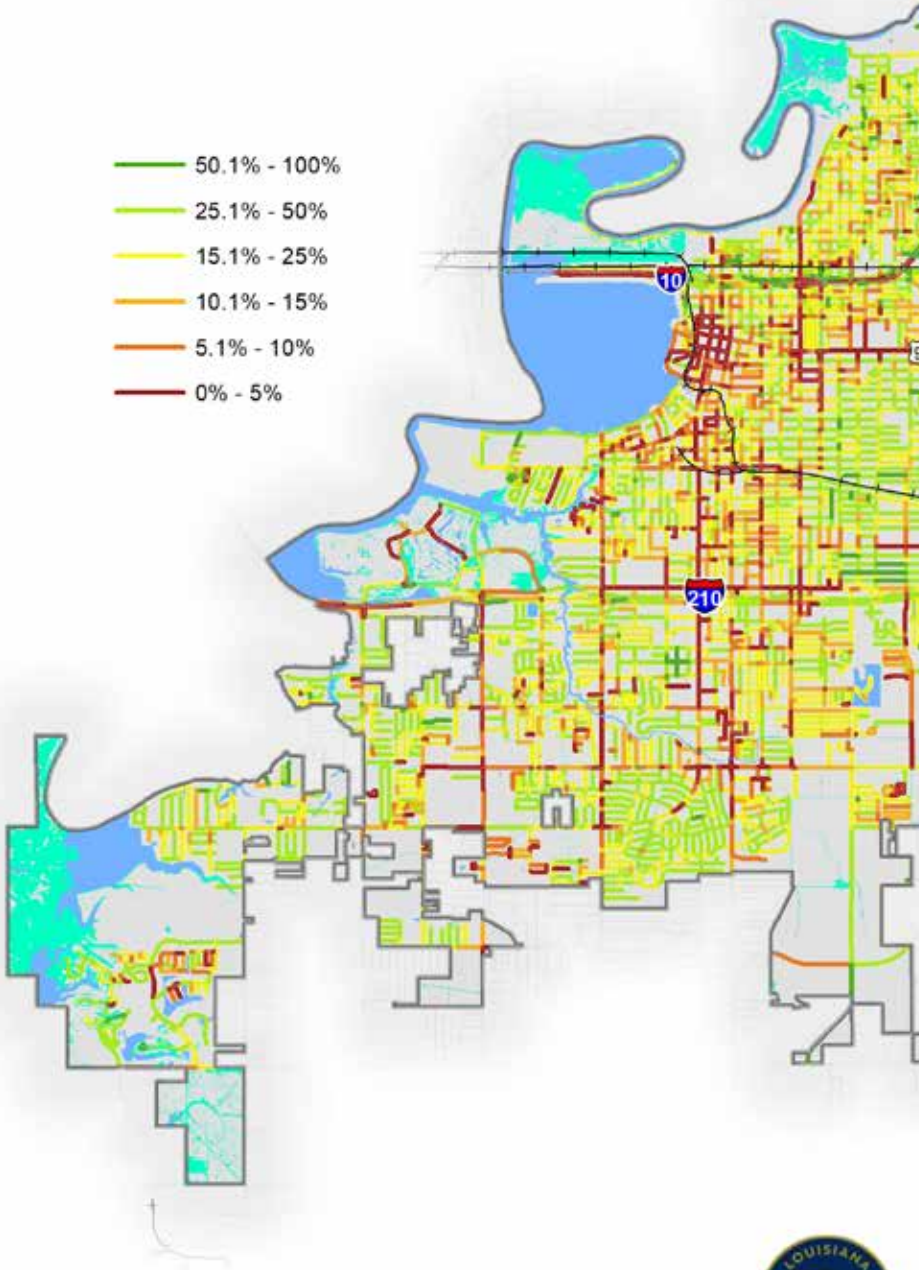
Percent Street Trees is calculated using the Land Cover Tree Canopy and road centerlines, which are buffered to 50 ft. outward from each road segment's centerline. The percent value represented is the percentage of tree cover within that 50 ft. buffer. See maps on the following 2 pages.



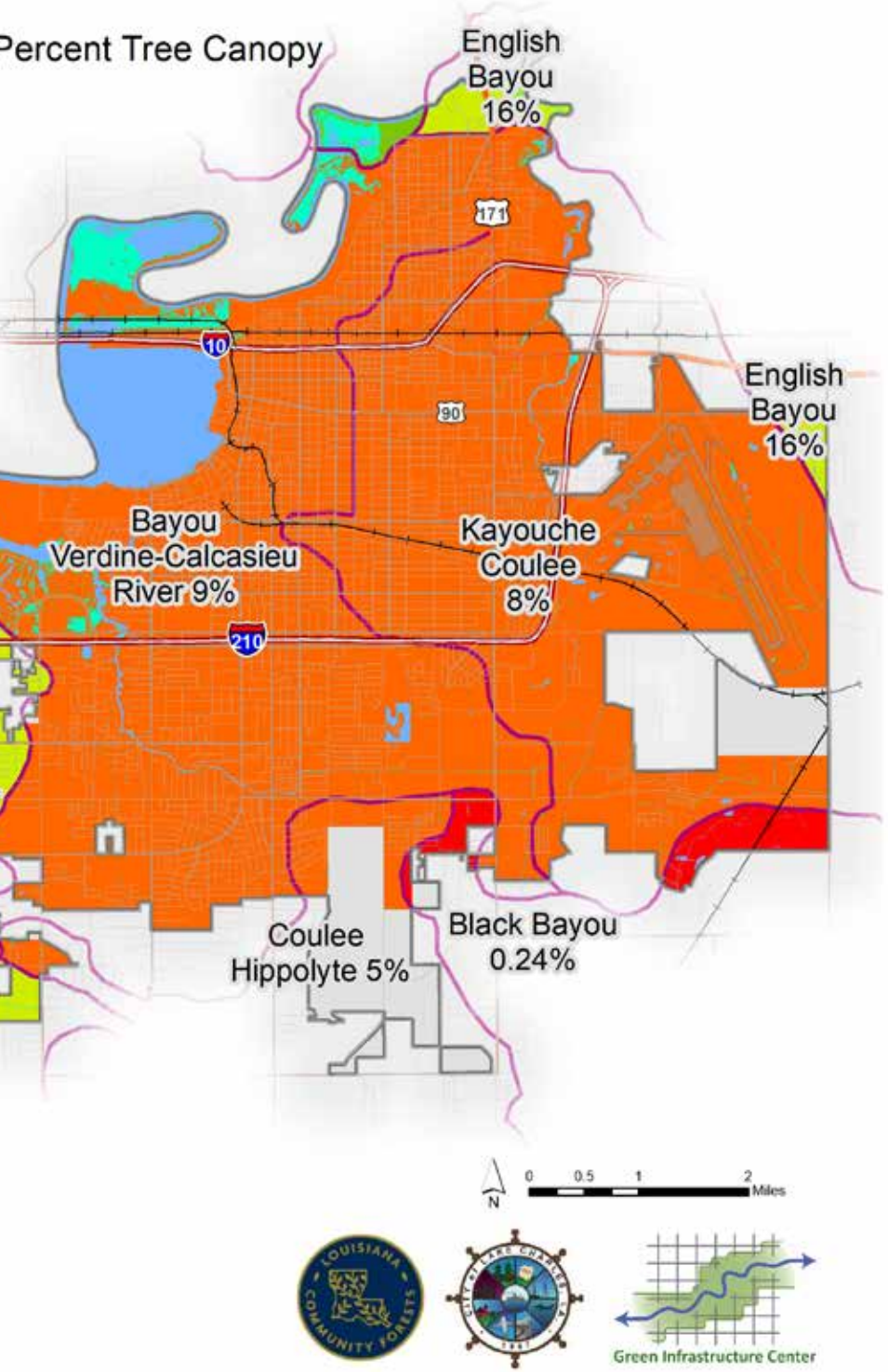
s have the most canopy (dark green) and which have the least (red). Streets
prioritized for tree plantings to facilitate uses, such as Safe Routes to School or
beautifying a shopping district.

Lake Charles

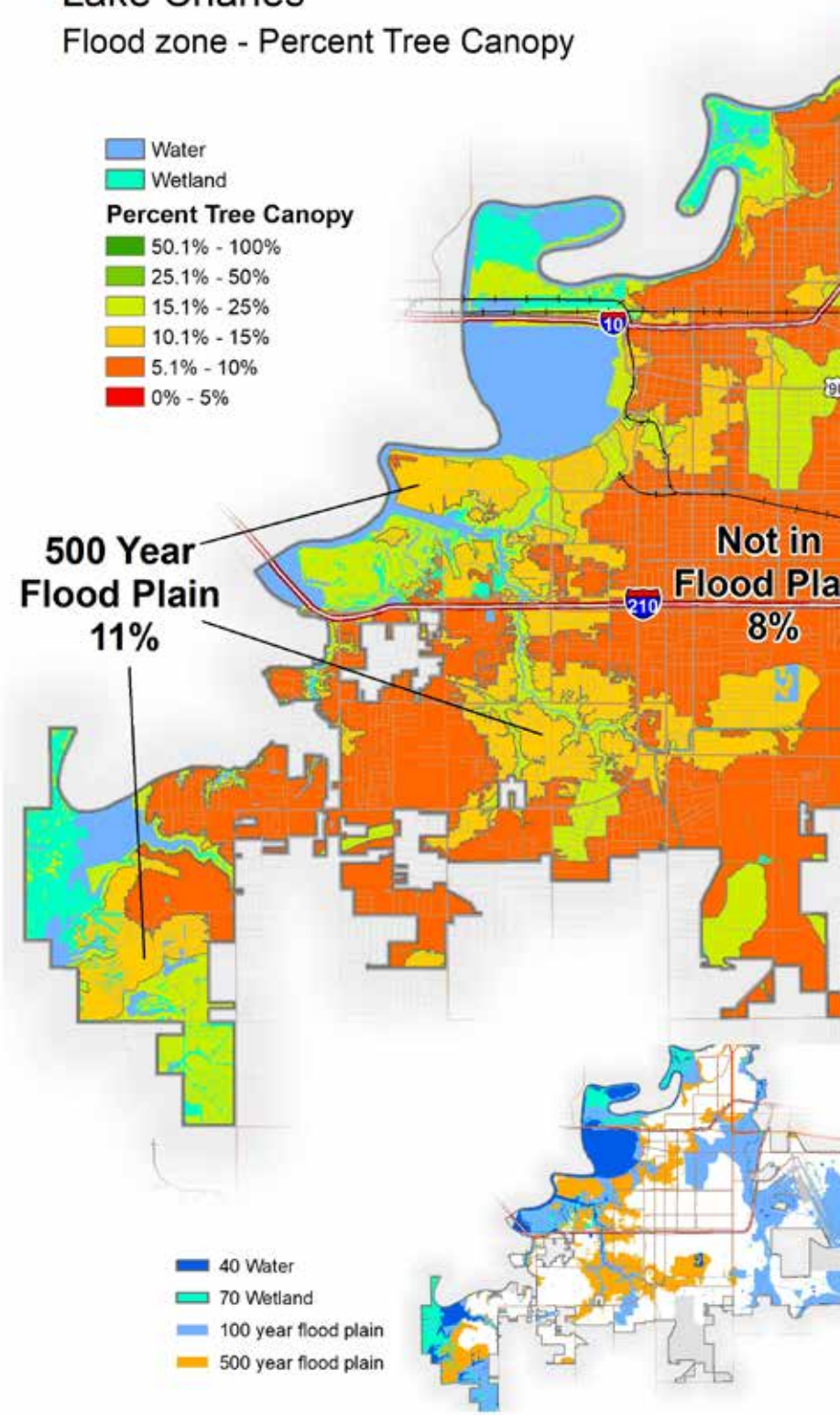
Potential Percent Street Trees



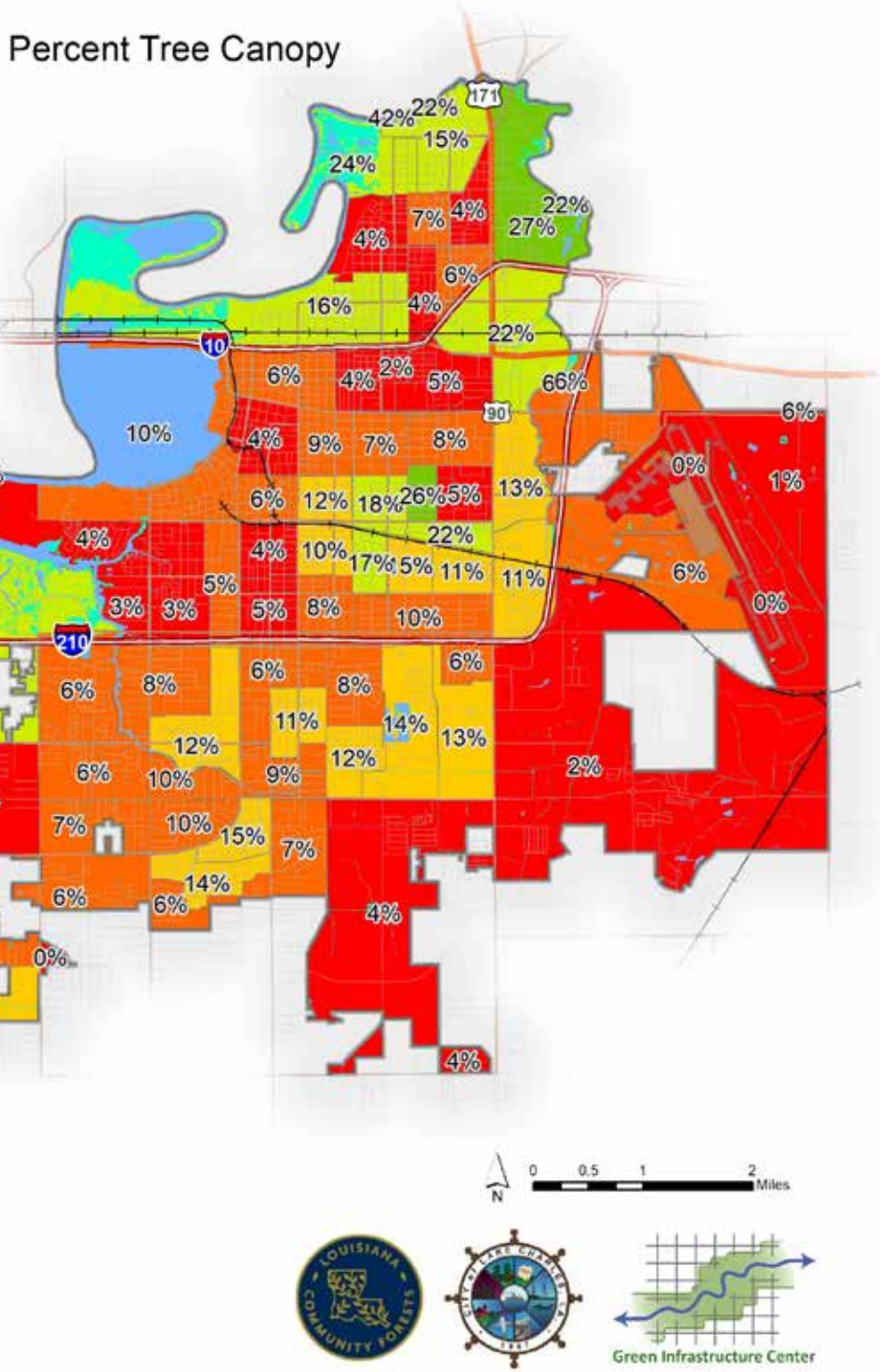
The potential street trees map shows which streets could support additional tre
Greater canopy coverage along streets and sidewalks can keep r



iction was analyzed for tree canopy. Tree canopy can reduce the amount of
n, nutrients, pesticides, sediment and other pollutants into nearby waterways,
lowering water quality.

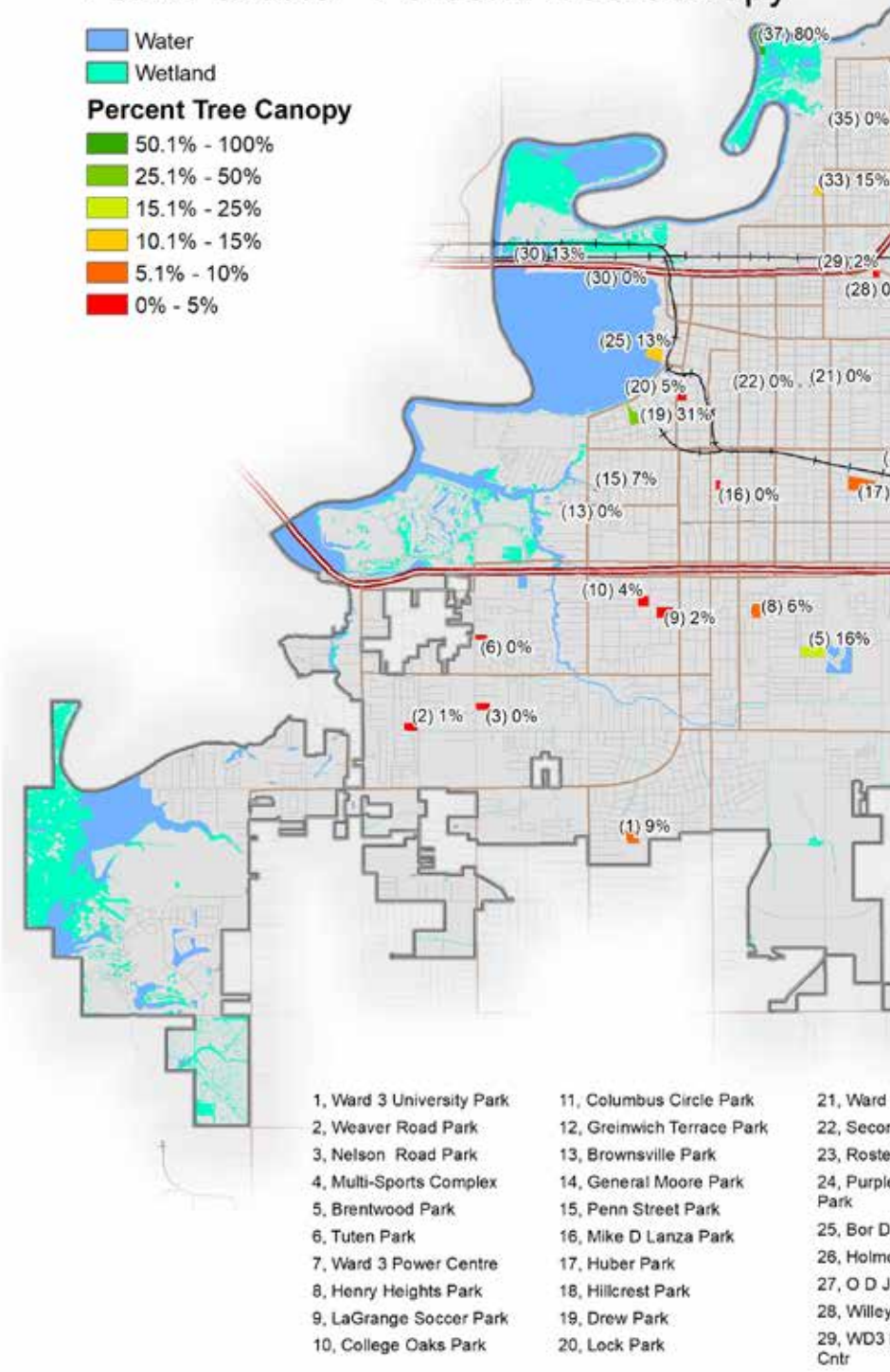


Flood zones are areas of the city more prone to flooding. Trees play a vital role



y is not evenly distributed across neighborhoods in Lake Charles. The city can
nd minority neighborhoods for more tree plantings and future tree giveaways.

Lake Charles
Park Parcels - Percent Tree Canopy



1, Ward 3 University Park
2, Weaver Road Park
3, Nelson Road Park
4, Multi-Sports Complex
5, Brentwood Park
6, Tuten Park
7, Ward 3 Power Centre
8, Henry Heights Park
9, LaGrange Soccer Park
10, College Oaks Park
11, Columbus Circle Park
12, Greinwich Terrace Park
13, Brownsville Park
14, General Moore Park
15, Penn Street Park
16, Mike D Lanza Park
17, Huber Park
18, Hillcrest Park
19, Drew Park
20, Lock Park
21, Ward
22, Secor
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Park
25, Bor D
26, Holm
27, O D J
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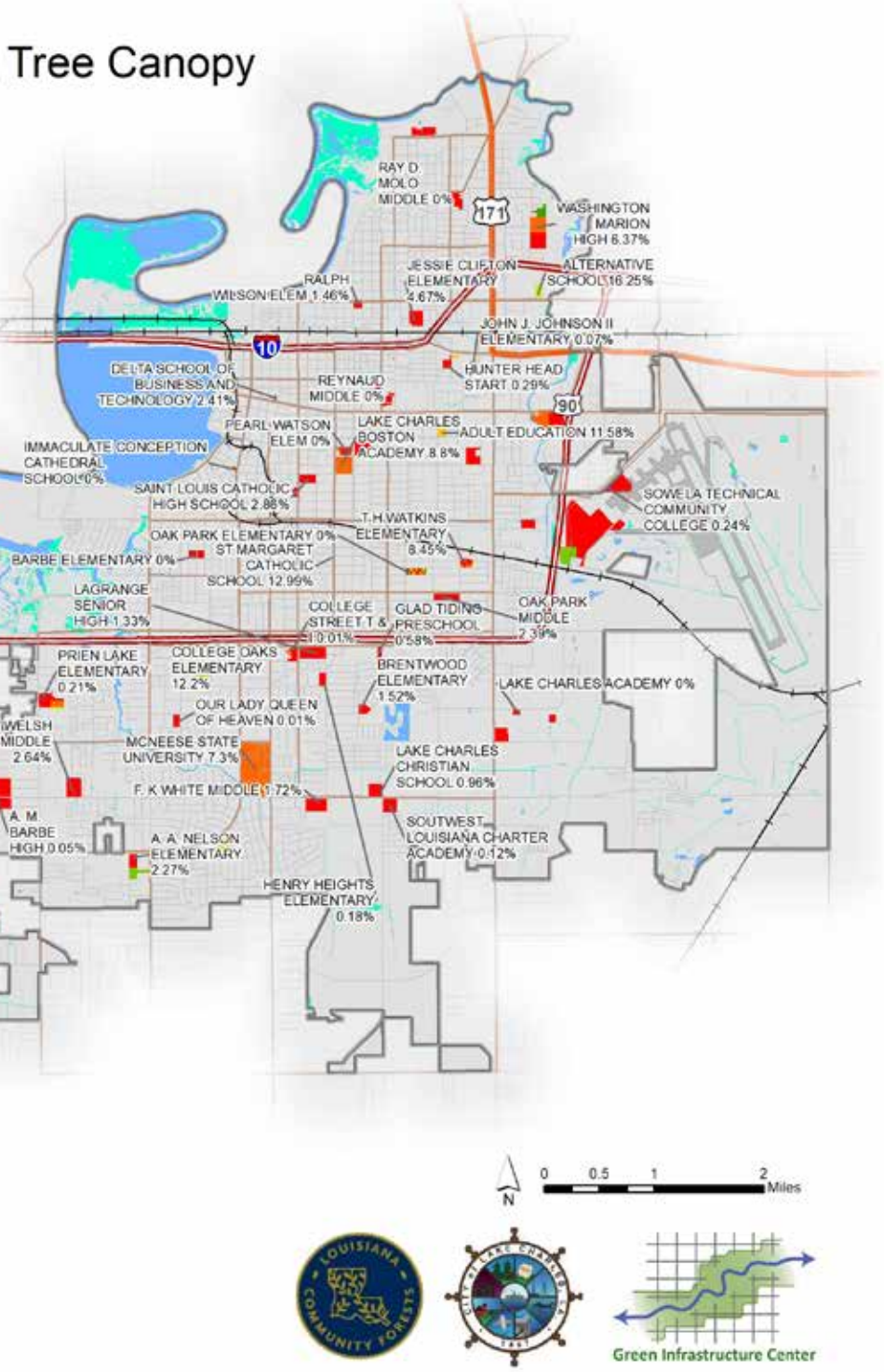
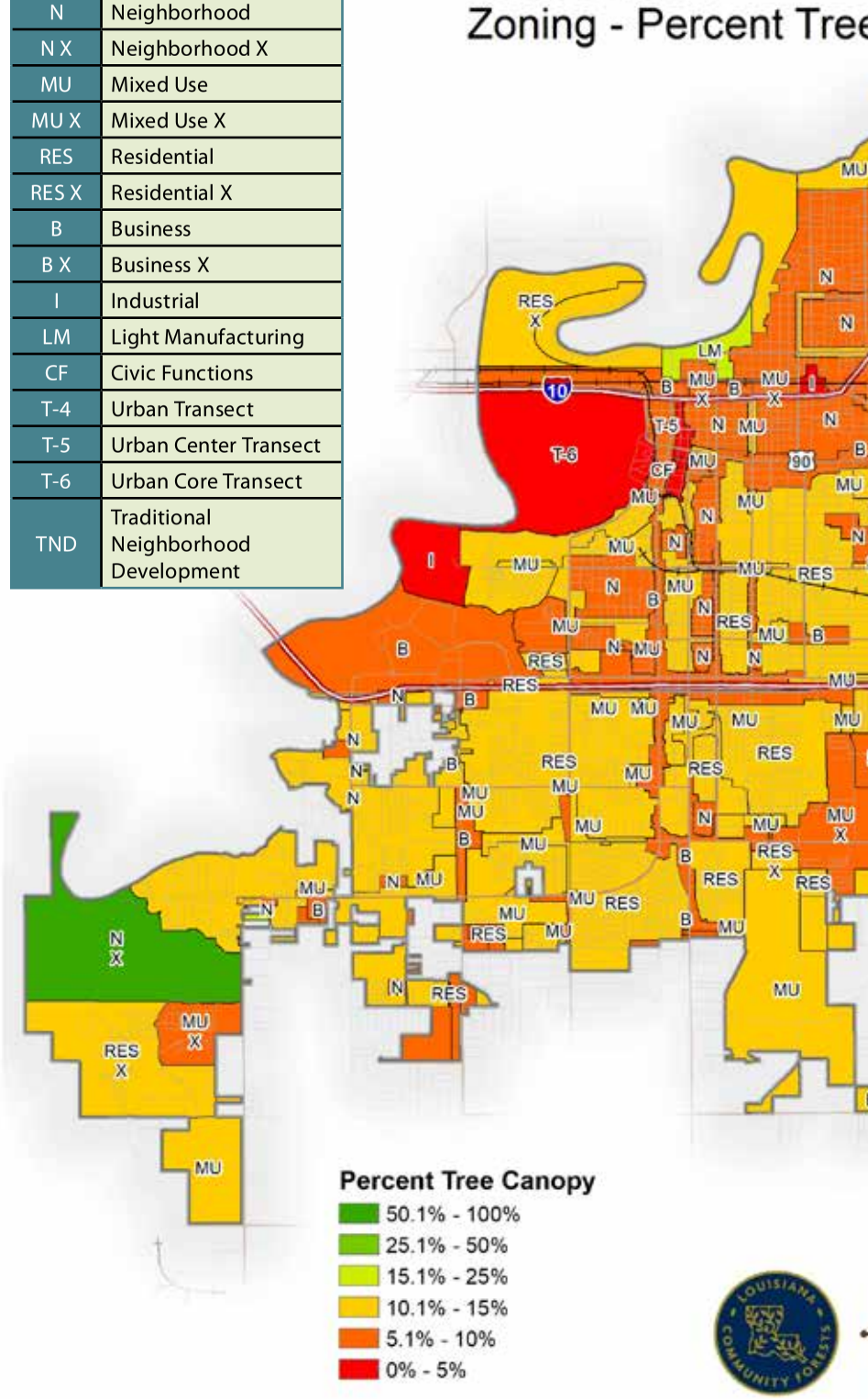
29, WD3
Cntr

This map shows which parks are well-treed and which parks are not. Many parks h
has prioritized park tree planting in the last few y

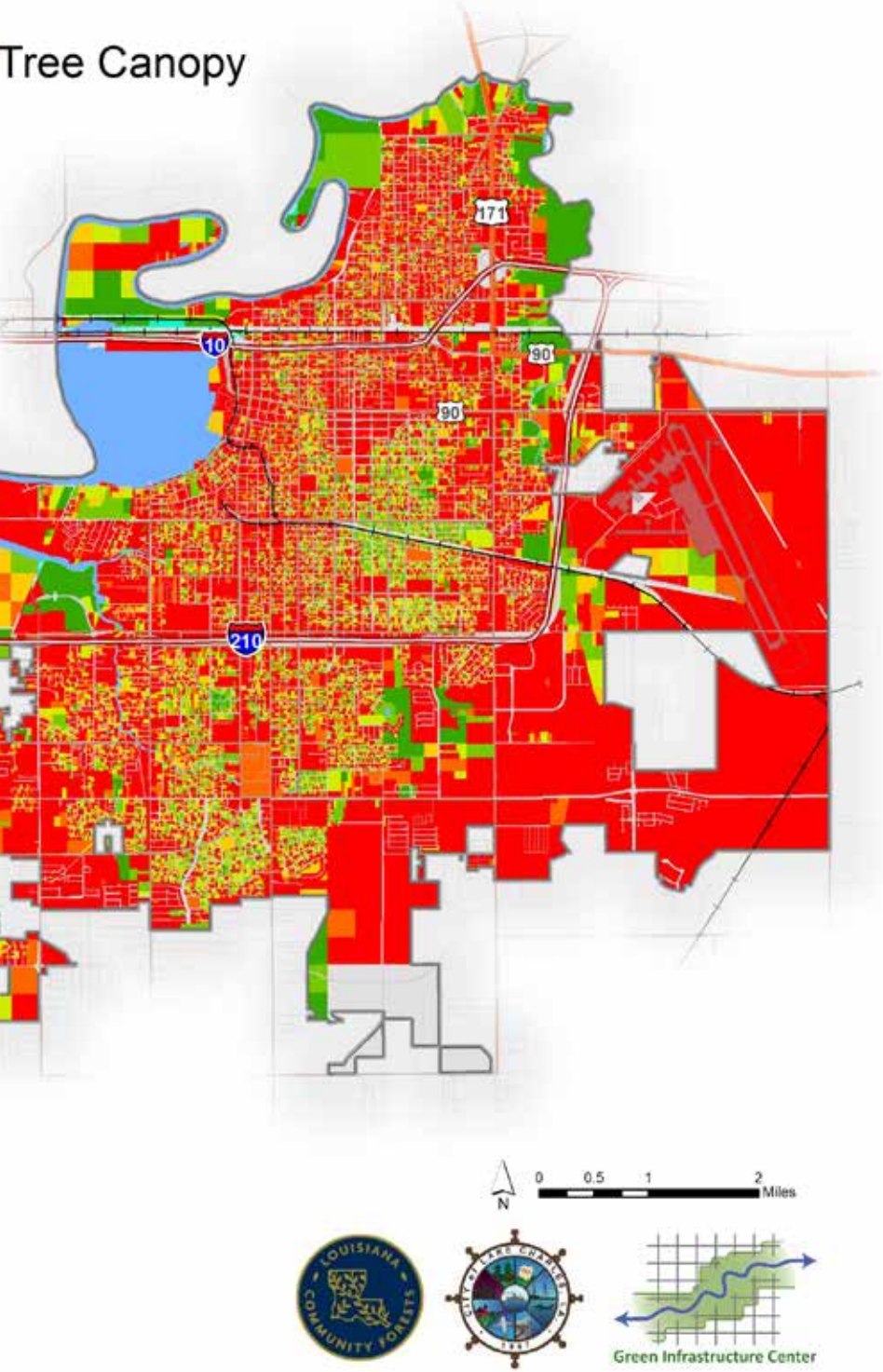


N	Neighborhood
N X	Neighborhood X
MU	Mixed Use
MU X	Mixed Use X
RES	Residential
RES X	Residential X
B	Business
B X	Business X
I	Industrial
LM	Light Manufacturing
CF	Civic Functions
T-4	Urban Transect
T-5	Urban Center Transect
T-6	Urban Core Transect
TND	Traditional Neighborhood Development

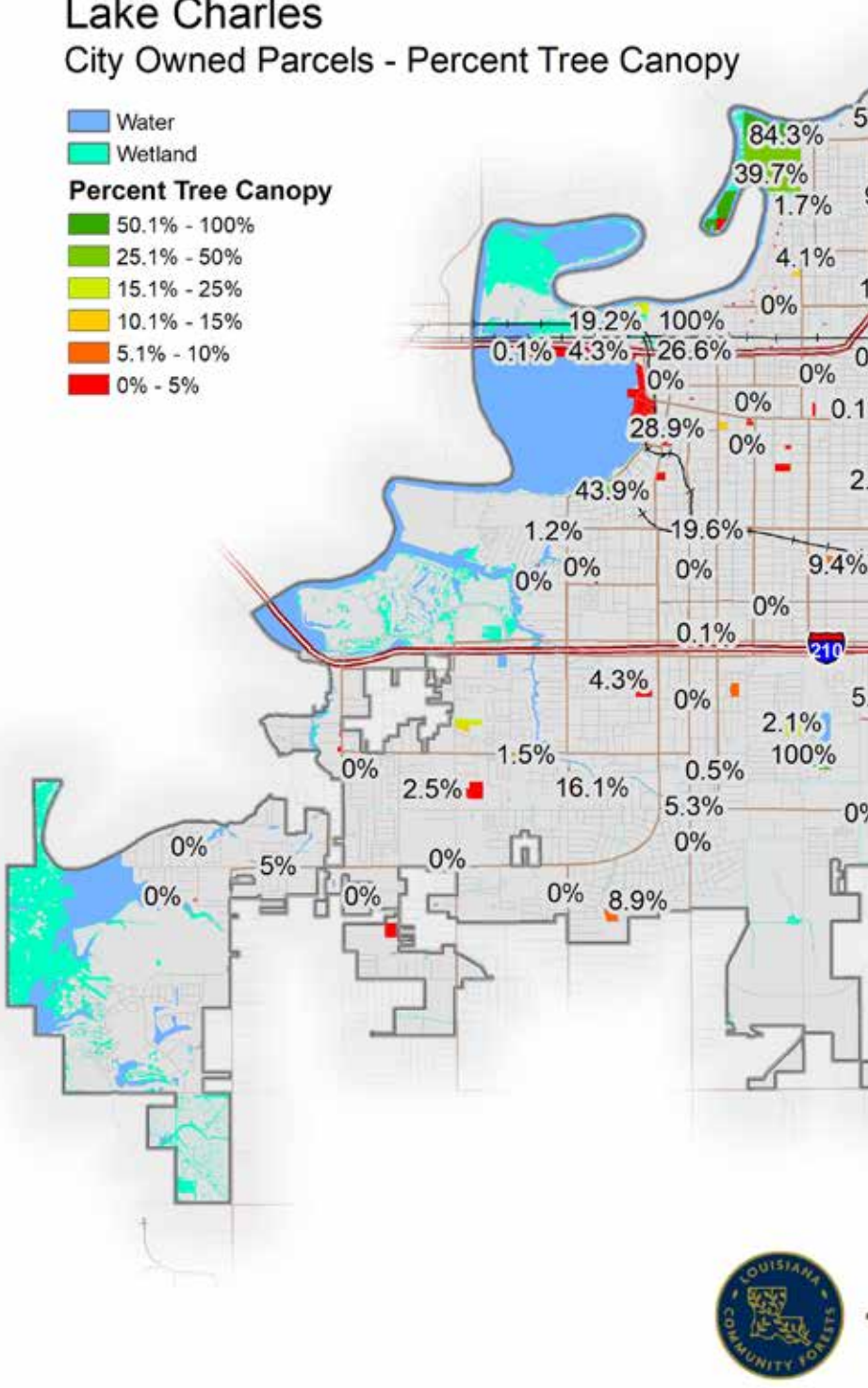


ts to increase tree canopy on campuses is a great way to educate the families e also providing greater mental and physical health for students.

This map depicts canopy by zoning classes. On average, lower impact zoning cla greater tree canopy and potential planting areas than do higher intensity classes



e canopy cover. The data show that many residential properties lack sufficient for more trees, particularly in neighborhoods of North Lake Charles.



This map shows where the city can plant additional public trees. The city can lead b on land it manages.

he urban forest. The
he city's tree canopy
W) Tool. The TSW
canopies and the
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nwater runoff.
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ound the tree and the
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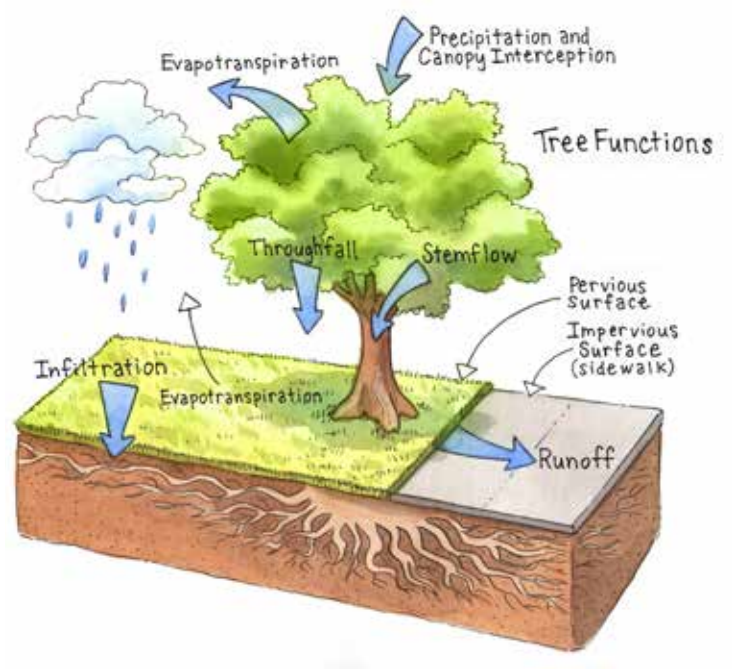
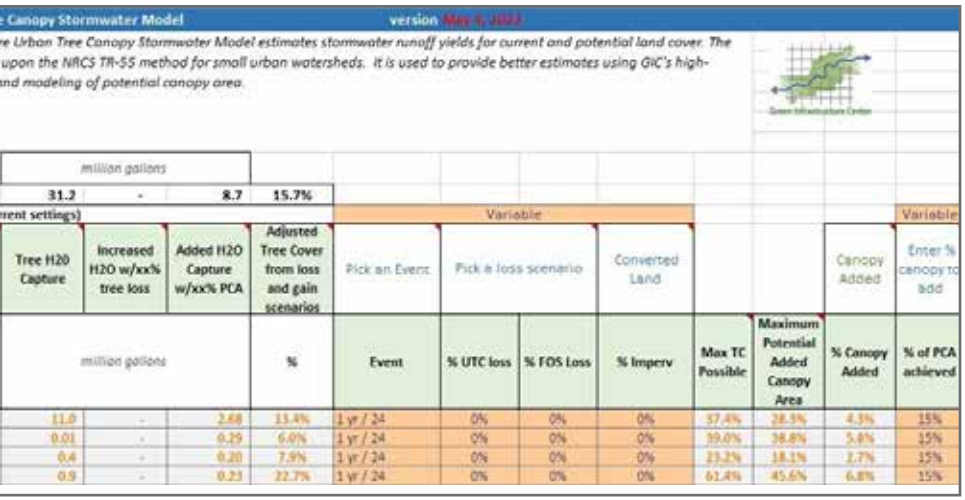


hypothetical 5% loss of tree canopy for the city, during a 10-year storm event, an additional 700,000 gallons of rainfall runoff would occur: that's more than an Olympic swimming pool's water volume. Conversely, if half of each plantable area were covered with new trees – increasing tree canopy – the TSW model shows that trees could capture an additional 49 million gallons of water during the same storm; or about 74 Olympic pools' volume of water.

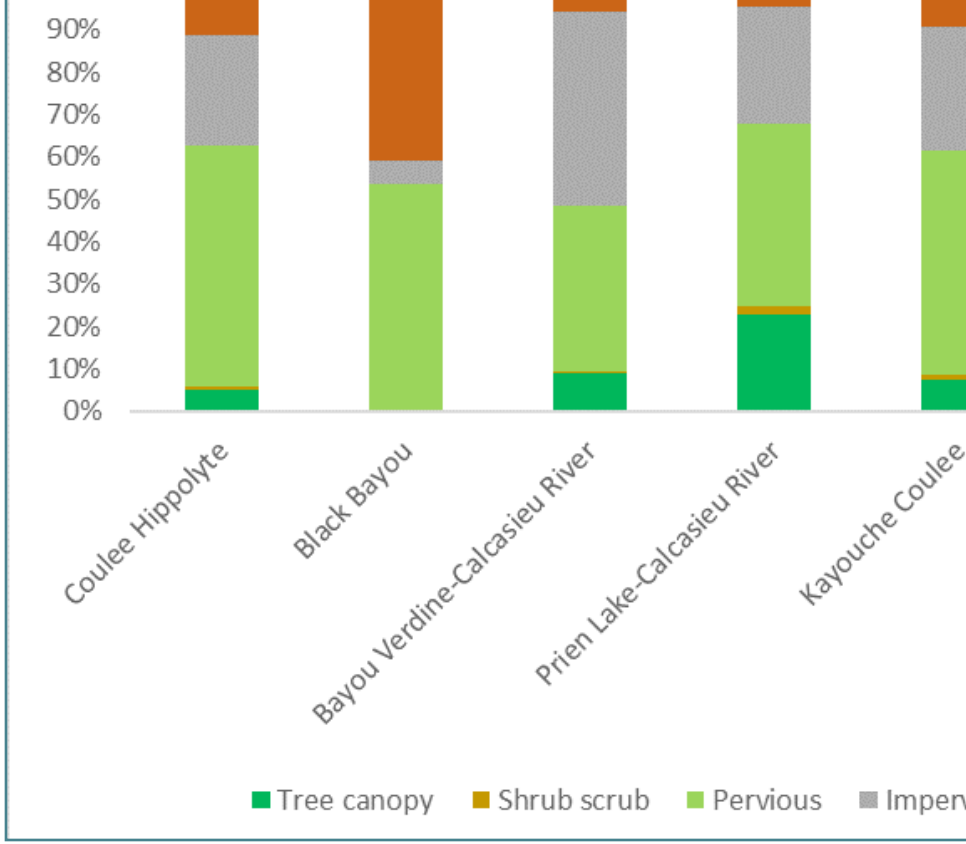
Combining the stormwater calculator with the canopy budget calculator tool, the city can estimate the cost-effectiveness of planting


e Canopy Stormwater Model version May 4, 2022

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

			million gallons									
			31.2	-	8.7	15.7%						
rent settings)						Variable						Variable
Tree H20 Capture	Increased H20 w/xx% tree loss	Added H20 Capture w/xx% PCA	Adjusted Tree Cover from loss and gain scenarios	Pick an Event	Pick a loss scenario		Converted Land			Canopy Added	Enter % canopy to add
		million gallons	%	Event	% UTC loss	% FOS Loss	% Imperv	Max TC Possible	Maximum Potential Added Canopy Area	% Canopy Added	% of PCA achieved
11.0	-	2.68	13.4%	1 yr / 24	0%	0%	0%	57.4%	28.5%	4.3%	15%
0.01	-	0.29	6.0%	1 yr / 24	0%	0%	0%	39.0%	36.8%	5.8%	15%
0.4	-	0.20	7.9%	1 yr / 24	0%	0%	0%	23.2%	18.1%	2.7%	15%
0.9	-	0.23	22.7%	1 yr / 24	0%	0%	0%	61.4%	45.6%	6.8%	15%

the city to see the water uptake by existing canopy and model impacts from changes,

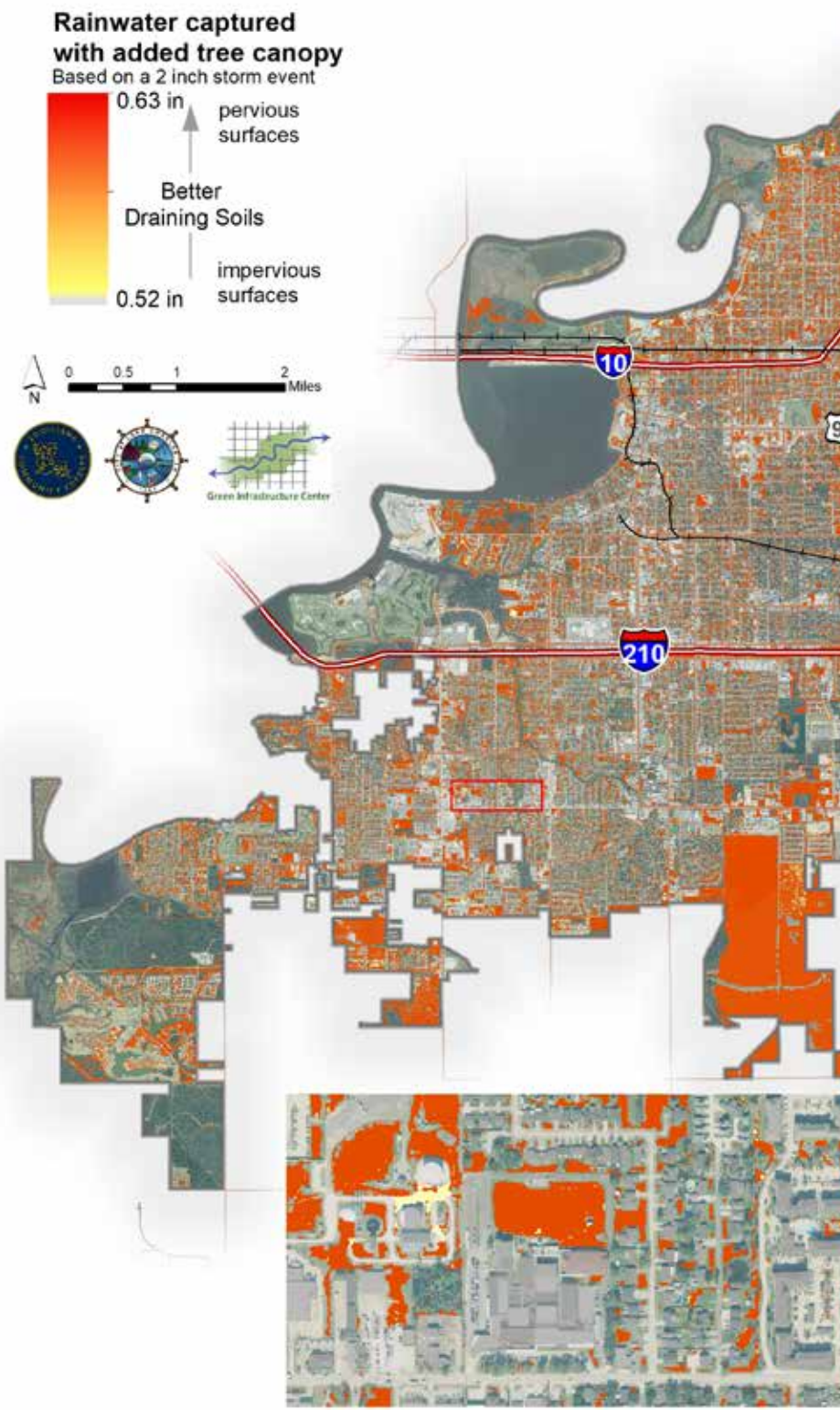


Combining the stormwater calculator with the canopy budget calculator tool, the city can estimate the cost-effectiveness of planting trees to mitigate stormwater runoff.

trees to mitigate stormwater runoff. Hypothetically if the city assumes a flat cost of $230 for the purchase and labor of planting a tree, then a 5% canopy increase (covering 20% of the total costs) would capture nearly 9 million additional gallons of stormwater during a 1-year/24-hour rainfall event (4.63 inches) at an average cost of $0.63 per gallon. These estimates illustrate the cost-effectiveness of using trees as a stormwater mitigation strategy in the community, in addition to realizing the other ecosystem service benefits trees provide.

Removal of mature trees and existing forests generates the greatest impacts for increasing stormwater runoff. As more land is developed, the city should seek to maximize tree conservation for maintenance of surface water quality and groundwater recharge. The following maps show areas that are the most important to retain trees for stormwater

e canopy that is in the best location (in dark green) for retaining stormwater on site.



This map identifies the best planting areas to plant trees to infiltrate st

peer-reviewed software
s urban and rural forestry
standard pollution
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the pollution removal

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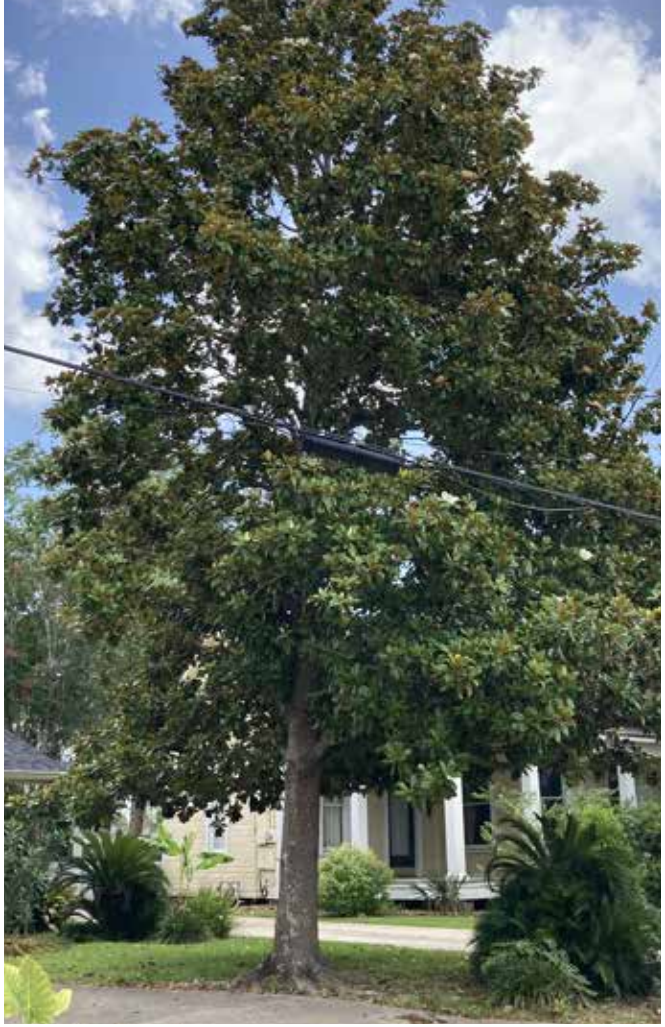

Air Quality Multipliers

enefit Description	Removal rate (lbs/acres/year)	Removal rate (lbs/year)
d annually	1.13	3,335
l annually	6.241	18,417
	48.212	142,274
than 2.5 microns and less than 10 microns	13.683	40,379
n 2.5 microns removed annually	2.463	7,268
nually	3.068	9,054
ed annually in trees	509.90	1,504,726

This review determined which practices make the city more impervious (e.g., too much parking required) and which make it more pervious (e.g., conserving trees or requiring open spaces). Documents reviewed during the codes, ordinances and practices analysis for the project include relevant sections of the city's current code that influence urban forest practices, runoff or infiltration. Data were gathered through analysis of city codes and policies, as well as interviews with city staff, whose input was incorporated directly on the spreadsheet summary prepared by the GIC. The spreadsheet provided to the city lists all the codes reviewed, interviews held and relevant findings.

Points were assigned to indicate what percentage of urban forestry and planning best practices have been adopted to date by the city. The spreadsheet tool created for city codes can also serve as a tracking tool and for determining other practices or policies the city may want to adopt in the future to strengthen the urban forestry program or to reduce impervious land cover. The less city land that is paved, the more room there is to add trees.

Categories the city scored best in were "Tree Care and Protection," "Implementation Capacity," and "Reducing Impervious Surfaces", while "Monitoring Progress," "Plans and Goals," and "Emergency Response" all had room for improvement. Best practices the city follows under "Implementation Capacity" include training staff to manage the urban forest. While the city does not have a dedicated city

arborist or urban fores
International Society
training. The city also
arboriculture to identi
The city contracts wit
when staff do not have
examples under "Tree
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IMPLEMENTATION CAPACITY

Codes and ordinances that specify tree planting and care are great but without property resources, implementation of codes and goal achieve

		Presentunicipality Comme	viewer Commen	Source	
Advisory Boards/Groups					
Is there a Tree Commission/Urban Forestry Commission/Tree Board?	N				Tre pla hav tha Me res mu Co Mu
Do the members of the Tree Commission/Urban Forestry Commission/Tree Board include representative from various occupations and areas of the municipality?	N				Ens of n Co den
Staff					
Is a certified arborist on staff?	Y	The city sent a public works staff member to get certified as an arborist.			A c mal tree cer
Is at least half of one staff member's job duties devoted to managing grants?	Y	Grant administration is spread out across departments and special projects.			Gra targ ma mo leas ma
Is there a full time regular staff member that has authority over day-to-day urban forestry	N				Urb rela

A snapshot of the types of questions or sections of code

ummary scores for city codes and policies within each category. The city scored best in 'Tree Care and Protection' and 'Reducing Impervious Surfaces' but had room for improvement in 'Monitoring Progress' and 'Emergency Response'.

and Goals" were an urban egies outlined, which the city partnership with the Green Forests. In addition, the city agement plan to support the an forest and to ensure it is dations under "Monitoring y data to support city s for the urban forest, as well tree plantings or removals. tree plantings can identify can limit unnecessary removals noved while also increasing the g hazardous trees.

ming recognized as a The city meets half of the pending and community o establish a Tree Board across multiple codes into a A membership demonstrates mmatic and policy elements Tree City USA member cities opportunities through the

TREE CITY USA®

To be recognized as a "Tree City USA" the City of Lake Charles needs to:

1. spend at least $2 per capita on tree care, planting or maintenance,
2. have a public tree ordinance
3. establish a Tree Board, and
4. hold an annual Arbor Day Celebration in the community.

Public Survey and Input

The Green Infrastructure Center created a public survey to inform this assessment. The survey was open for six weeks from June 1st to July 15th 2022. Links to the survey were shared through the city's social media, sent directly to community groups and shared with attendees at city meetings. It also was shared at community engagement open houses held for a larger regional resiliency planning effort called Just Imagine. This effort was led by a coalition of local partners, including the City of Lake Charles. Three days of open houses were held for the public to review top-rated economic and environmental resiliency projects. GIC shared the results of the urban tree canopy analysis and gathered additional input from attendees. Thirty-one residents filled out the survey. The city will continue to gather more additional community input concerning the urban forest, tree planting efforts and opportunities to get involved.

Following are highlights from the public survey.

Tree values

The community overwhelmingly ranked shade (84%) as the number one community value trees provide. As extreme heatwaves become more common in Louisiana and across the southern U.S., the ability of trees to mitigate urban heat island impacts, reduce energy costs and protect public health are becoming increasingly important.

Tree concerns

Based on recent storm events, respondents ranked falling trees and resultant property damage as their top concerns. Selecting proper tree planting siting and selection of species can mitigate some of those risks as well as doing tree risk assessments around critical public infrastructure to identify hazards and mitigate risk.

Tree planting locations

The top places residents wanted to see trees planted in the community (in order) were along streets, in parks, stormwater mitigation sites and hot areas. Urban tree canopy data from this assessment can guide city efforts to identify specific sites or neighborhoods for these tree plantings or tree giveaways.

Strategies to increase canopy

The public thought the best three strategies were: city tree giveaways for residents, requiring developers to plant more trees and city tree planting in public spaces and ROWs.

Informing Campaign

"Just Imagine" is a reg community plan to rev create a more resilient Louisiana. This report can be used to support of trees and green infr to achieve many of the Imagine's goals as the region prepare for maj in infrastructure and e development.

Some examples of hov inform the Just Imagi

Bayou Greenb

- Use this assessmer along proposed sec tree plantings along benefits.

Strong Downt

- Re-design streetsca adequately sized tr trees. Any installed include spaces for t

housing authority to replace lost canopy in the large public housing development.

- Partner with Barbe Elementary School to plant trees with students and use the tree canopy and potential planting area (PPA) data to inform planting locations. This can be used as an annual Arbor Day Celebration activity.
- Use street tree canopy data and overlay with Safe Routes to school for students to increase canopy along their walking routes.

Waterfront Development

- Plant trees at the waterfront park and parking lots. Many parking lot islands are lacking any trees and can easily be planted.
- Plant strategic tree buffers and living shorelines to protect waterfront developments from storms. Buffers can be designed to avoid overly limiting views and waterfront access.

The waterfront

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venue. While the city
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The city and its partners have started planting the

o Credit: Lindsey Janies, courtesy of Lake Charles Southwest Louisiana CVB

based on the land cover and ecosystem service modeling, analysis of the tree canopy and
s and policy review. As noted earlier, the 10.6% tree canopy cover is unevenly distributed across
cover in Lake Charles listed in priority order include:

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role of trees as green infrastructure (note: additional documentation steps are required). Adding trees as green infrastructure can also be used to justify funding tree planting as green infrastructure under FEMA's Hazard Mitigation and Building Resilient Infrastructure and Communities (BRIC) grant programs.

3 **Continue tree plantings in parks and rights-of-way and for key streets where green infrastructure and shade are needed.** The city has planted over 370 trees in various parks in partnership with local businesses and volunteers since last December. The city in partnership with the Louisiana Department of Transportation has planted 770 trees along the interstate in three phases between 2017 and 2020. The public identified streets and the hottest areas of the city as a top priority for tree planting efforts. Use the street tree coverage map developed by GIC to target streets with low tree canopy coverage and higher than average surface temperatures to increase shade along city streets.

The city planted trees in cooperation with the Louisiana Department of Transportation to beautify the I-10 corridor.

4 **Establish a tree board or commission**. A Tree Board or Commission comprised of community stakeholders will increase advocacy for Lake Charles's urban forest. Typical responsibilities for a tree board include grant writing, planning the Arbor Day celebration and other tree events, serving as ambassadors for the urban forest, and acting as an advisory body for tree related issues. A Tree Board is also required for designation as a Tree City USA which opens up financial opportunities for the city. The Tree Board should be made up of a diverse group of stakeholders (age, interest, expertise, etc.) and meet at least quarterly. Lake Charles has already developed a coalition of businesses, foundations, nonprofits, and community members interested in seeing more trees planted.

necessary investments in green infrastructure. It can also incentivize residents, developers and property owners to incorporate green infrastructure best management practices into new projects, or through retrofits. Allow developers and property owners to use tree plantings to offset the amount of the fee. Ensure that utility fee revenues are used to support public tree plantings.

6 **Develop a stormwater best management practice design manual for Lake Charles which includes both tree planting and constructed green infrastructure as best management practices (BMPs)**. Without standards, innovative stormwater techniques such as green roofs, suspended pavement systems, vegetated swales and tree pits cannot be credited toward stormwater requirements. The city should develop stormwater best management practice standards, along with incentives for developers and homeowners to install green stormwater technology. The city should continue to install these practices on city-owned buildings and properties to serve as educational demonstrations. A good example of such applications are the recent flood and stormwater resiliency enhancements installed at Hillcrest Park.

The city installed a demonstration green infrastructure project at Hillcrest Park featuring trees and bioswales to mitigate

8 **Establish a p**
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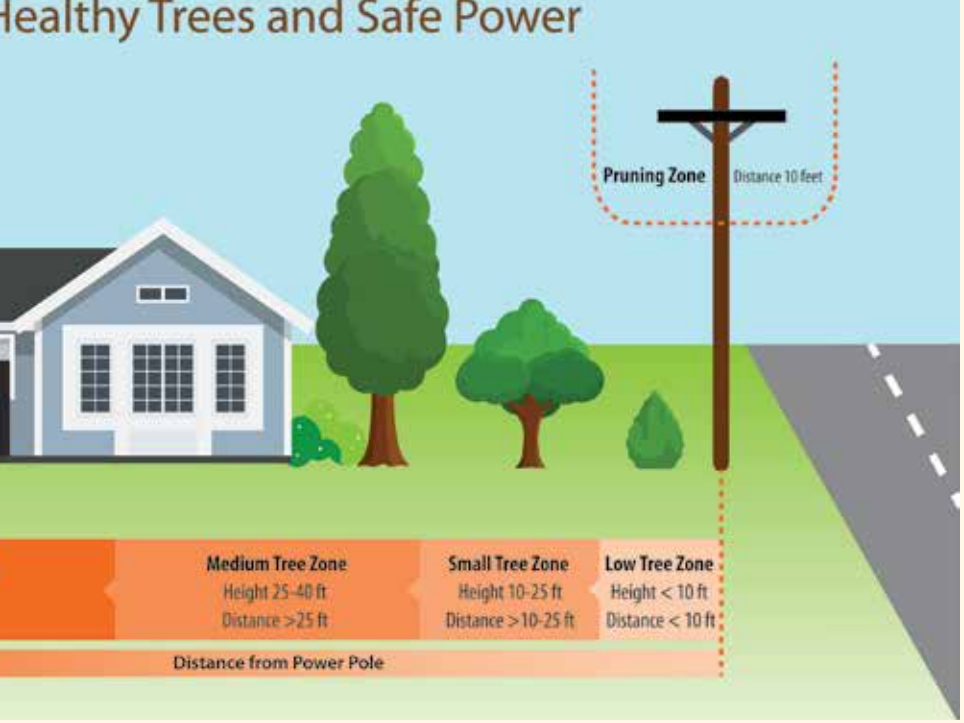

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11 **Use public tree inventory data to track city assets**. Integrate public tree data into the city's asset management tracking software. This will allow the city to track and monitor its assets for tree locations, condition and maintenance needs. These data are critical for securing future FEMA reimbursement to replace trees under its Public Assistance grants available after federally-declared disasters.

12 **Conduct annual proactive tree risk assessments in highly trafficked areas of the city**. Tree risk assessments can be used to determine and develop plans to mitigate tree risks, such as diseased limbs that may fall. In highly trafficked areas, these assessments should be done annually. Implementing proactive tree risk assessments will reduce risks and potential losses. The city should send ISA-certified arborists on staff to additional Tree Risk Assessment Qualification (TRAQ) trainings. The city should have someone on staff trained in tree risk assessment to allow for a more rapid evaluation of tree risk in the event of emergency, immediately following a storm.

13 **Develop an urban forest management plan for the city**. An urban forest management plan (UFMP) details the vision and the process for managing the city's urban tree canopy. It is used to achieve local government and community goals to proactively manage the city's urban canopy and achieve long term benefits. A UFMP also informs budgeting for urban forest

to help mitigate future tree losses from new development or storms.

15 **Require and enforce 600, 1,000, and 1,500 cubic feet soil volume planting requirements for small, medium, and large trees respectively**. At a minimum, canopy trees require 1,000 cubic feet of soil volume to thrive, as recommended by the Environmental Protection Agency (Stormwater to Street Trees, 2013). Greater soil volume and soil areas will also decrease a tree's risk of failure during a storm by providing adequate area for root anchoring.

16 **Update the zoning code to establish higher minimum tree canopy percentages or a minimum number of additional trees for new developments**. Current standards require two trees be planted per single-family residential lot and one tree per 40 linear feet in nonresidential and multi-family lots. The city can increase these standards to require developers to plant more trees on site. For example, establish a minimum percentage of 20% tree canopy for residential zones or increase the number of required trees on single-family lots to four trees per lot. Another avenue to achieving greater canopy onsite is by updating canopy standards for parking lots. Currently, the city code allows for small trees to be planted at a higher density versus the planting of fewer larger shade producing trees. The city could require only the planting of large shade canopy trees in parking lots (Class A trees) and prohibit smaller trees (Class B trees) from these sites in order to maximize shade and stormwater benefits. Smaller trees could be allowed only where planting strips are constrained by other factors such as underground utilities. The city could also increase the number of required trees to be planted based on either the number of parking spaces (one tree island for every eight parking spaces) or by reducing the distance from one tree every 65 feet (current code) to one tree for every 45 feet or less.

17 **Incentivize developers to incorporate and retain mature trees on sites and protect those trees during construction.** Large mature trees provide greater and more immediate ecosystem service benefits than newly planted trees used for mitigation. The city's code can be amended to incentivize retention of mature trees for meeting stormwater requirements. Other types of incentives include faster permitting for preserved trees or patches of forest. The tree preservation code should also provide specific protections for mature trees during the construction process such as require fencing a distance of 1.5' times the tree's diameter at breast height (DBH) from the tree, exclude storage and staging of materials near the tree, place clearly visible signage and avoid trenching utilities that would impact tree roots. Existing large trees should be indicated on site plans along with tree protection measures

This tree is no
construction. Heav
roots and lead

18 **Enforce pena**
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19 **Continue the**
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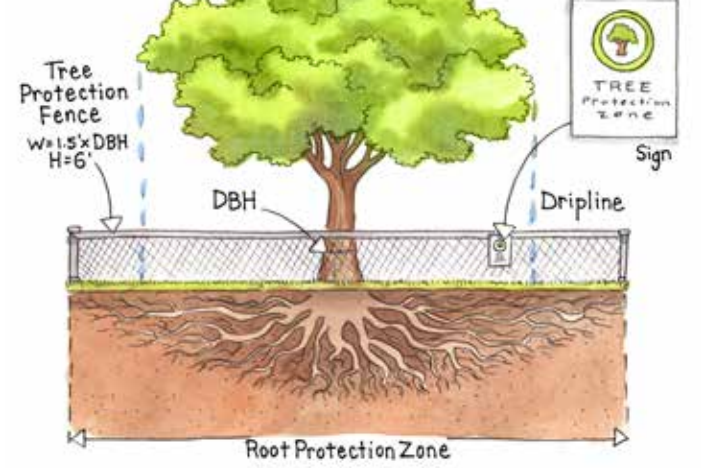
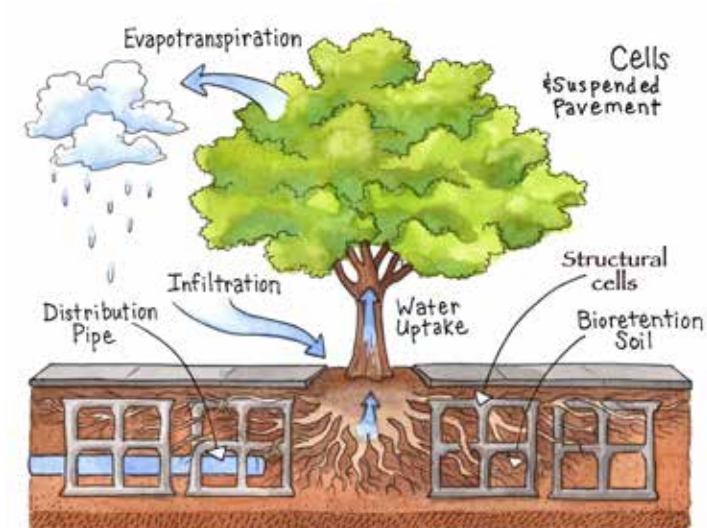


Tree Protection Fence and Signage

a standard tree protection sign which summarizes the dos and don'ts of working near and around tree protection zones. Additional training may be helpful to ensure that developers comply with the city's tree ordinances and understand how to protect trees during construction. If the work crews are of different nationalities, consider signage that has multi-lingual instructions.

Tree Planting

In urban environments, many trees do not survive to their full potential life span. Factors such as lack of watering or insufficient soil volume and limited planting space put stresses on trees, stunt their growth and reduce their lifespans. For every 100 street trees planted, only 50 will survive 13-20 years (Roman et al 2014). This means that adequate tree well sizing standards are a critical factor in realizing



Planting trees in the right place away from power lines can avoid harmful over pruning.

the advantages of a healthy urban forest. At a minimum, canopy trees require 1000 cubic feet of soil volume to thrive. In areas where space is tight or where heavy uses occur above, underground tree support cells can be used to stabilize and direct tree roots towards areas with less conflicts (e.g., away from pipes). *See diagram on page 44.*

In addition, large trees should not be planted where they may interfere with overhead lines. GIC updated the city's preferred tree species list that includes details for which species can be planted where. Having an updated, preferred tree species list allows the city to set standards for tree placement and siting within its jurisdiction. For example, some trees thrive in a backyard but not in a parking lot due to heat sensitivity. These and other practices, implemented to provide long term care, protection and best planting practices for the urban forest, will ensure that investments in city trees will pay dividends for reducing stormwater runoff, as well as cleaner air and water, lower energy bills, higher property values and natural beauty long into the future.

o credit: City of Lake Charles

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Lake Charles should u
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tree maintenance records and expenditures as part of the city's asset management system will demonstrate the role trees play as critical green infrastructure.

Lastly, it is recommended that the city conduct a land cover assessment every four years to compare tree canopy change over time and progress towards the 15% coverage goal. Keeping tree canopy coverages at levels that promote public health, walkability, and clean water is vital for livability and for meeting state water quality standards. Regular updates to land cover maps allow for this analysis and planning to take place and to identify and address negative trends as well. These and other practices, implemented to provide long term care, protection and best planting practices for the urban forest, will help ensure that investments in city trees will pay dividends for reducing stormwater runoff as well as clean air and water, lower energy bills, higher property values and natural beauty long into the future.

Photo Credit: Lindsey Janies, courtesy of Lake Charles Southwest Louisiana CVB

r Analysis Methods

r the methodology
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Tree Canopy.

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3. Wooded wetlands were identified based on where NDVI is above 0 OR feature height is above 10 ft and intersects NHD water/wetland.
4. Scrub/Shrub. Spectrally these features appear very similar to tree canopy but do not meet the height requirement to be considered a tree and are above 1 meter in height.
5. Turf/Pervious are features identified as "green" or typically above 0 in NDVI but have a feature height less than 1 meter.
6. Impervious surfaces were created using an object-based recognition tool ArcGIS add-on called Feature Analyst and existing vector data such as road edge and building polygons. These features are typically below 0 on an NDVI.
7. Bare earth and Sand were easily confused with impervious surfaces but typical had a NDVI value closer to 0.

A Confusion Matrix was run to test the accuracy of the canopy data, with these results:

Note: Bare earth is easily mis identified with impervious surfaces. Curve numbers in the TSW Calculator are similar and this does not affect analysis. In some places, sidewalks or golf cart paths were identified as bare earth under canopy. There are few places like this, and the overall area of the class is small – so the percentage may appear high.

The NAIP 2019 image was originally used as the primary input. However, during the course of the project, the 2022 NAIP imagery became available. Therefore the 2019 classification was created using an NDVI image to show where tree canopy had changed (i.e., it went from being 2019 tree canopy to an NDVI value of less than 0, indicating that it had become an impervious feature).

st the accuracy of the canopy data which resulted in ....

es	C_10	C_30	C_50	Total	Urban Canopy Accuracy
ds	26	0	0	26	100.0%
th	2	130	3	137	95.9%
es	0	2	86	88	97.7%
al	28	132	89	251	
cy	92.9%	98.5%	96.6%		96.4%

the landcover layer and relevant data in order to exclude unsuitable tree planting locations or where it would interfere with existing infrastructure.

- Potential Planting Area (PPA)
- Potential Planting Spots (PPS)
- Potential Canopy Area (PCA)

The **Potential Planting Area (PPA)** is created by selecting the landcover features that have space available for planting trees, then eliminating areas that would interfere with existing infrastructure.

Initial Inclusion selected from GIC-created land cover pervious surfaces class.

Exclusion features applied:

- The pervious surfaces were then buffered in 10 ft. from all impervious surfaces including buildings and roads.
- Playing fields (i.e.: baseball, soccer, football) as well as golf courses, cemeteries, airports and other incompatible land uses were then identified where visually possible. (Digitized by GIC)
- Once this initial phase was completed, the Potential Planting Area data were reviewed by the city and manually edited to best represent city expectations of where planting was allowed (e.g., not on play fields). In addition, areas that were known to be planned for development were removed.

This additional work to exclude known areas that cannot be planted resulted in a more accurate and realistic calculation of plantable areas and the number of new trees that can be added.

The **Potential Planting Spots** (PPS) are created from the PPA. The potential planting areas (PPA) are run through a GIS model that selects spots a tree can be planted depending on the size tree's that are desired.

- Tree planting scenarios were based on a 20 ft. and 40 ft. mature tree canopy with a 30% overlap. Therefore, the planting spots are 16 ft. and 32 ft. apart respectively.

The **Potential Canopy Area** (PCA) is 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 trees in the remaining spaces. Planting spots were assigned a buffer of 10 or 20 ft. to result in 20 and 40 ft. tree canopy that overlaps by 30%. This reduces gaps that would be found at the corners of adjacent circles and reflects the reality that trees overhang and intermingle with adjacent trees.

Tree over street

Trees over forest

Tree over lawn

Tree over parking lot

This new approach allows for more detailed assessments of stormwater uptake based on the landscape conditions of the City's forests. It distinguishes whether the trees are within a forest, a lawn setting, a forested wetland or over pavement, such as streets or sidewalks. This is because the conditions and the soils in which the tree is living affect the amount of water the tree can intercept.

The analysis can be used to create plans for where adding trees, or better protecting them, can reduce stormwater runoff impacts and improve water quality. This methodology was developed and tested in 13 communities in the south under a grant from the Southern Region of the USDA Forest Service. For more about the project, please visit: http://www.gicinc.org/trees_stormwater.htm

Photo Credit: Lindsey Janies, courtesy of Lake Charles Southwest Louisiana CVB

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