Utilizing the Urban Forest to Manage Stormwater:

Norcross and Alpharetta, GA

August 8, 2019

Presented at
TREES AS GREEN STORMWATER INFRASTRUCTURE: GA Tree Council

By Karen Firehock
Executive Director

Slide Show Topics

Benefits of Urban Canopy

Trees as Green Stormwater Infrastructure

Stormwater Calculator Tool

Policies and Practices Audit Tool

Land Image Analyst Tool

Summary Findings

The Green Infrastructure Center (GIC) is a nonprofit organization that helps communities evaluate green assets and manage them to maximize ecology, economy and culture.

We do this by:

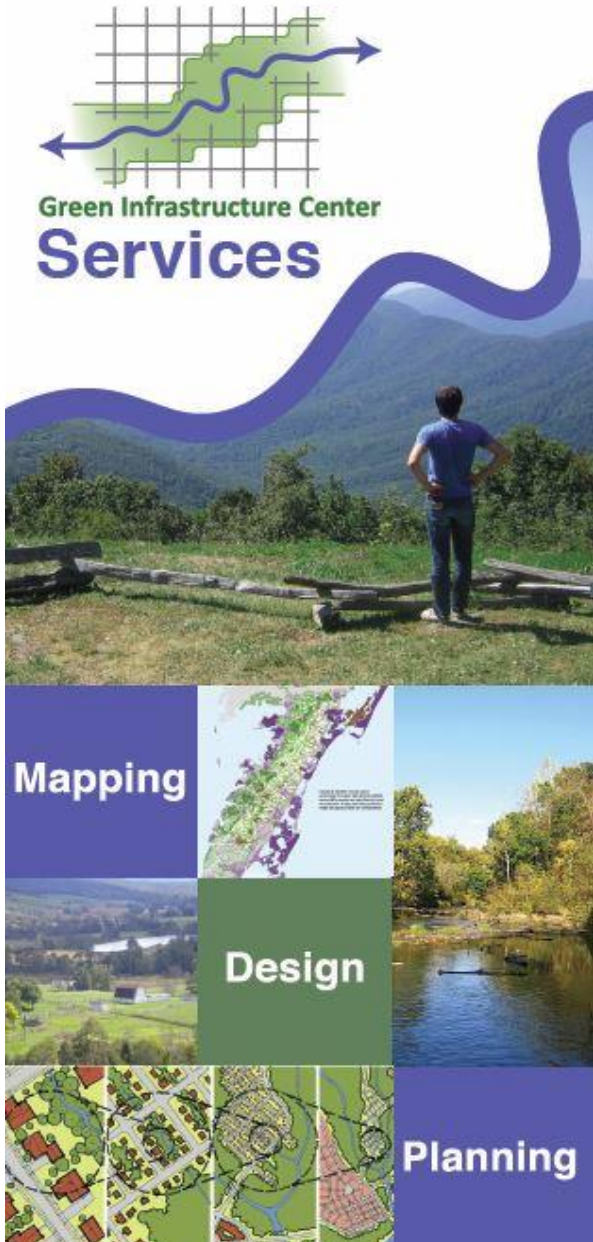
Mapping land cover and urban tree canopy

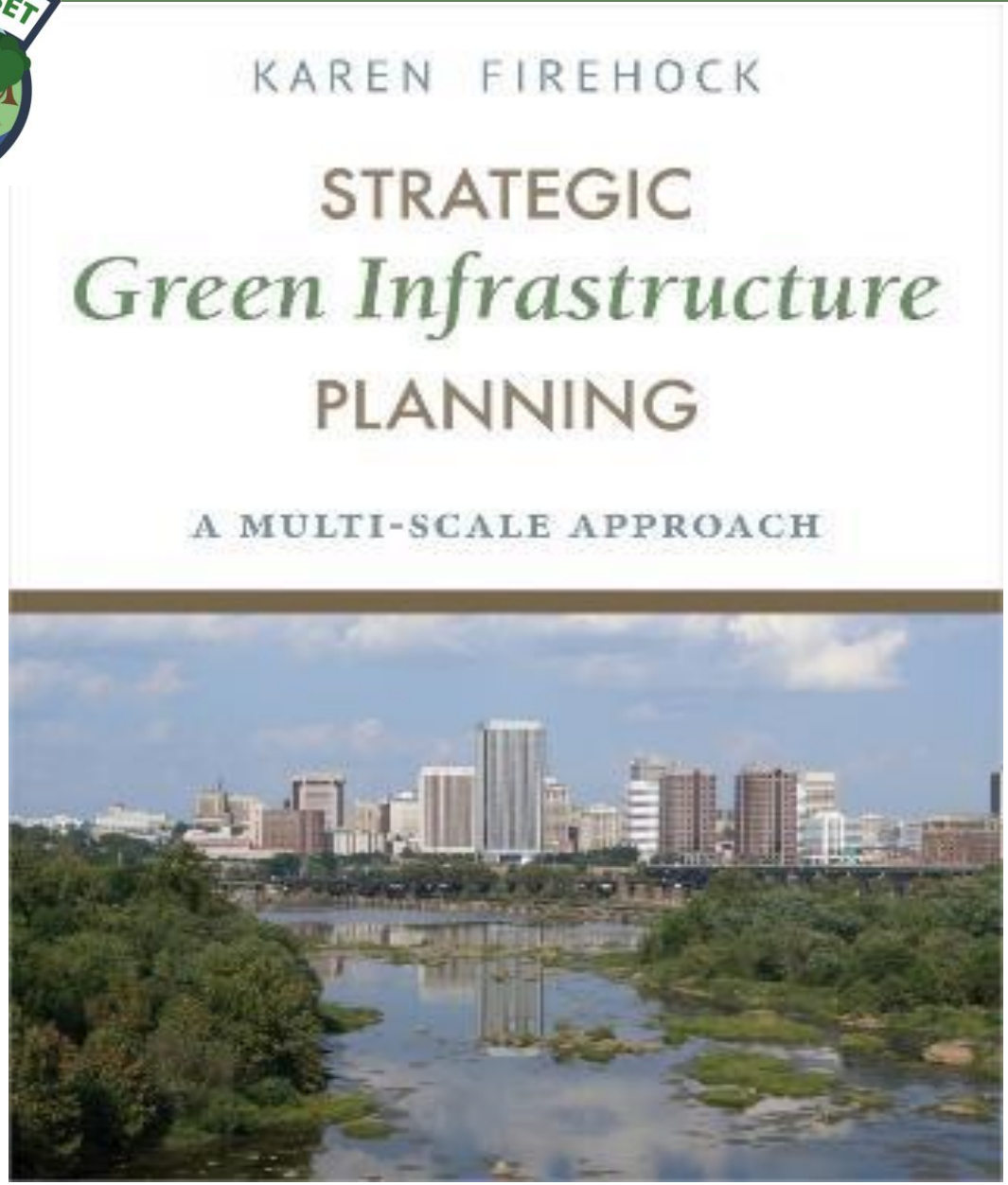
Modeling high value wildland habitats

Creating strategic green infrastructure plans

Writing, teaching and training

www.gicinc.org





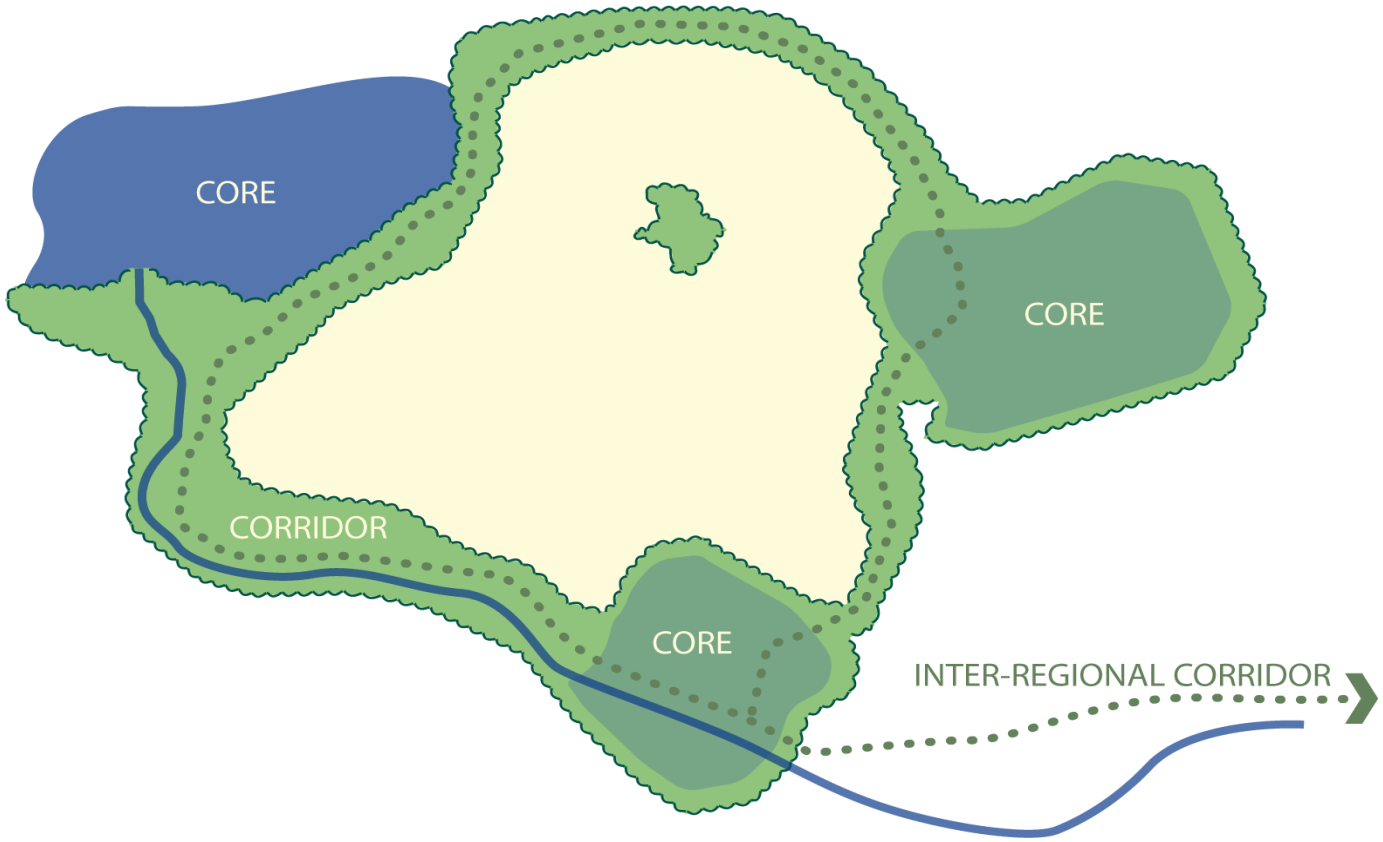
GIC created guides and models for green infrastructure planning at the national, state and county scale.

Our national book available from Island Press (left) has a national focus and more urban examples.

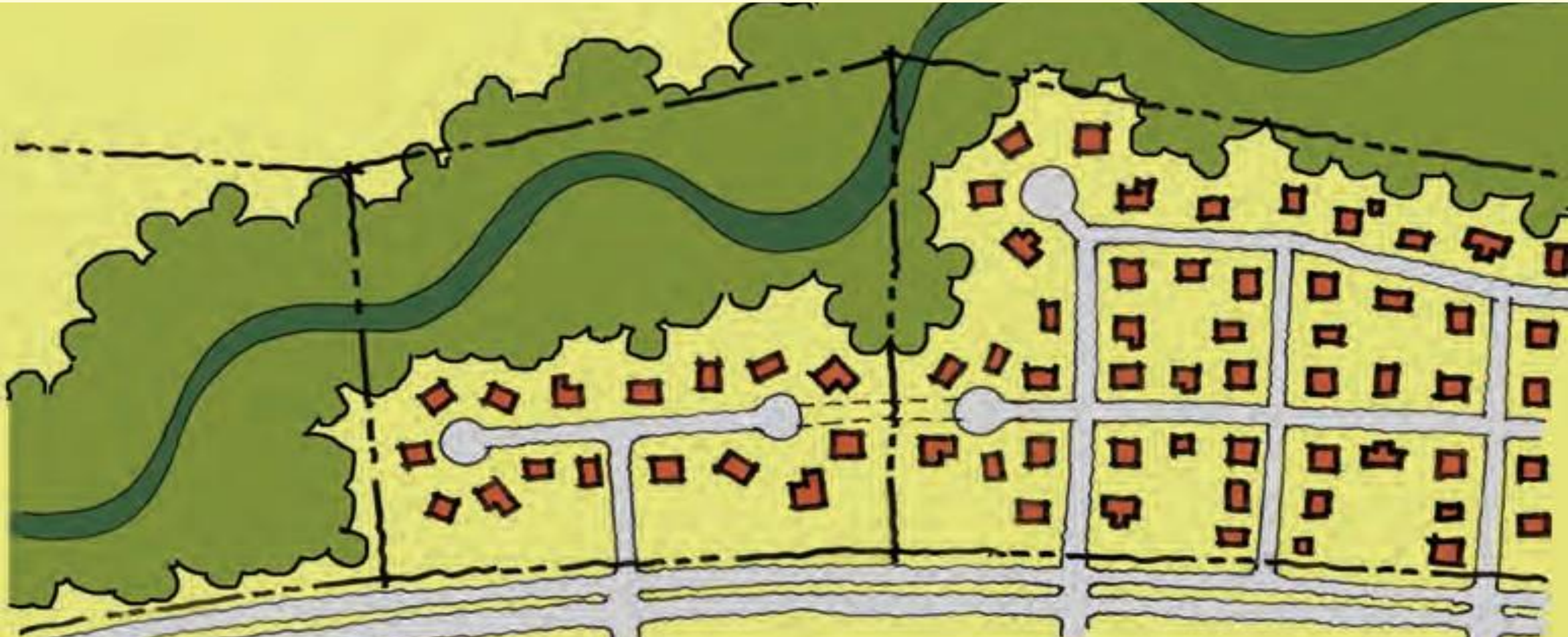
Green Infrastructure Planning Requires Thinking About How to Connect the Landscape

Not just key habitat patches but how we connect them!

The more connected the landscape, the more resilient it is!



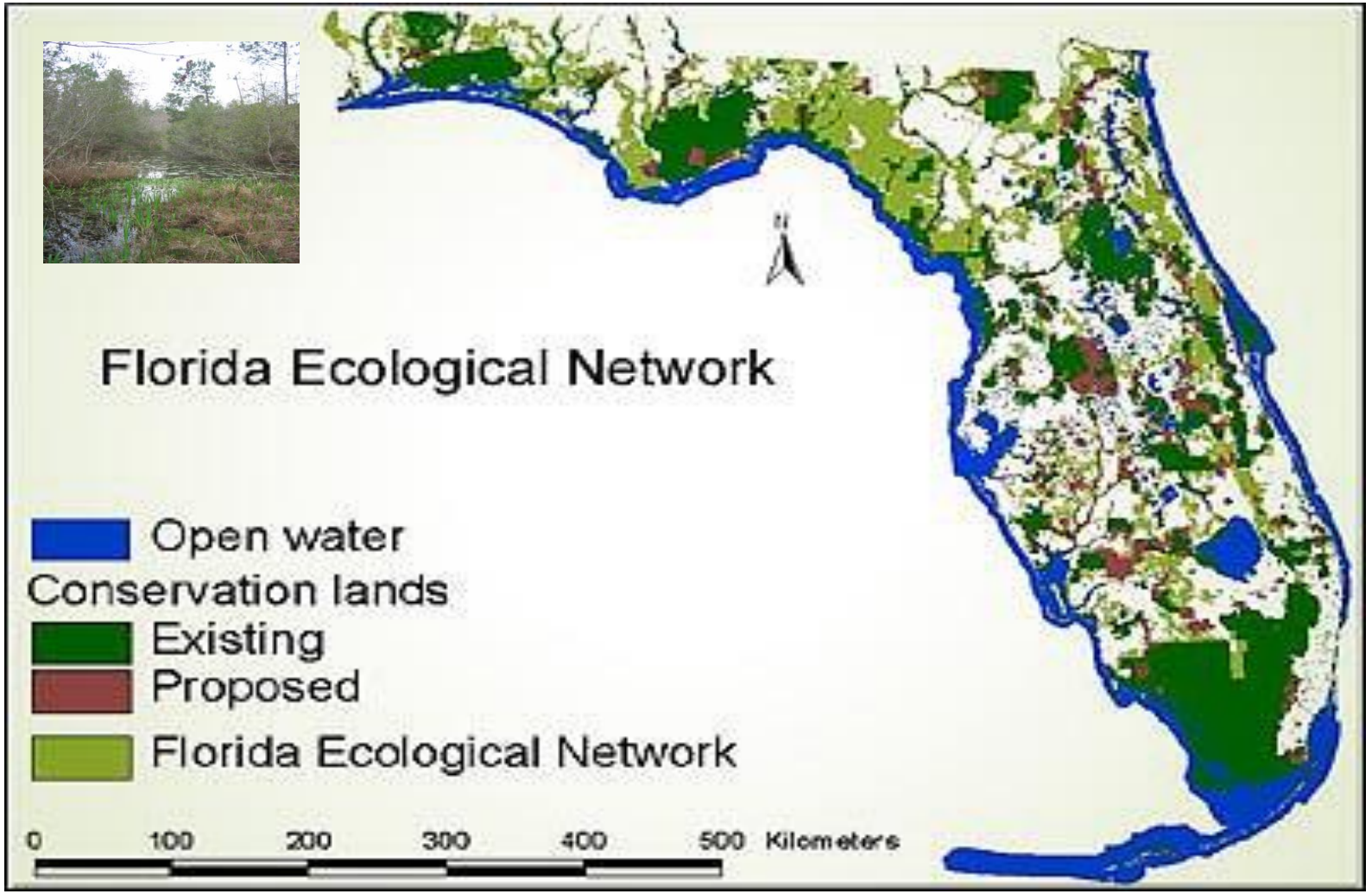
The problem of developments that protect green space without thinking about connections beyond parcel boundaries …



Origin of the Term "Green Infrastructure"

Florida coined the term "Green Infrastructure."
in a *1994* report to the governor on land conservation strategies.

It was intended to reflect the notion that natural systems are important components of our "infrastructure."



Definition: What is green infrastructure?

A map of a city for one of GIC's projects (left) shows a neighborhood's gray infrastructure including buildings and roads. Classified high-resolution satellite imagery (right) adds a green infrastructure data layer (trees and other vegetation) .

Green Infrastructure Definition Expands

In 2006, EPA added Best Management Practices such as raingardens to the definition. We consider this as 'constructed green infrastructure.'

The key is to first consider natural infrastructure (trees, forests, rivers) protect them and connect them, build in the least impactful manner, then mitigate impacts.

So, ***first conservation, then mitigation.***

Rain gardens

Permeable pavers

Filterra Box Biofilter

Trees: Create Healthy Communities

- Access to fitness opportunities. (addresses obesity, nature deficit disorders)
- Clean air – trees absorb pollutants, VOCs, filter runoff, cool the city. (combat asthma)
- Well being and mental health - -people heal faster when they can see or access green. (hospitals need this for patients, reduces absenteeism of workers)
- Less crime occurs near trees. (issue especially for downtowns and public housing areas)
- Employees will exercise if they can access green where they work and on the way to work. (addresses employee health)

Urban Tree Canopy Values

Trees provide more attractive areas for development, historic districts, commercial areas opportunities for people to interact with nature.

A study by the University of Washington found that people shopped longer and more often in tree-lined retail areas and spent about 12 percent more money.

Trees = more tax revenue even in developed commercial districts!

Job Development

Small companies, especially those that are have well paid and skilled workforce place a strong importance on the "green" of the local environment.
Crompton Love and Moore, 1997

The creative class: artists, media, lawyers, analysts, make up 30 percent of the U.S. workforce and they place a premium on outdoor recreation and access to nature. Florida, 2002

Trees and parks attract better paid jobs and thus a better tax base = $

Trees to Offset Stormwater Project

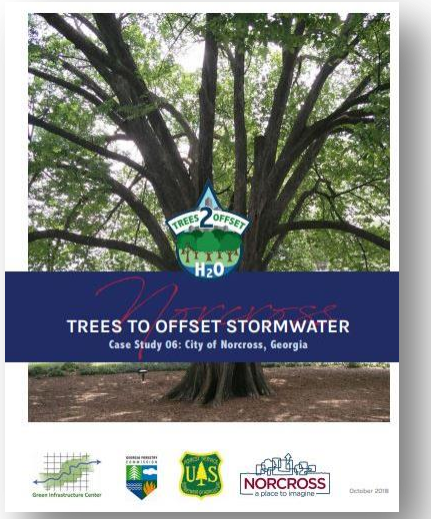
GIC partnered with forestry agencies in 6 states to show how the urban forest can be utilized to manage stormwater.

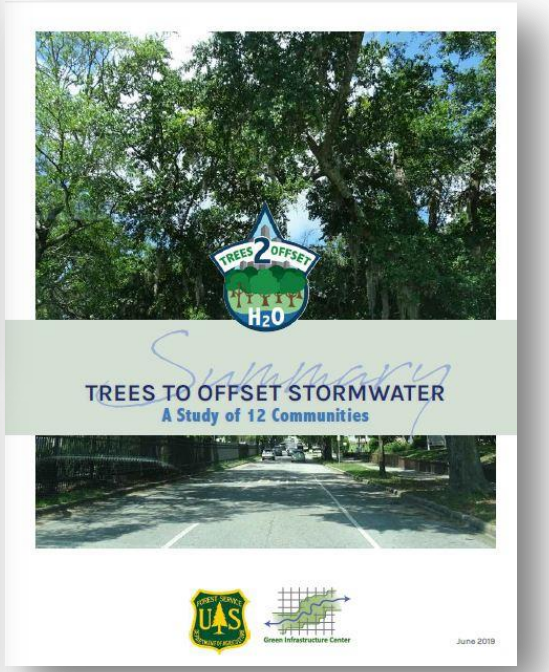
Funded by the southern region of the USDA Forest Service.

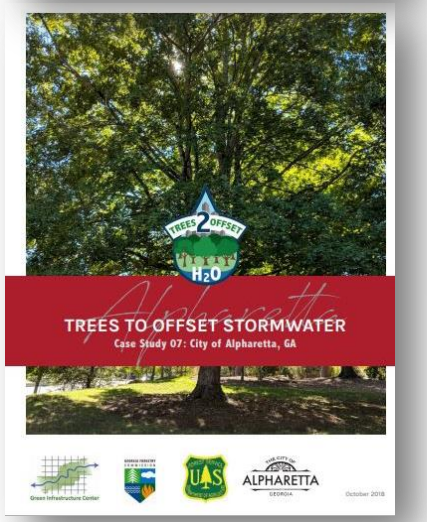
6 southern states:
FL, AL, GA, SC, NC, VA

GA Cities: Norcoss and Alpharetta

Project Outcomes







- Map cities' urban forest and possible planting areas.
- Link urban forests to stormwater management.
- Calculate stormwater uptake by trees
- Recommend new programs, codes, processes to integrate trees as part of stormwater management
- Sharing the work – city case booklet
- Final report summarizes best practices

Find project case booklets and final report at:
http://www.gicinc.org/trees_stormwater.htm

Trees: the original – and best – green infrastructure!

Trees give us cleaner air, shade, beauty and stormwater benefits at a cost that is far cheaper than engineered systems!

Estimates for the amount of water a typical street tree can intercept in its crown, range from 760 gallons to 4000 gallons per tree per year, depending on species.

Most stormwater goes directly to streams!
When stormwater goes under the buffer, it is not cleansed.

=

Results of too much runoff …

- Severely eroding banks
- Silt covers stream bottom, unstable bars
- Large debris flows and flood debris on banks
- Lack of vegetation
- Strange odors, colors
- Toxics, lack of fish or invertebrates

Debris flows & erosion

Streambank failure

Water flow strategies

How do we make this…

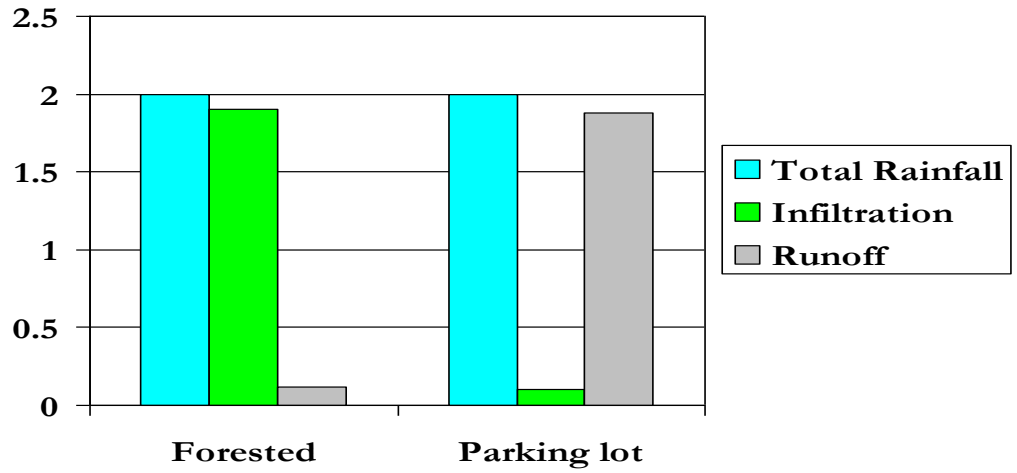
function like this?

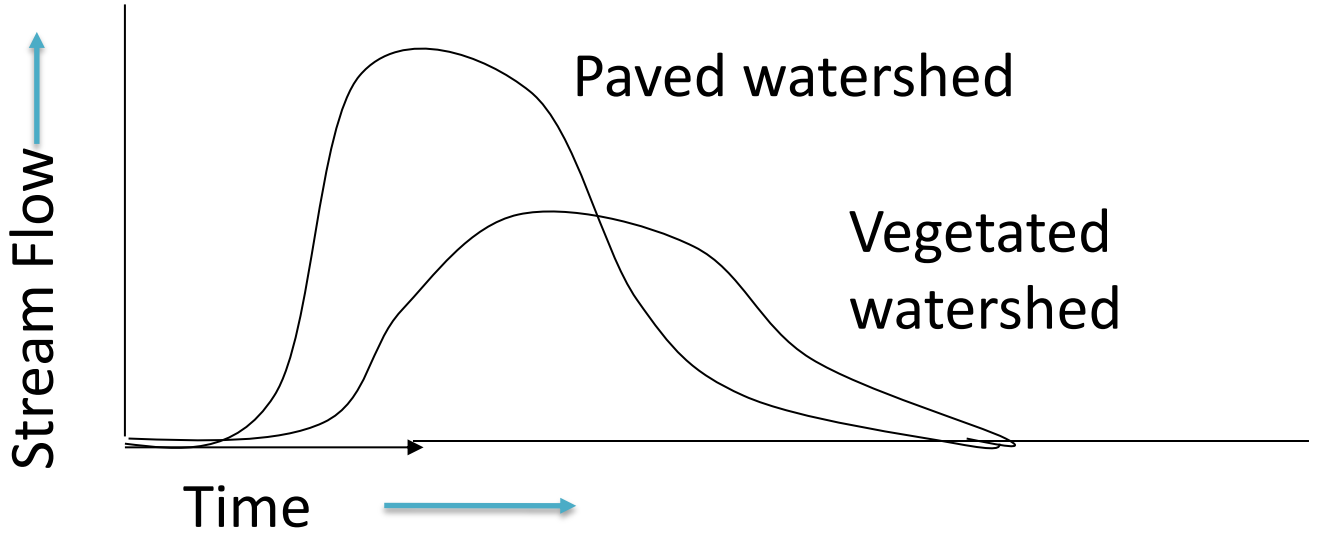
Paved Areas Can Cause Extreme Flows

1. Impervious surfaces prevent rain infiltration, causing greater runoff volume and velocity.

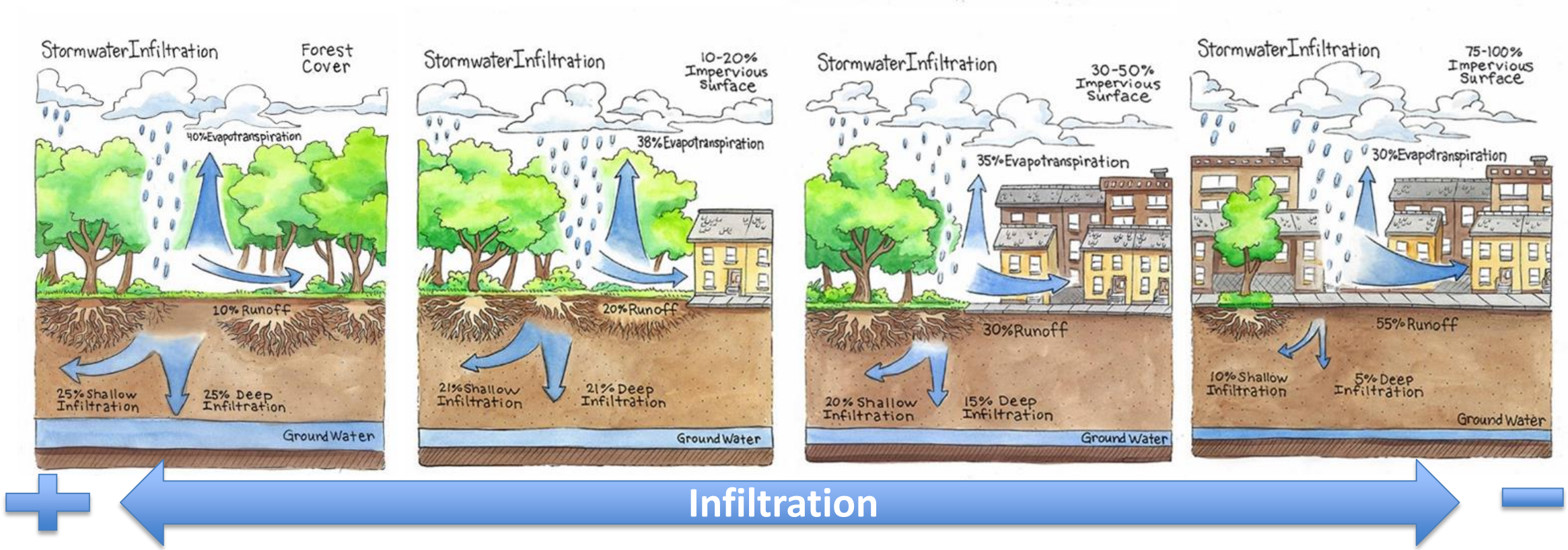
2. Storm flows peak sooner in the stream at higher volumes.

3. Higher volumes and velocities of runoff lead to more flooding and damages – the firehose effect!





As land cover changes, so does stormwater infiltration …



This parking lot could be retrofitted so we get less of this …

One acre of pavement releases 36 times more runoff than a forest.

During a rainfall event of one inch, one acre of forest will release 750 gallons of runoff, while a parking lot will release 27,000 gallons.

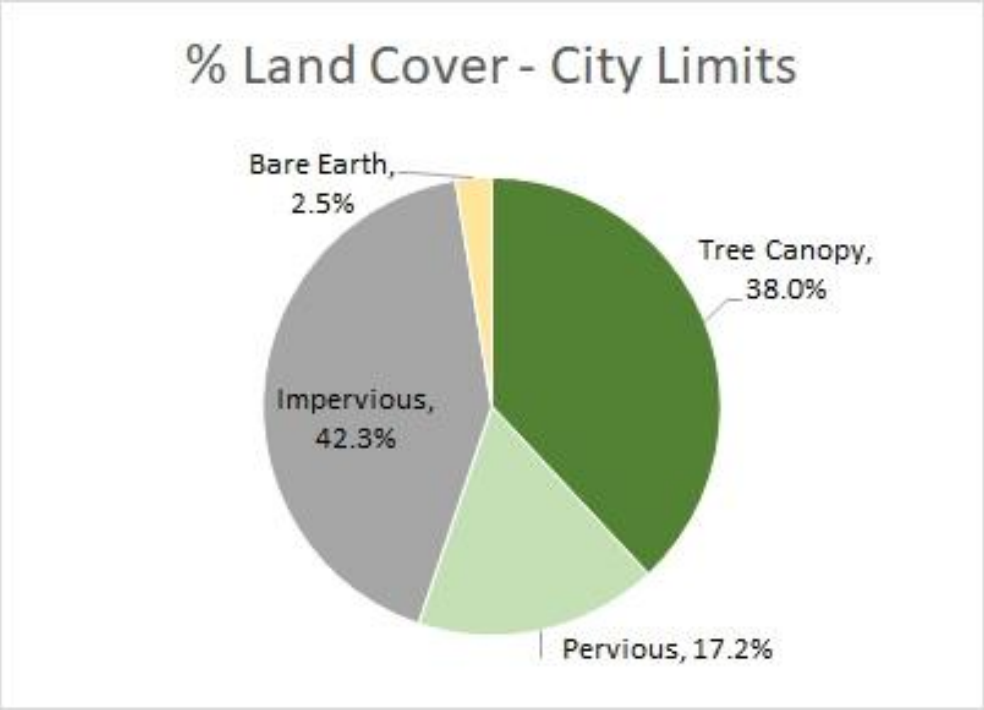
(PennState Extension).

Flooding in Alpharetta

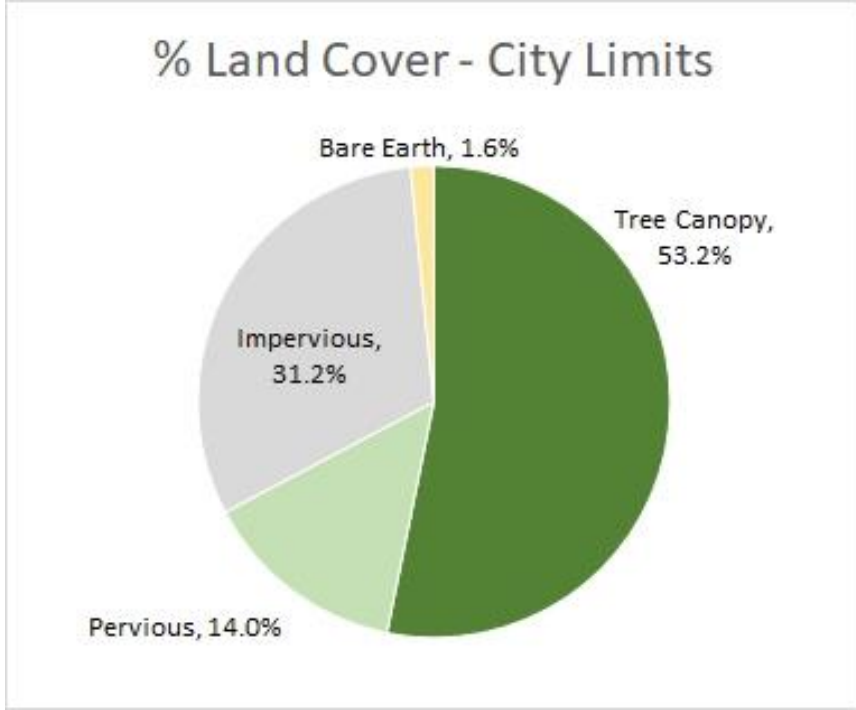
How Much Canopy Do We Have? Using Image Classification

Image classification is the process of breaking an image into spatial land coverages (including tree canopy, other vegetation, impervious surfaces such as buildings, streets and parking lots).

Norcross, GA Example Tree Cover

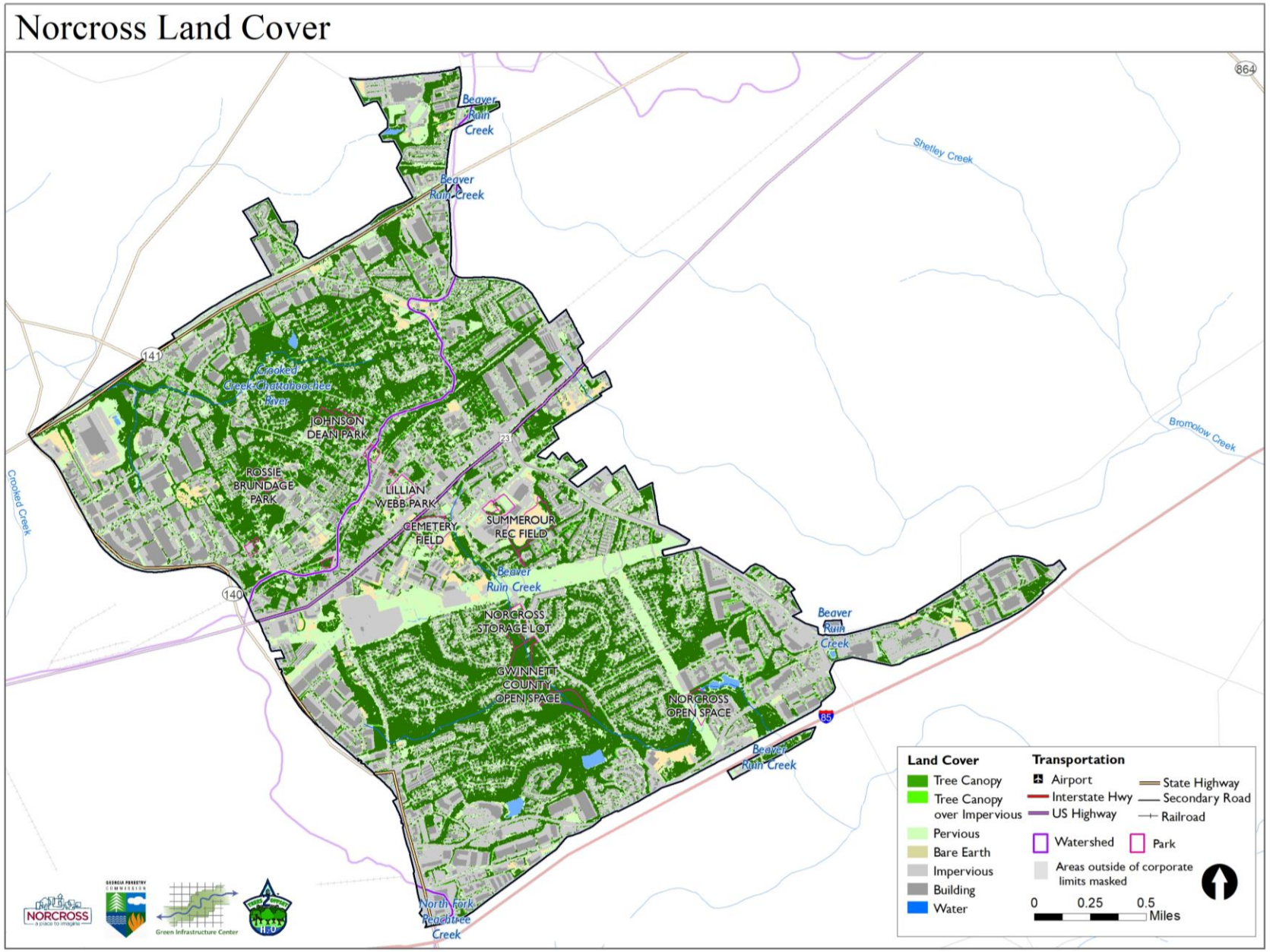


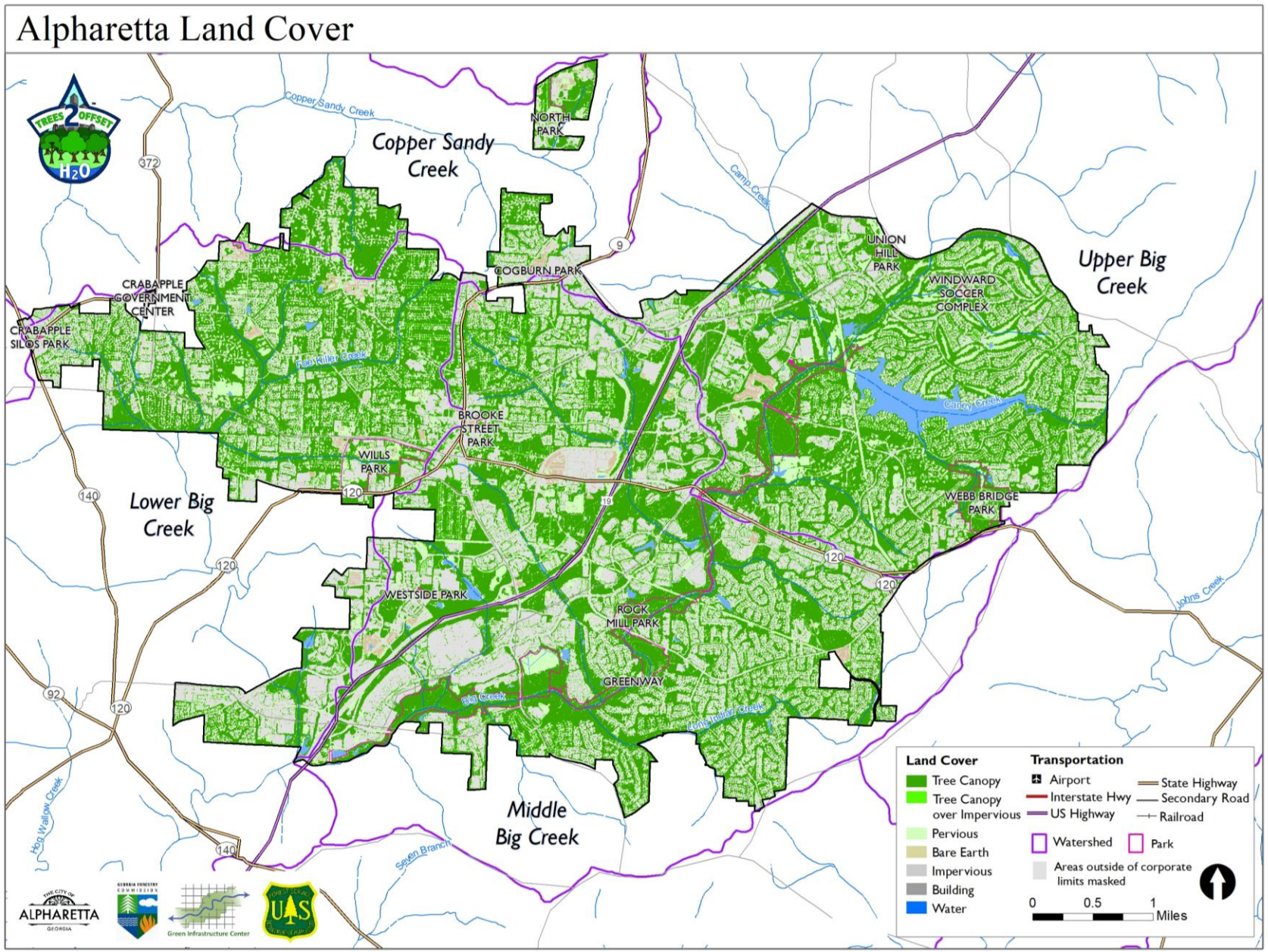
Alpharetta, GA Example Tree Cover



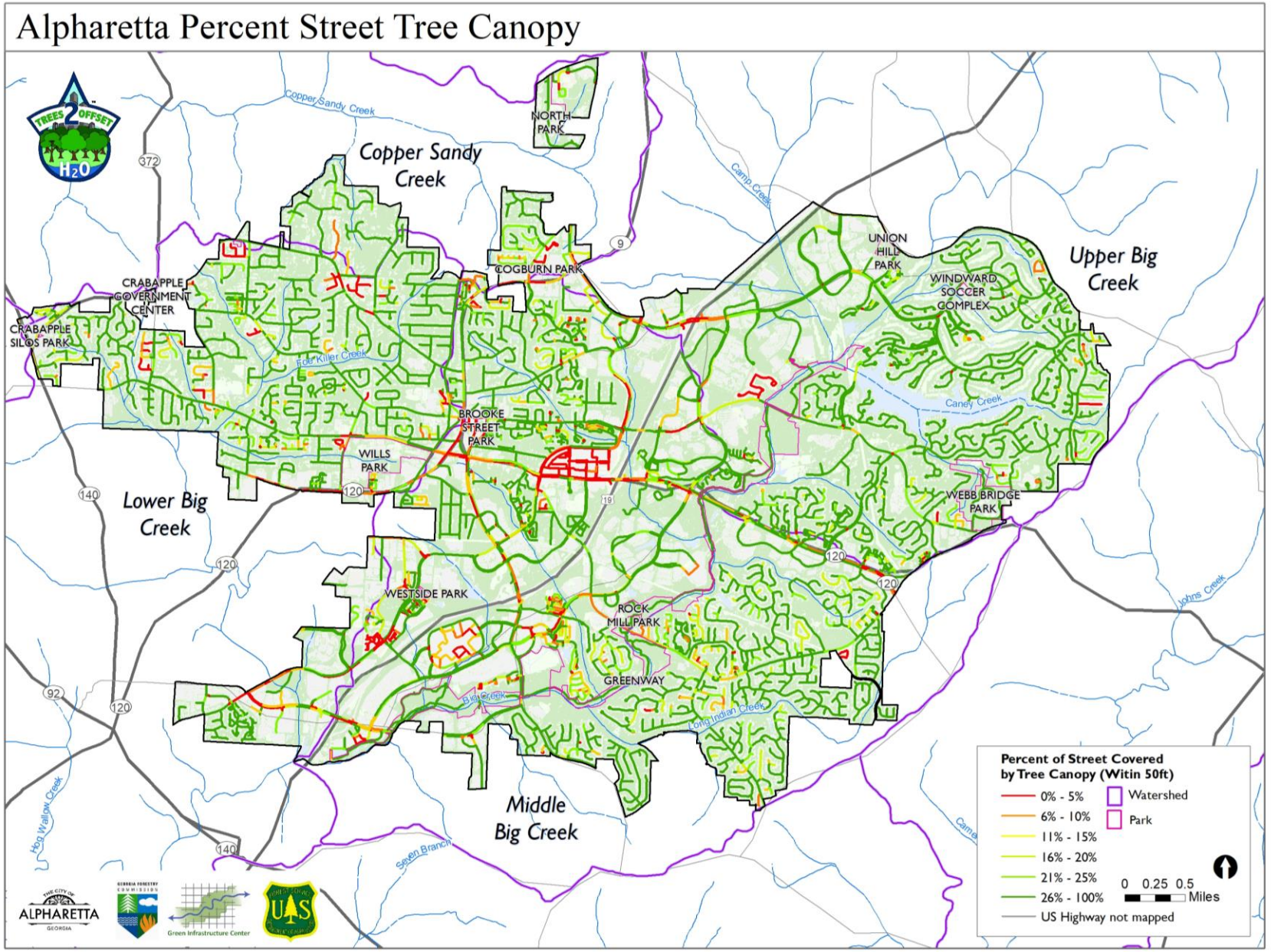
We mapped each community's canopy.

Norcross Land Cover

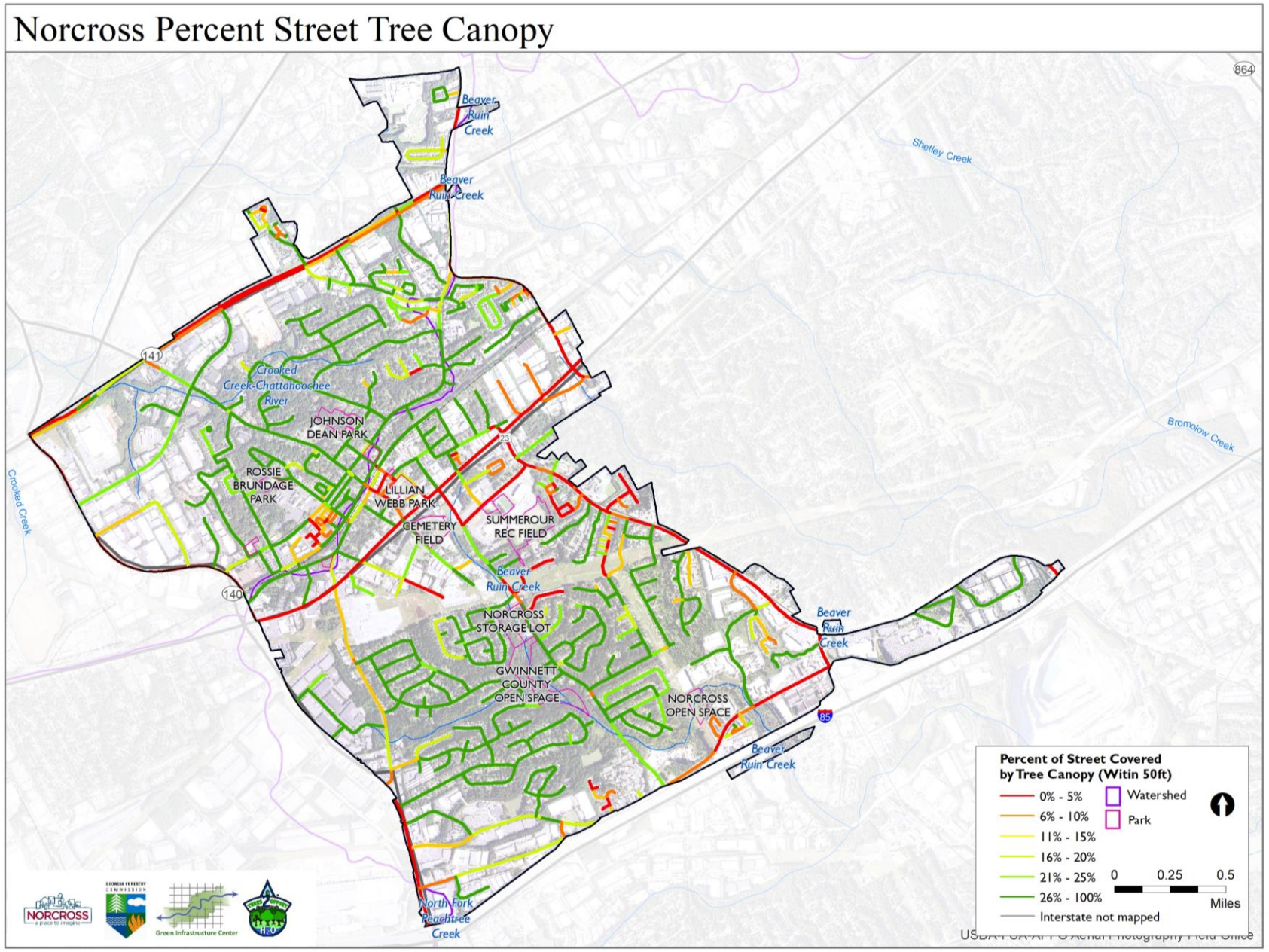



Alpharetta Land Cover
Copper Sandy Creek
Upper Big Creek
Lower Big Creek
Middle Big Creek
NORTH PARK
COGBURN PARK
UNION HILL PARK
WINDWARD SOCCER COMPLEX
CRABAPPLE GOVERNMENT CENTER
CRABAPPLE SILOS PARK
BROOKE STREET PARK
WILLS PARK
WEBB BRIDGE PARK
WESTSIDE PARK
ROCK MILL PARK
GREENWAY
Camp Creek
Cat Killer Creek
Canoy Creek
Johns Creek
Big Creek
Long Killer Creek
Hog Wallow Creek
Seven Branch
Land Cover
Tree Canopy
Tree Canopy over Impervious
Pervious
Bare Earth
Impervious
Building
Water
Transportation
Airport
Interstate Hwy
US Highway
State Highway
Secondary Road
Railroad
Watershed
Park
Areas outside of corporate limits masked
0
0.5
1
Miles

How green are the city's streets in Alpharetta?

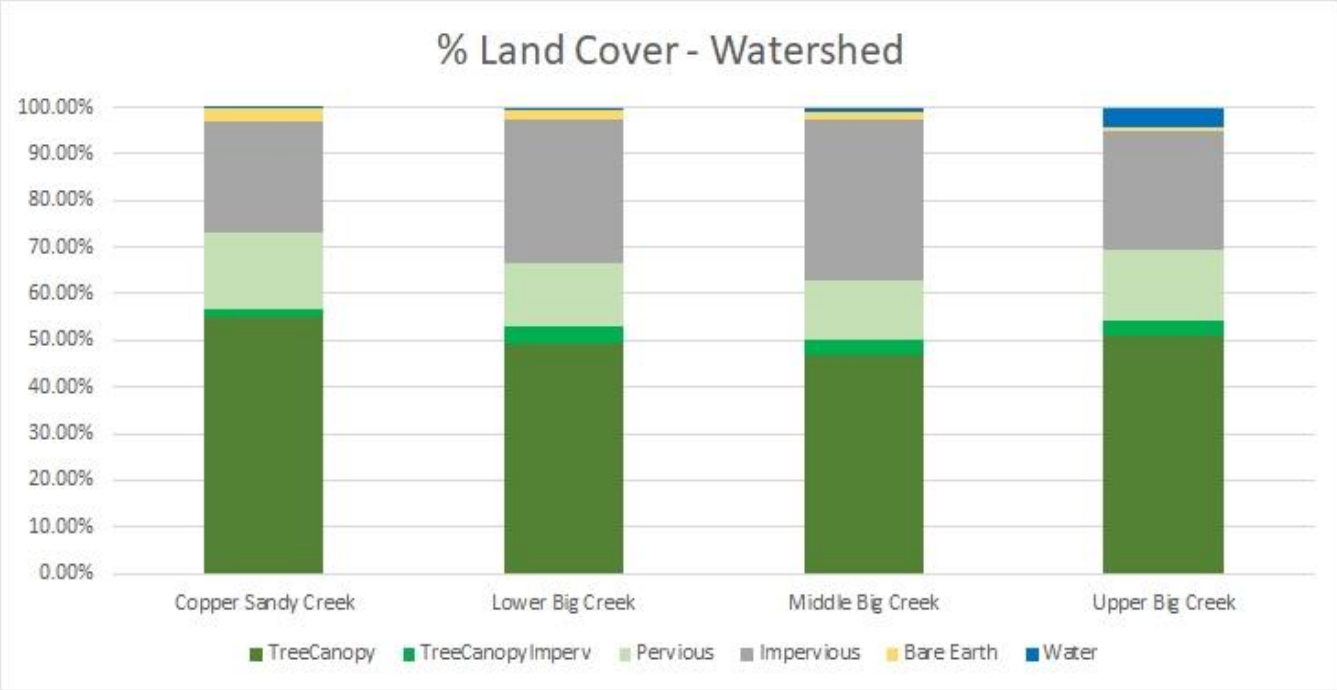


How green are the city's streets in Norcross?

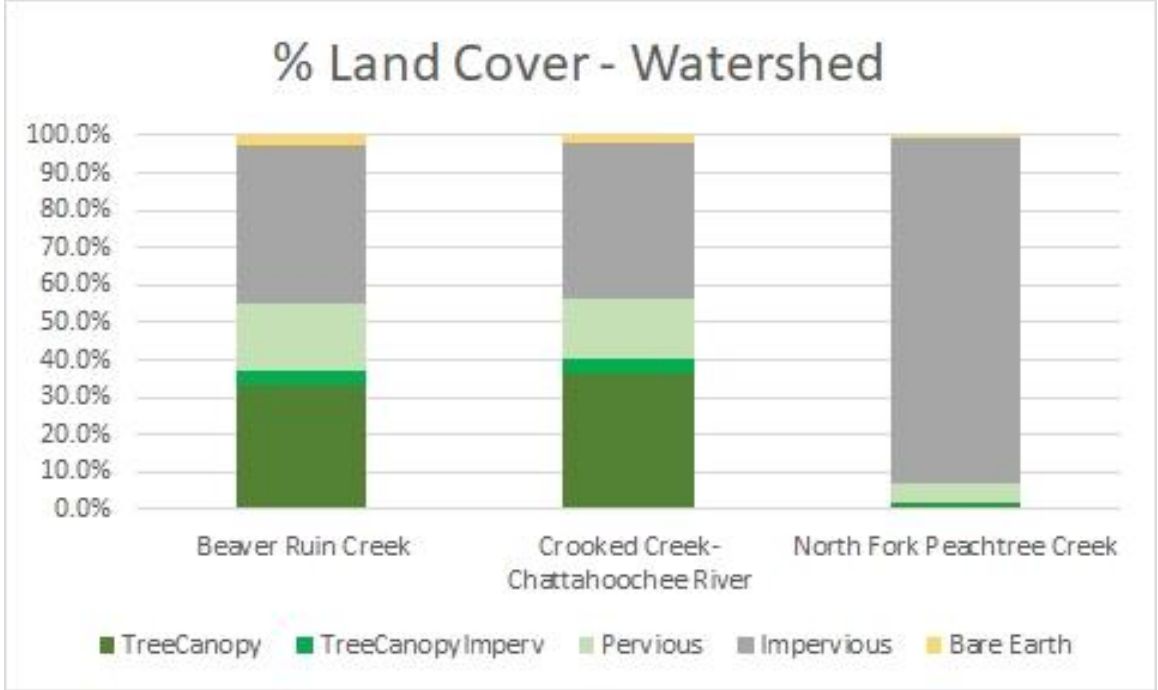


Land Cover

Alpharetta



Norcross



What would it take to reach certain canopy goals?

Percent of PPA Covered	New TC (Sq. Ft.)	New AOI TC %	Small Trees	Medium Trees	Large Trees	Total Trees
1%	750,777	26.82%	466	289	153	908
2%	1,501,554	26.98%	933	579	307	1,819
3%	2,252,331	27.15%	1,399	869	460	2,728
4%	3,003,108	27.31%	1,866	1,158	614	3,638
5%	3,753,885	27.47%	2,333	1,448	767	4,548
6%	4,504,661	27.64%	2,799	1,738	921	5,458
7%	5,255,438	27.80%	3,266	2,027	1,075	6,368
8%	6,006,215	27.97%	3,733	2,317	1,228	7,278
9%	6,756,992	28.13%	4,199	2,607	1,382	8,188
10%	7,507,769	28.30%	4,666	2,896	1,535	9,097
11%	8,258,546	28.46%	5,133	3,186	1,689	10,008
12%	9,009,323	28.63%	5,599	3,476	1,843	10,918
13%	9,760,100	28.79%	6,066	3,765	1,996	11,827
14%	10,510,877	28.96%	6,533	4,055	2,150	12,738
15%	11,261,654	29.12%	6,999	4,345	2,303	13,647
16%	12,012,431	29.29%	7,466	4,634	2,457	14,557
17%	12,763,207	29.45%	7,932	4,924	2,611	15,467
18%	13,513,984	29.62%	8,399	5,214	2,764	16,377

Possible Planting Area

Mapped open space shows where trees can be planted to soak up stormwater.

Possible Planting Area (PPA)

Potential planting area data

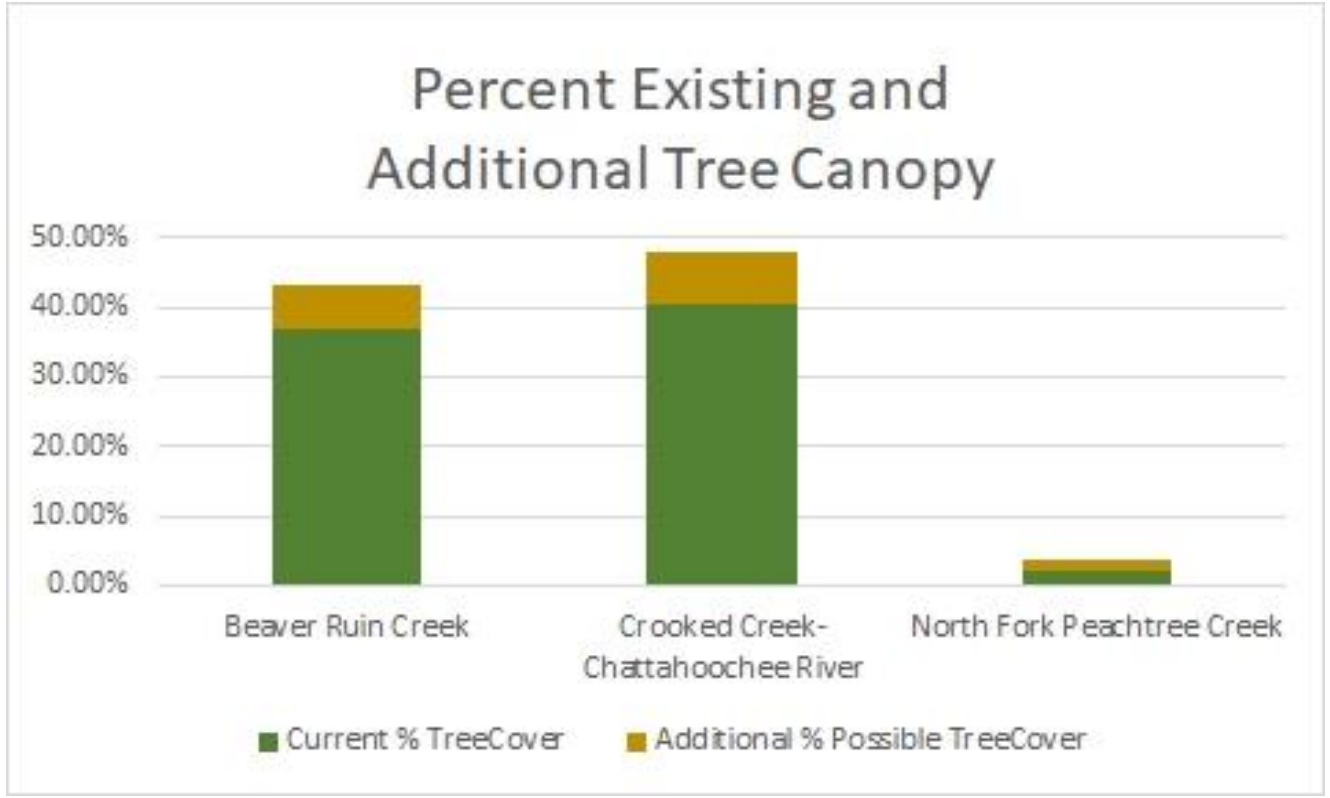
NAIP Image

Possible Planting Area (PPA)

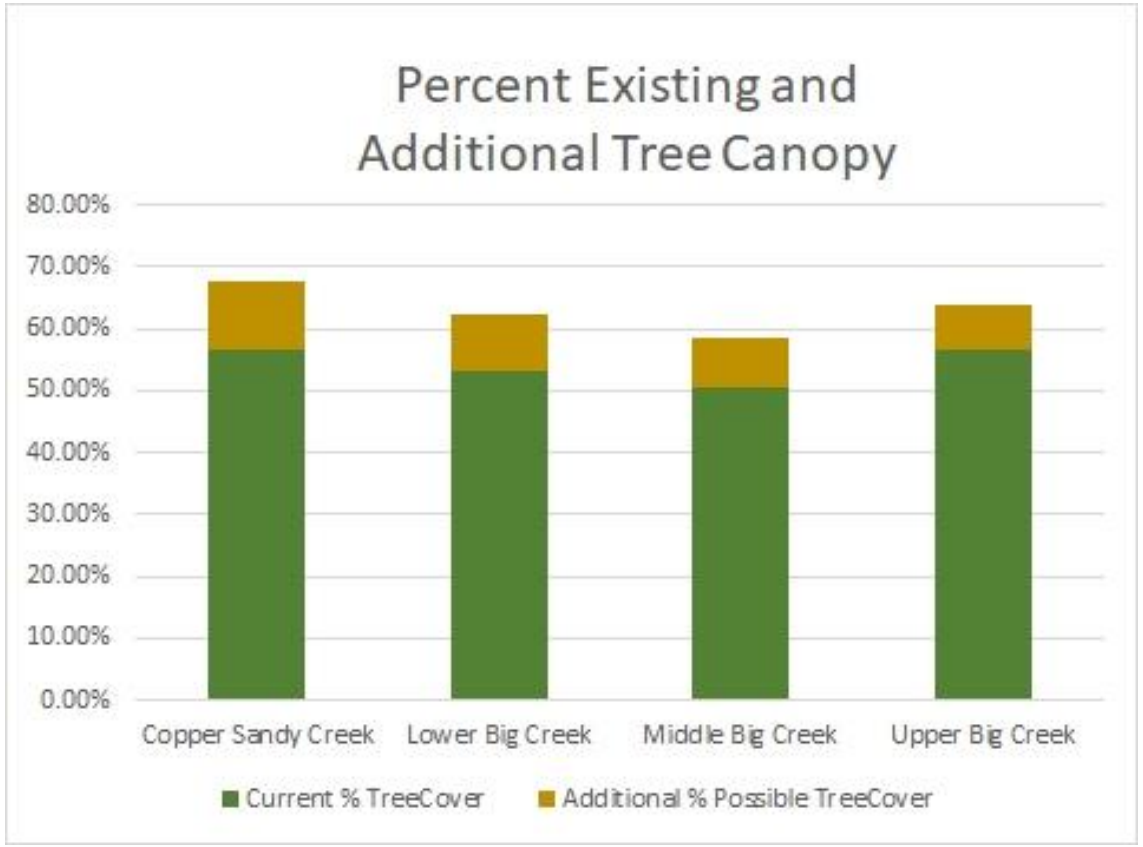
Possible Planting Spots (PPS)*

Possible Canopy Area (PCA)

Results:



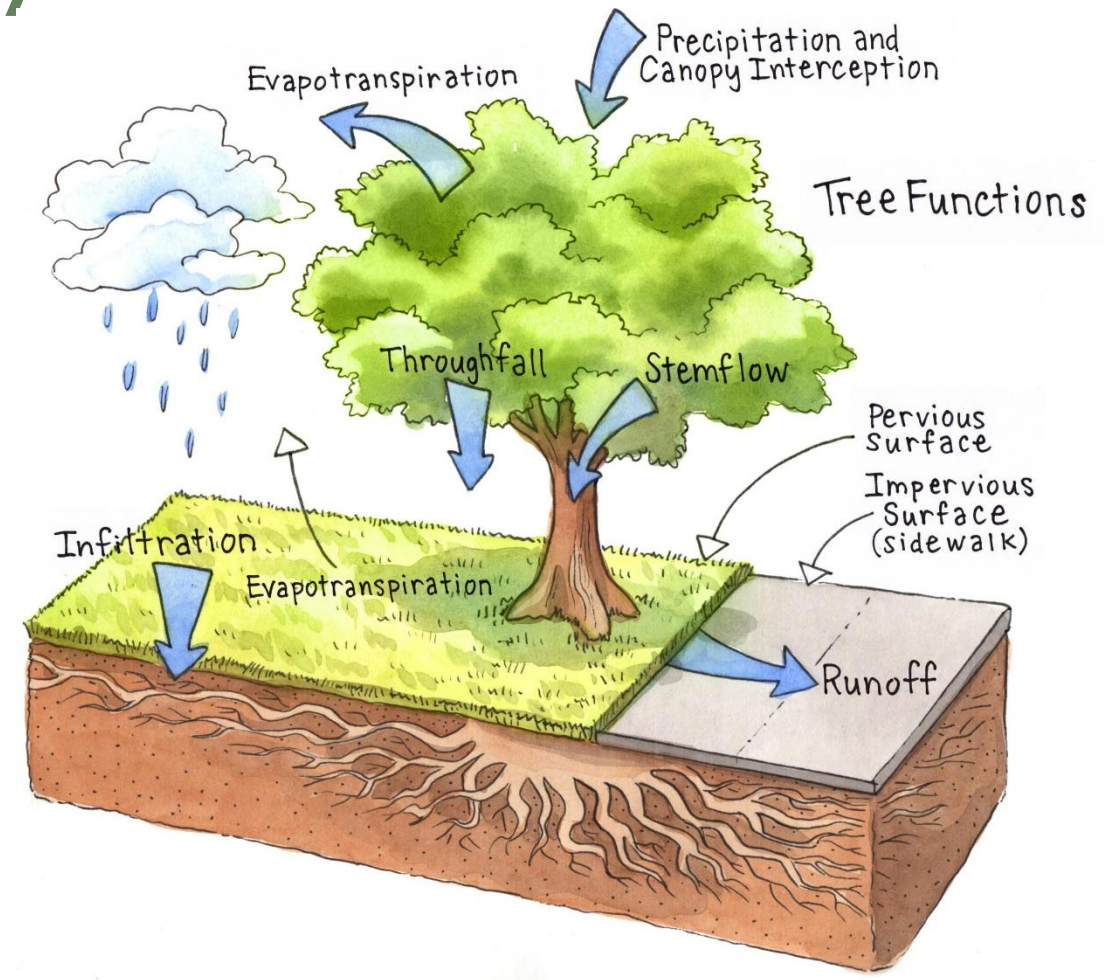
Norcross



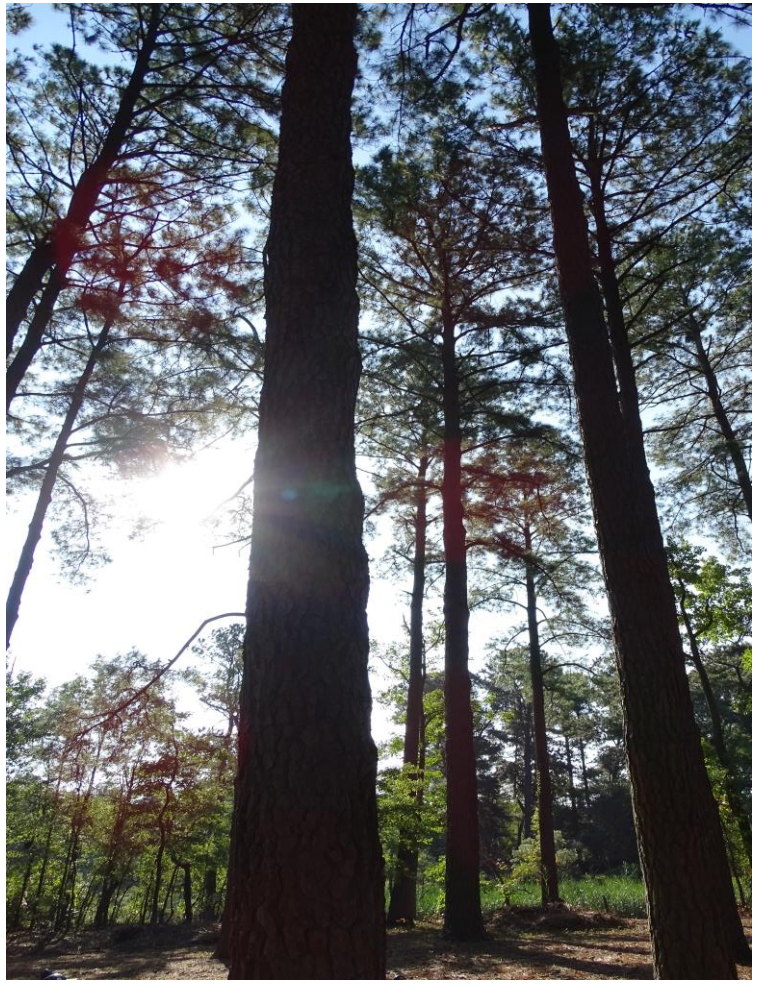
Alpharetta

Urban Tree Canopy and Water

- 20% of annual rainfall or > retained in crown (Xiao et al., 2000)
- Delays runoff up to 3.7 hours
- ↑ infiltration capacity of soils



How much stormwater do the trees take up?



Benefits are typically modeled on a tree-by-tree basis. We need to be able to apply benefits on a per unit area basis…

We need to analyze trees based on the conditions of the setting and soils by watershed.

Forestry Work Group Study

Tree canopy reduces the proportion of precipitation that becomes stream and surface flow, also known as *water yield*. The Hynicka and Divers study (2016) modified the water yield equation of the NRCS model by adding a canopy interception term (C_i), resulting in:

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

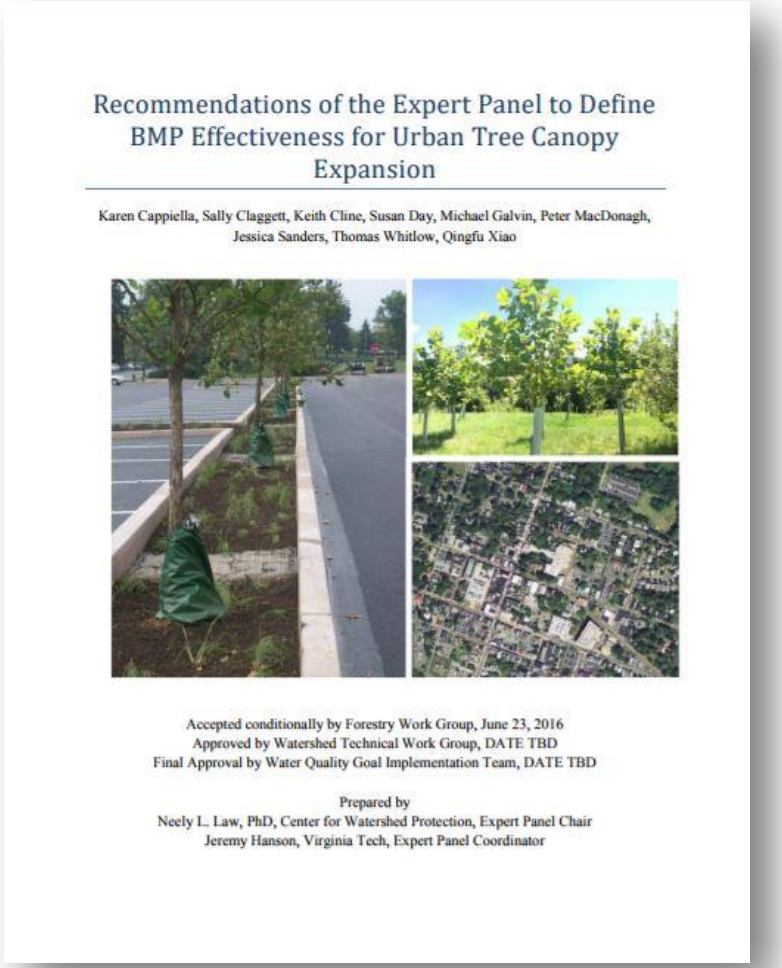
Where R is runoff

P is precipitation

I_a is the initial abstraction,

S is the potential maximum retention after runoff begins for the subject land cover.

(S = 1000/CN – 10)



Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion

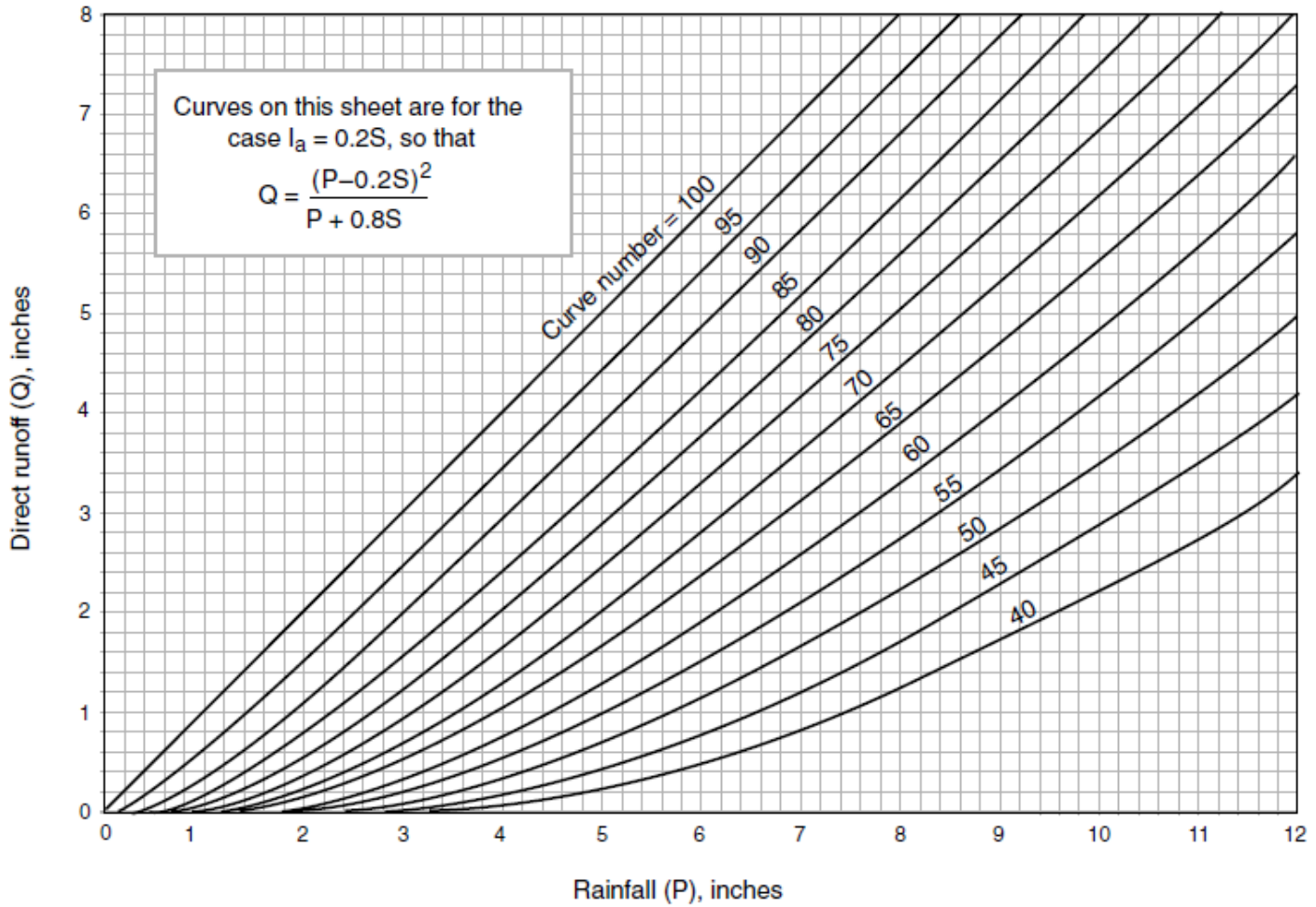
Karen Cappiella, Sally Claggett, Keith Cline, Susan Day, Michael Galvin, Peter MacDonagh, Jessica Sanders, Thomas Whitlow, Qingfu Xiao

Accepted conditionally by Forestry Work Group, June 23, 2016
Approved by Watershed Technical Work Group, DATE TBD
Final Approval by Water Quality Goal Implementation Team, DATE TBD

Prepared by
Neely L. Law, PhD, Center for Watershed Protection, Expert Panel Chair
Jeremy Hanson, Virginia Tech, Expert Panel Coordinator

The NRCS Runoff Curve Number (CN)

- ✓ A coefficient used to estimate runoff from precipitation, accounting for losses due to canopy interception, surface storage, evaporation, transpiration and infiltration
- ✓ Curve numbers have been developed for a variety of land covers and soil conditions



Curve Number Selection

Major factors determining CN are

- ❑ The hydrologic soil group (defined by surface infiltration rates and transmission rates of water through the soil profile, when thoroughly wetted)
- ❑ Land cover types
- ❑ Hydrologic condition – density of vegetative cover, surface texture, seasonal variations
- ❑ Treatment – design or management practices that affect runoff

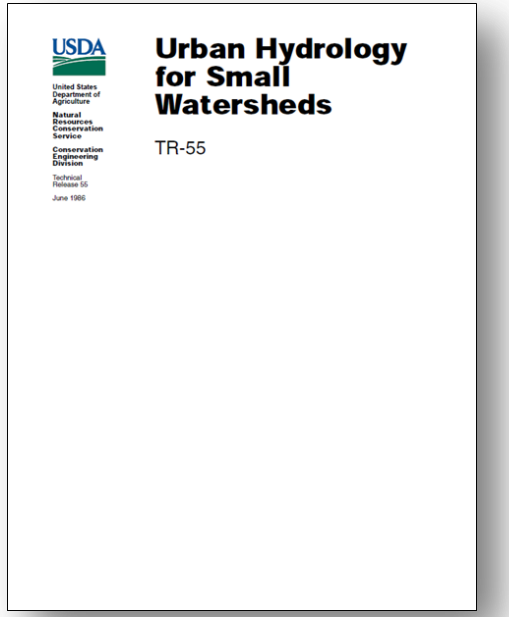
The parking lot curve # is about 98 while below it's 40. Higher curve #s = more runoff.

Tree Over Parking Lot

Tree Over Street

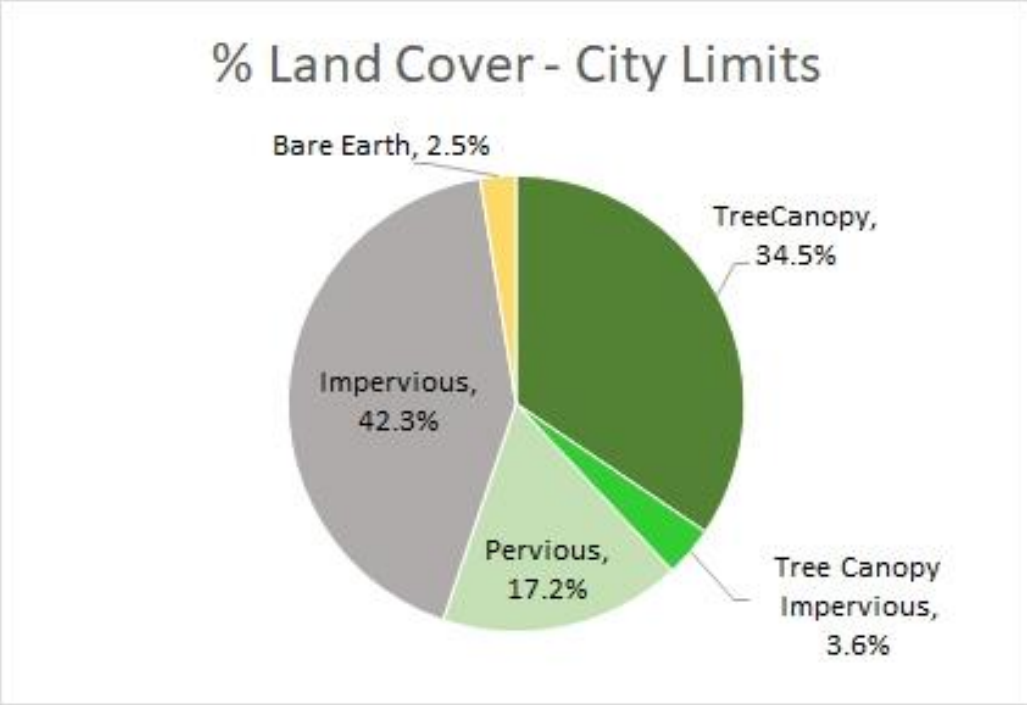
Tree Over Lawn

Tree Over Natural Forest Cover

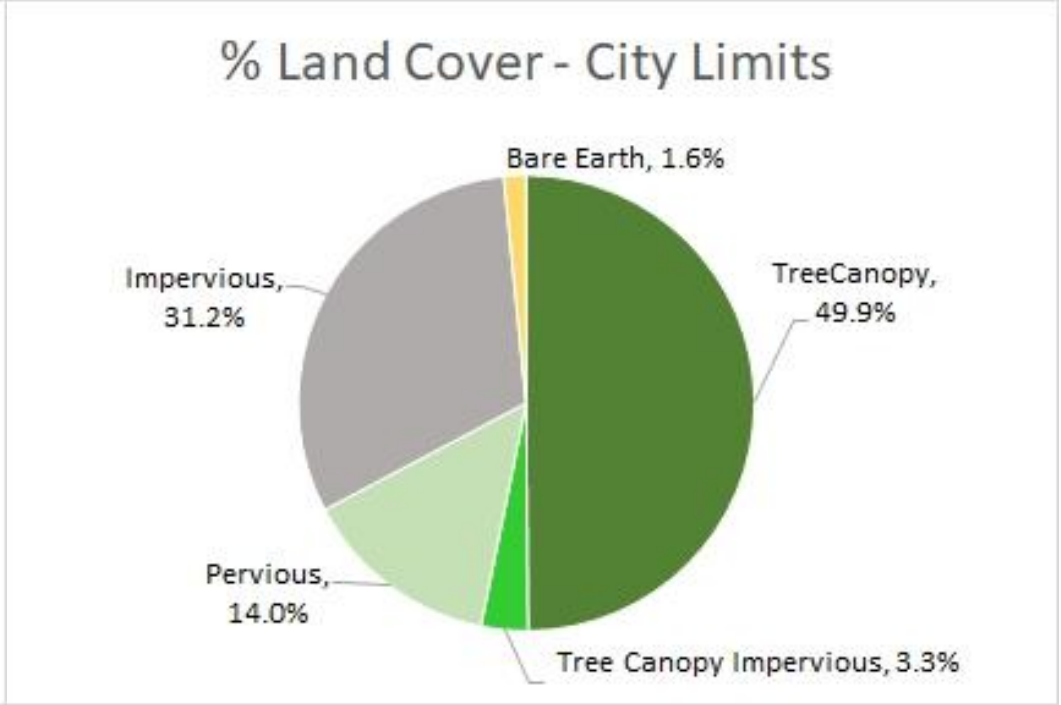


Trees take up more or less water depending on their settings so our high resolution 1 meter x 1 meter maps account for conditions of the urban forest.

Norcross, GA Modified Tree Cover



Alpharhetta, GA Modified Tree Cover



We modified land cover to account for understory land cover.

The GIC's stormwater calculator uses land cover and soils to model the benefit of maintaining or increasing urban canopy.

Alpharetta, Georgia, USA — **Urban Tree Canopy Stormwater Model** — version July 2, 2019

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.

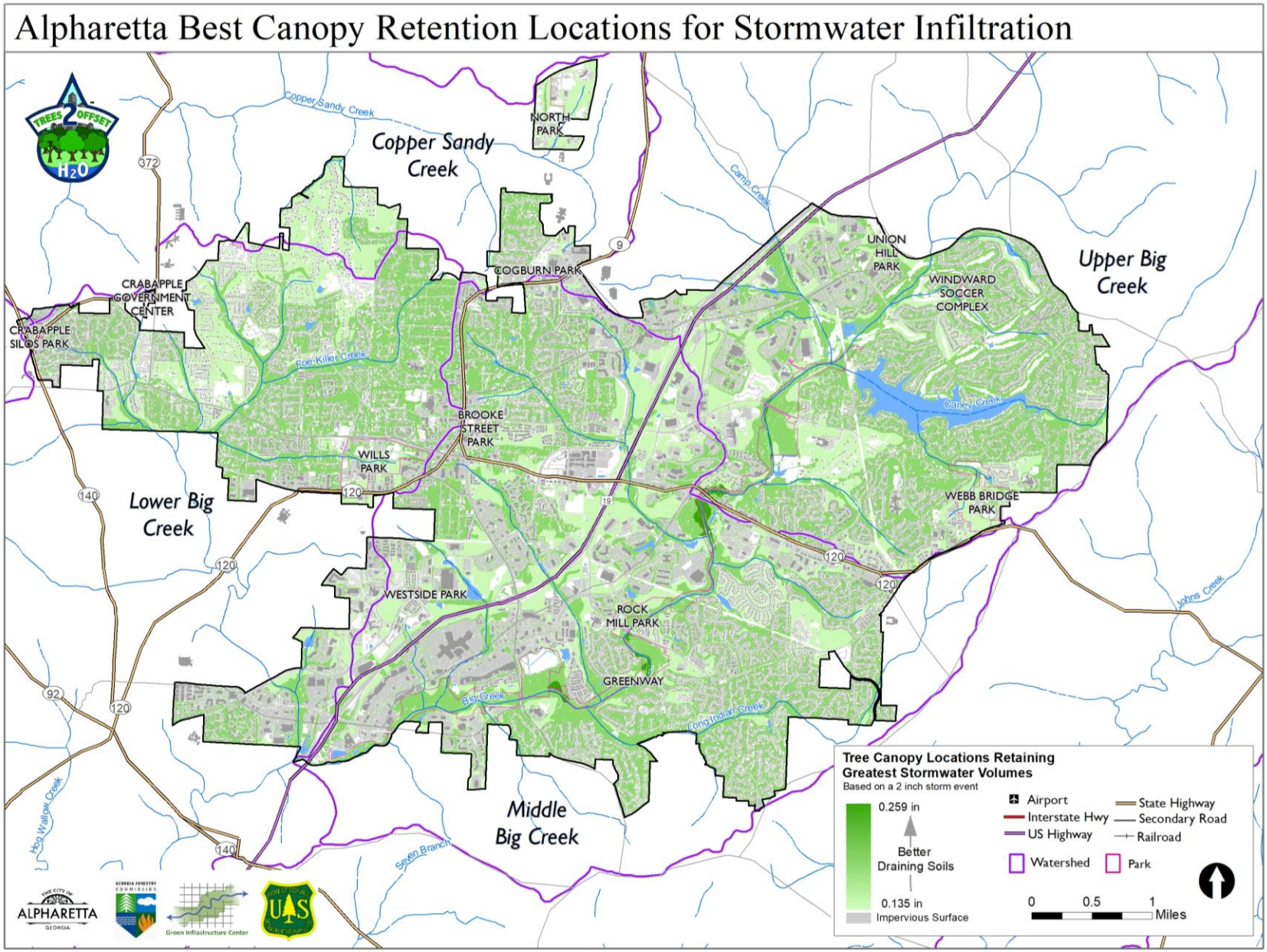
					million gallons												
	TOTALS	53.2%	31.1%	41.4	28.3	1.7	57.3%										
	Statistics by Drainage Basin (current settings)							Variable									
	Area	Current Tree Cove	Current Imperviou Cover	Tree H_20 Capture	Increased H_2O w/xx% tree loss	Added H2O Capture w/xx% PPA	Tree Cover Goal	Pick an Event	Pick a loss scenario		Converted Land					Canopy Added	
		%		million gallons			%	Event	% UTC loss	% FOS Loss	% Imperv	PCA	PPA	% of Land			
1	Copper Sandy Creek	56.8%	23.7%	2.1	1.50	0.11	62%	1 yr / 24 hour	10%	10%	40%	67.8%	11.0%	5.5%			
2	Lower Big Creek	53.3%	30.8%	9.1	6.33	0.41	58%	1 yr / 24 hour	10%	10%	40%	62.2%	8.9%	4.4%			
3	Middle Big Creek	50.7%	35.0%	17.8	11.96	0.72	55%	1 yr / 24 hour	10%	10%	40%	58.6%	7.9%	4.0%			
4	Upper Big Creek	56.5%	26.7%	12.4	8.49	0.42	60%	1 yr / 24 hour	10%	10%	40%	64.1%	7.6%	3.8%			

The stormwater calculator also shows the reductions or additions of nitrogen, phosphorus and sediment runoff astrees are lost or gained.

		19241	22	1553	31	1306	23	2086	3	108	3	102	2
	Variable	Statistics by Drainage Basin (current settings)											
Canopy Added	Enter % to be planted	Non-Point Pollution Captured by Existing Trees (% = percent of total load without trees)						Change in Pollution Load from Landuse Variables (% = percent increase or decrease of total load)					
% of Land	% of PPA	N lbs/yr	N (%)	P lbs/yr	P (%)	SED t/yr	SED (%)	N lbs/yr	N (%)	P lbs/yr	P (%)	SED t/yr	SED (%)
5.5%	50%	3,206	27	261	34	193	20	332	4	17	3	12	2
4.4%	50%	12,547	21	1,010	29	912	21	1,275	3	65	3	60	2
4.0%	50%	25,363	21	2,048	30	1,705	21	2,754	3	142	3	132	2
3.8%	50%	17,706	25	1,431	34	1,184	27	1,985	4	104	4	105	3

All planted areas are not equal…

Optimal Tree Retention Locations



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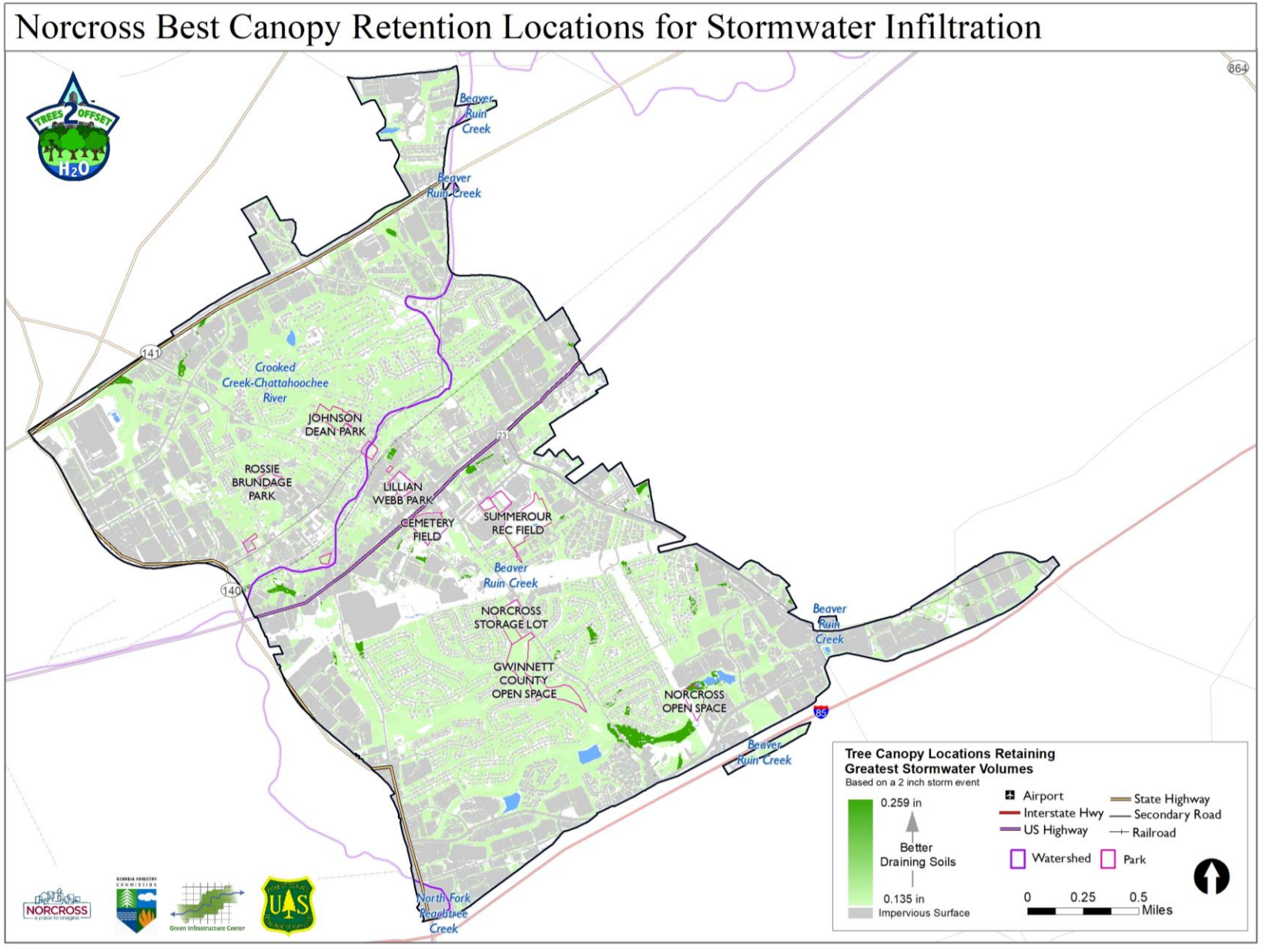
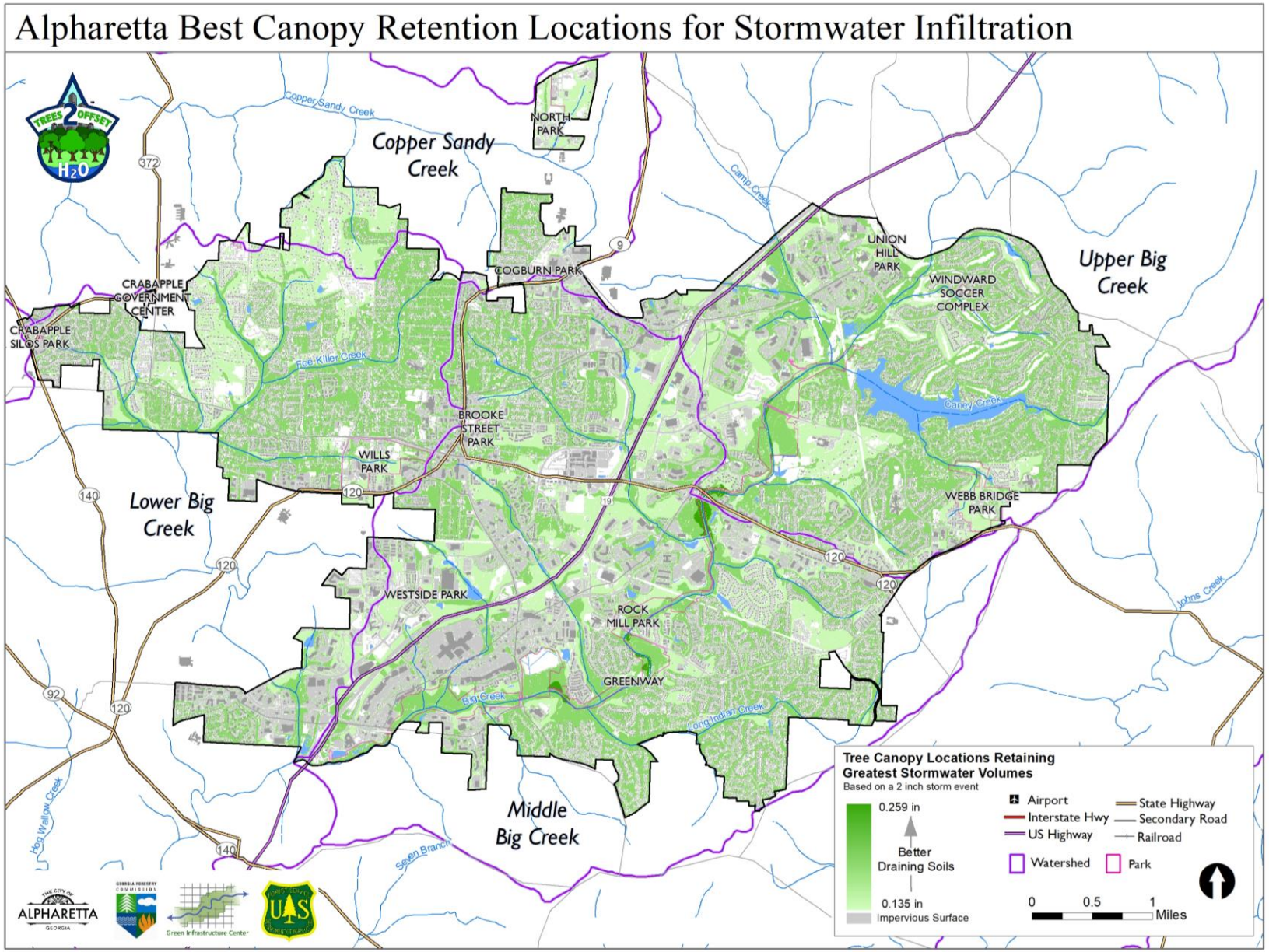


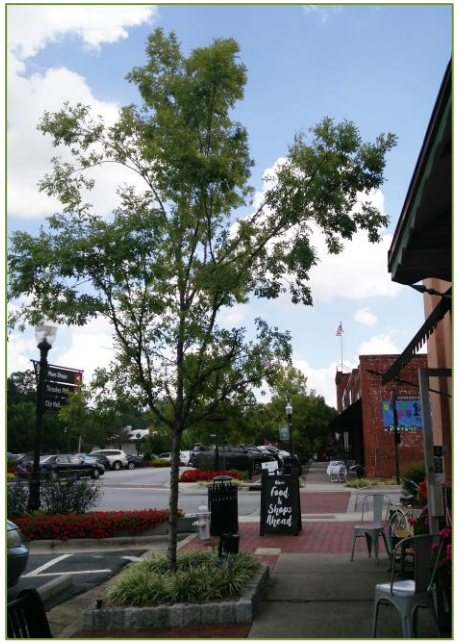
All potential planting areas are not equal…

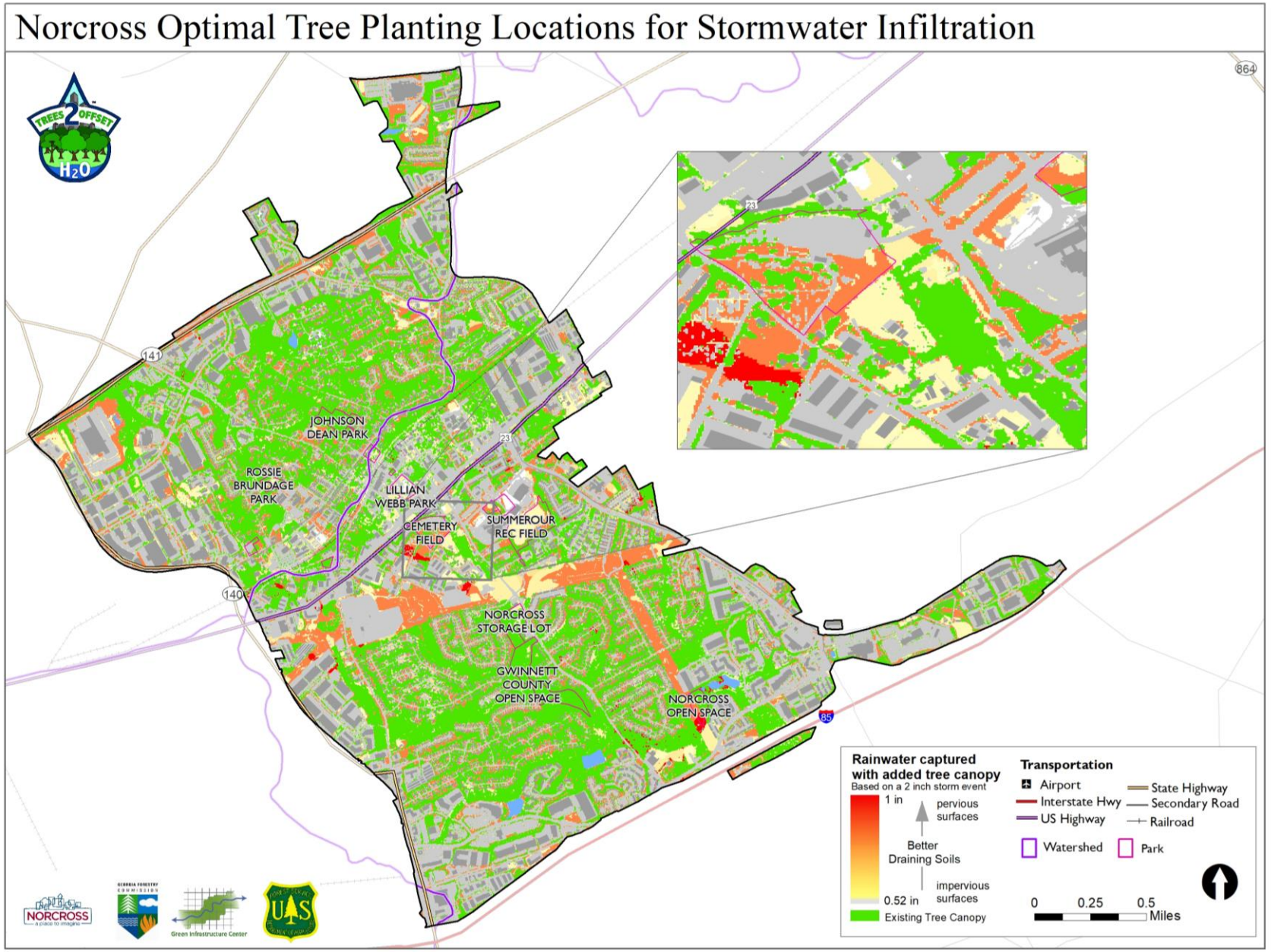
Optimal Tree Planting Locations



All potential planting areas are not equal…

Optimal Tree Planting Locations





How do we increase stormwater infiltration and use trees to help?

The Codes, Ordinances and Forest Practices Audit Tool (COFPAT) answers two questions:

Do city policies allow too much impervious area and runoff?

Does the city mandate excessive parking area, overly wide streets?

Does the city provide incentives to reduce impervious area?

Can the city manage and expand the urban forest to soak up more water?

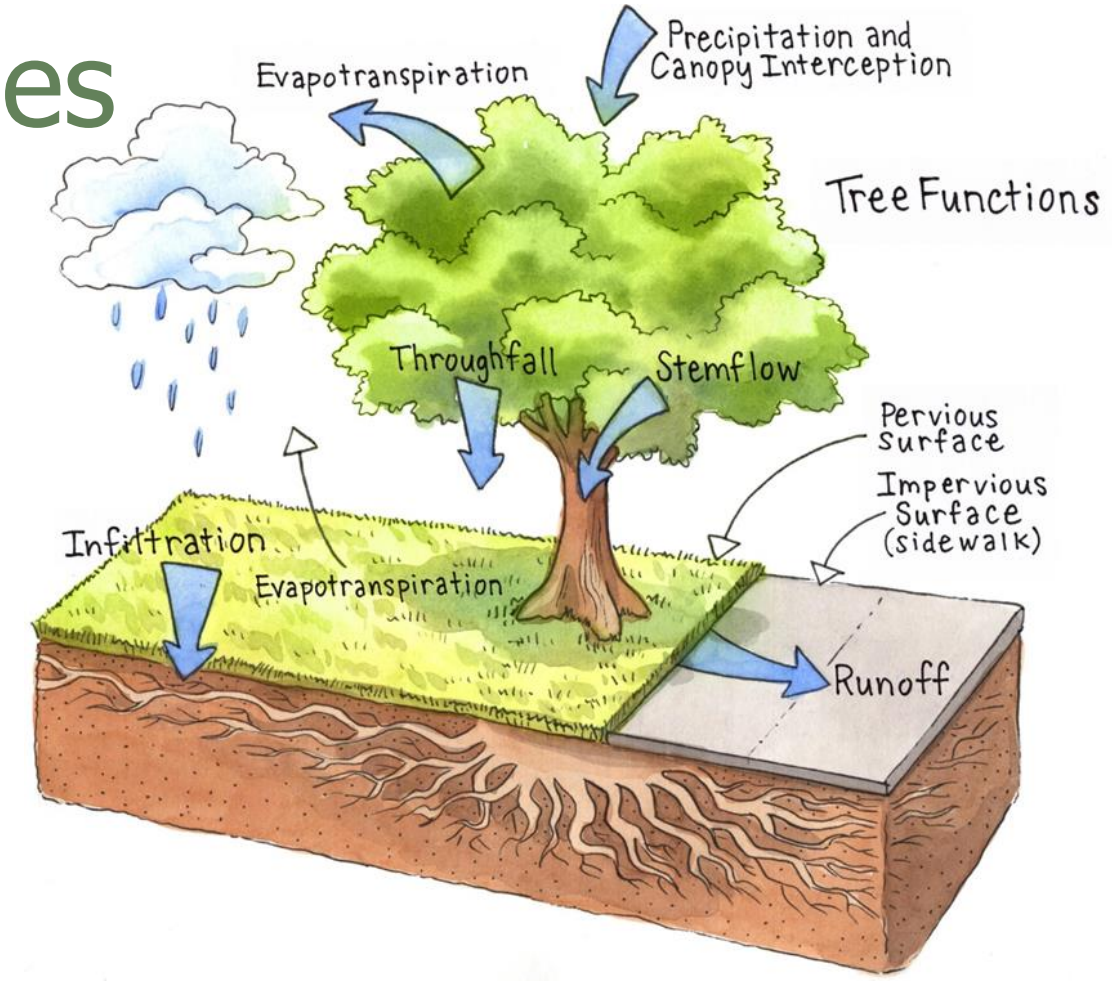
Are tree care and management well funded and implemented?

Does the city have a strategy for planting trees where they are most needed?

Link a city's urban trees to its stormwater infrastructure.

- Establish city trees' role as infrastructure to receive federal aid for post-storm clean up efforts.

- Credit urban trees in a stormwater utility fee to promote more urban tree plantings.

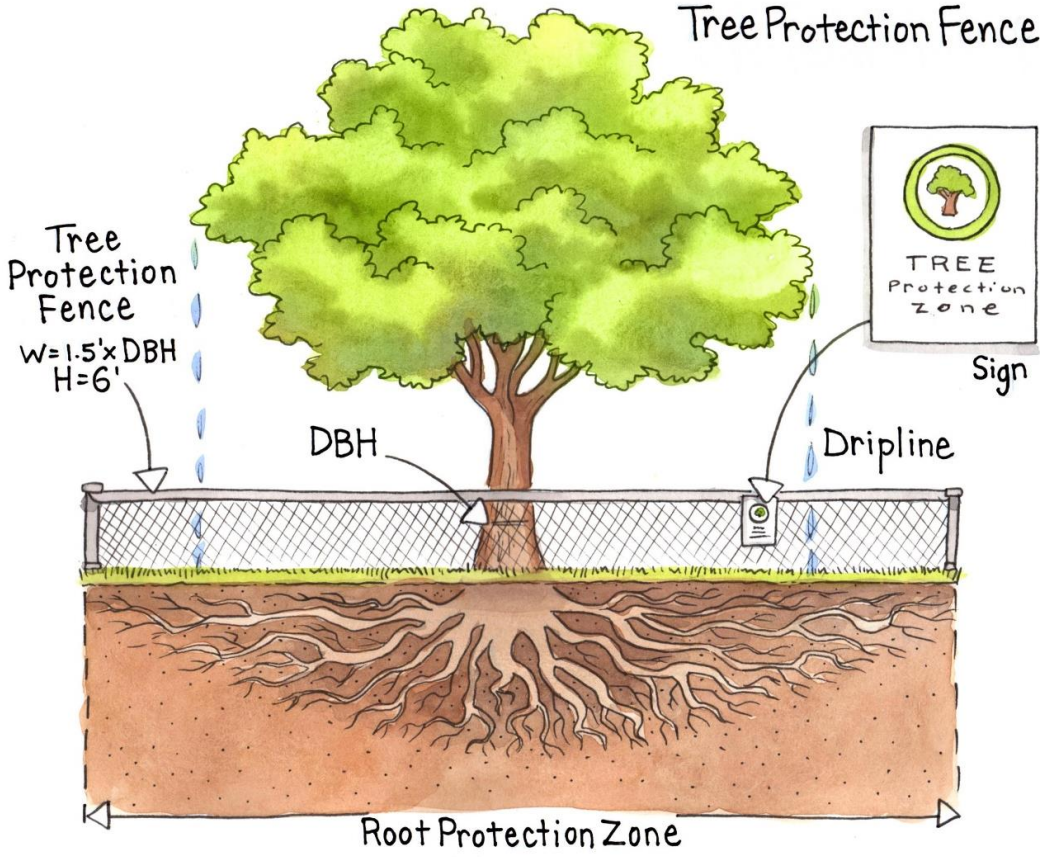


Work with developers to shrink the footprint.

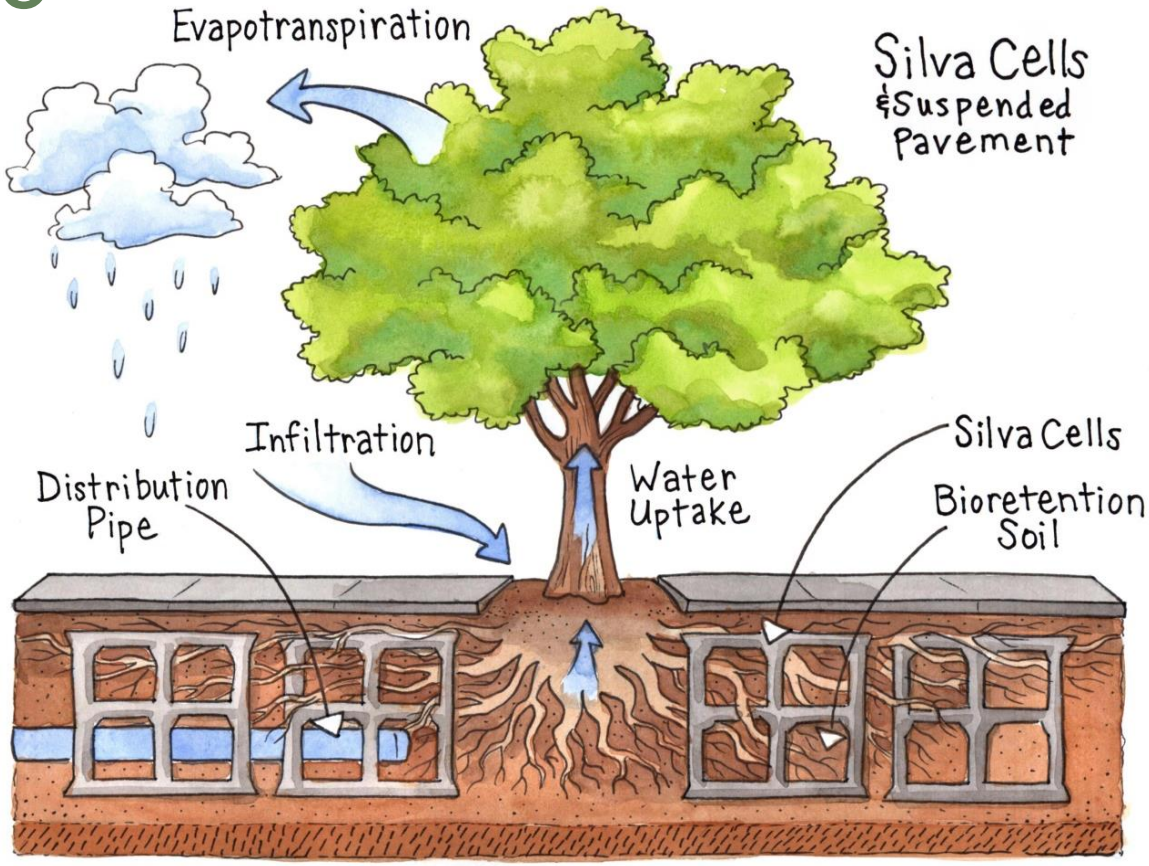
- Do not permit lot line to lot line clearing. Require retention of healthy clusters of trees.
- Look for opportunities to minimize impervious surfaces by meeting with developers BEFORE plans are finalized and INCLUDE the urban forester/arborist on staff.

Protect trees and the root zone.

- Use steel tree protection fencing in place of orange mesh where tree damage during construction is likely.
- Protect as much of the root zone as possible.
- Provide matting or other structures to support roots and avoid conflicts.



Use structural supports to extend tree roots under pavement and use permeable pavement above.



Permeable pavers allow water to reach tree roots. Tree at left is planted with sliva cell and above pavers that allow water through.

Reduce parking space requirements and increase parking lot perviousness and shade.

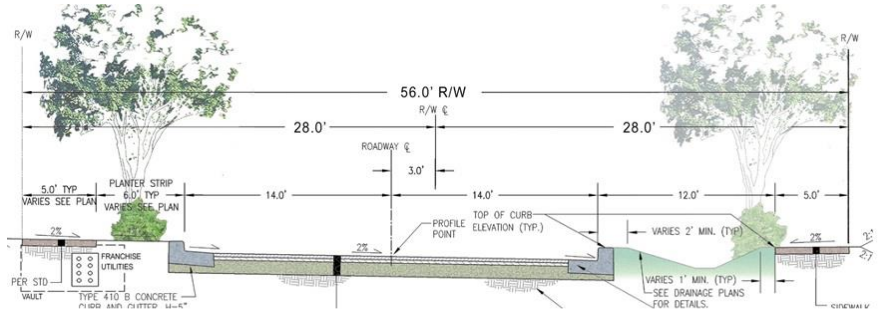
- Some parking lots have excess spaces and therefore excess impervious surfaces and more stormwater runoff. Use variable spaces and parking maximums.
- Use Low Impact Development (LID) approaches to increase parking lot perviousness, trees to provide more shade and water capture and increase attractiveness.

Versus

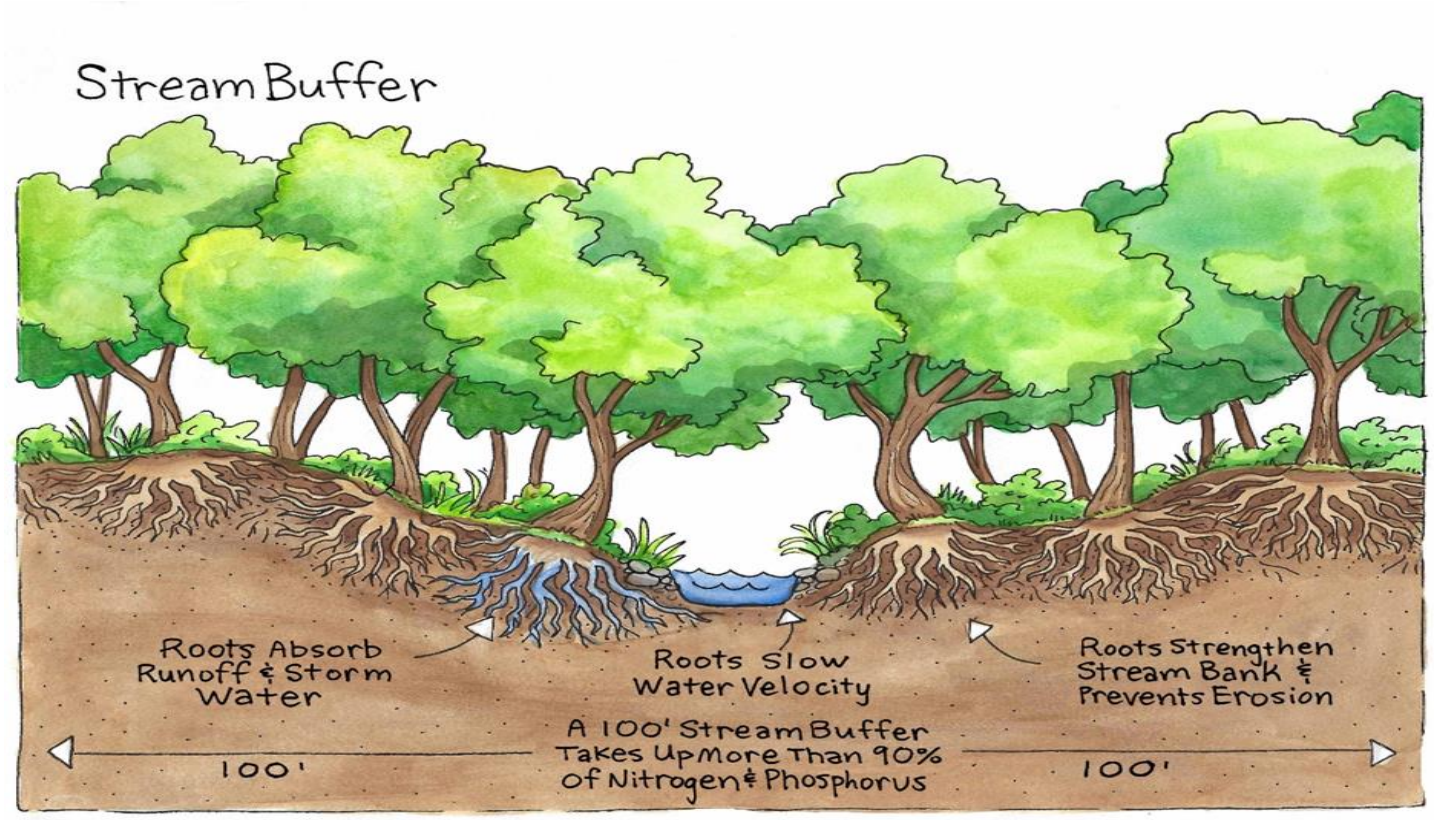
Redesign Streets as Complete 'Green' Streets

Complete green streets allow for

- ✓ Treatment of stormwater on site
- ✓ Reduction of urban heat island effect
- ✓ Beautification: increase in downtown foot traffic
- ✓ Habitat corridors



Adopt a stream buffer ordinance



A 100-foot wide buffer removes more than 90% of nitrogen, phosphorus and sediment from overland runoff.

Develop a Tree Stewards Group.

Some cities had active partnerships while others did not. We encouraged all cities to foster or support a community arm to help with planting and education.

Community members value their trees and should be engaged to plant – especially since 80% of land is in private ownership.

Help the Community Plant Trees

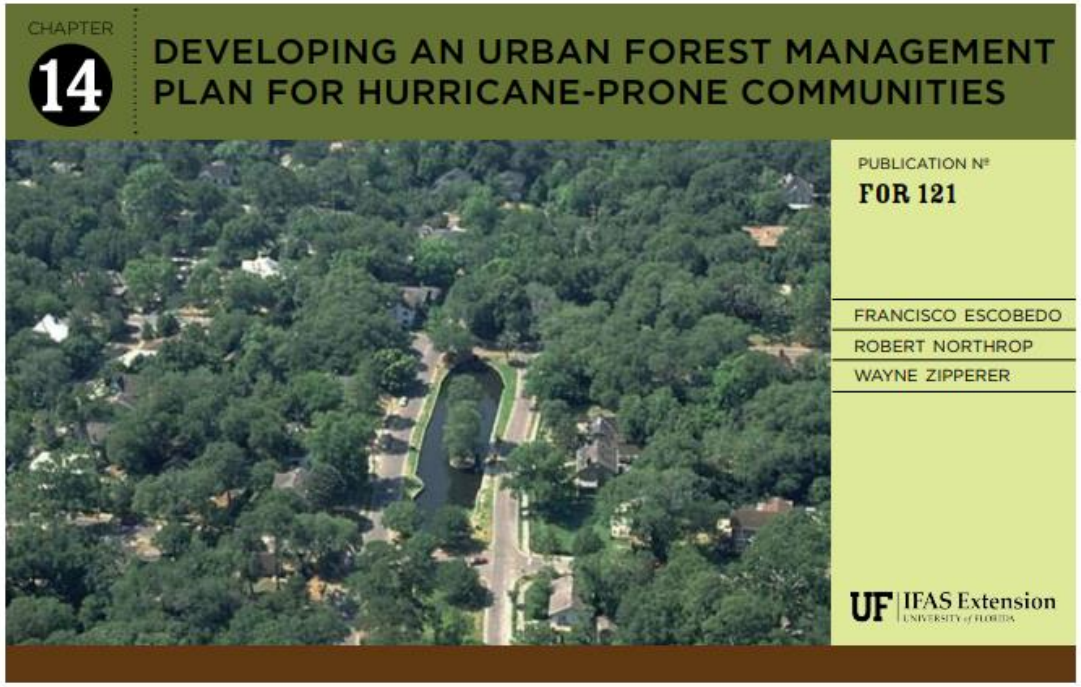
Volunteer planting is key! The GIC has planted trees on both public and private property. Cities usually need to launch a planting campaign to meet planting goals. Above are images of GIC volunteers and staff planting trees for stream buffers and safe routes to school in Richmond, VA.

Conduct land cover assessment every 4 to 5 years.

Compare tree canopy levels over time. Use the TSW map as a baseline for the future!

Understand where tree loss is occurring and take mitigation steps. We developed a budgeting tool for cities to calculate the cost of tree planting using the data from the project!

Develop an Urban Forest Management Plan



- Set clear measurable goals with actionable steps for a municipality's urban forest.
- Link urban forestry goals to those of other departments (including Planning, Parks and Recreation, Public Works etc.)

Develop a Forestry Emergency Response Plan

- Include sections and document protocol on tree risk assessment completion on city-owned property.
- Include sections on risk management and pre-disaster response.
- FEMA can reimburse for trees lost IF they were surveyed ahead of time and referred to as green infrastructure!

For more see EPA's guide to storm smart cities https://www.epa.gov/sites/production/files/2018-04/documents/storm_smart_cities_508_final_document_3_26_18.pdf>

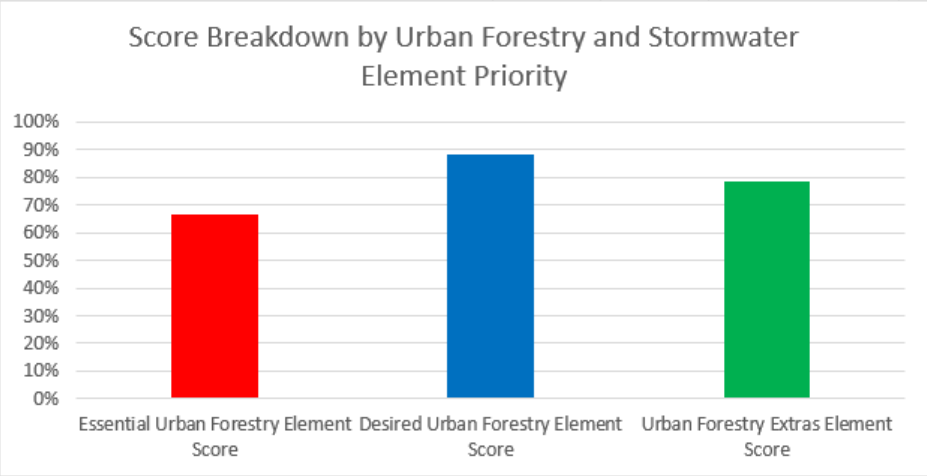
What to Look For! TSW Codes, Ordinances & Practices Tool

	A	B	C	D	E	F	G	H	I	J
1	**Trees and Stormwater Codes, Ordinances, and Practices Audit**									
2	**TREE CARE AND PROTECTION**									
3	Understanding the codes and ordinances that impact individual trees paints a picture for impacts on the urban tree canopy as a whole. This includes information about tree protection									
4	requirements, tree care practices and requirements on tree planting.									
5				**Presently of Jacksonville Comme**		**GIC Comments**	**Source**	**What to Look For**	**Score**	**Potential**
6		**Tree Protection**								
7			Are other kinds of tree protection allowed/enforced (e.g. root pruning, mulch mats, aeration)?	No	In ord, not enforced.			Create root pruning, mulch matting, and aeration matting details. Require the inclusion of these details on all development plans. Inspect the site for adequate tree protection mechanism installation before any further work is permitted on-site. If all details are required and construction may not proceed on-site until tree protection device inspections have been completed, apply one point. If details are required but inspections are not required or details are not required and	0	1
8			Is there a penalty or planting requirement for removing a certain number of DBH inches in trees?	No		(Need to get a permit to remove protected trees.)		Set minimum canopy levels by zoning area. Incite a fine or planting requirement when tree removals exceed set levels. Municipalities using a fine or planting requirement when tree canopy coverage is lowered beyond set levels score one point. Municipalities not using a fine or planting requirement when canopy coverage is lowered	0	1
9			Are developers permitted to clear lot line to lot line? Are there incentives to not do this?	Yes, allowed		Must request an exemption to cut a protected tree. (Instead, require a minimum DBH inches per acre remain on site). From Comp Plan "The City shall encourage landowners and developers to protect or preserve Environmentally Sensitive Lands within developments, where feasible. Developers will be informed, through development review processes, and provided options for preservation of these areas." How often are exemptions to cut protected trees granted?	Sec. 656.1205 Zoning Code	Implement discouragements to the practice of lot line to lot line clearing. Municipalities employing effective discouragements for the practice of lot line to lot line clearing score one point. Municipalities not employing effective discouragements for the practice of lot line to lot line clearing score zero points.	0	1

Each municipality gets a score by priority and topic

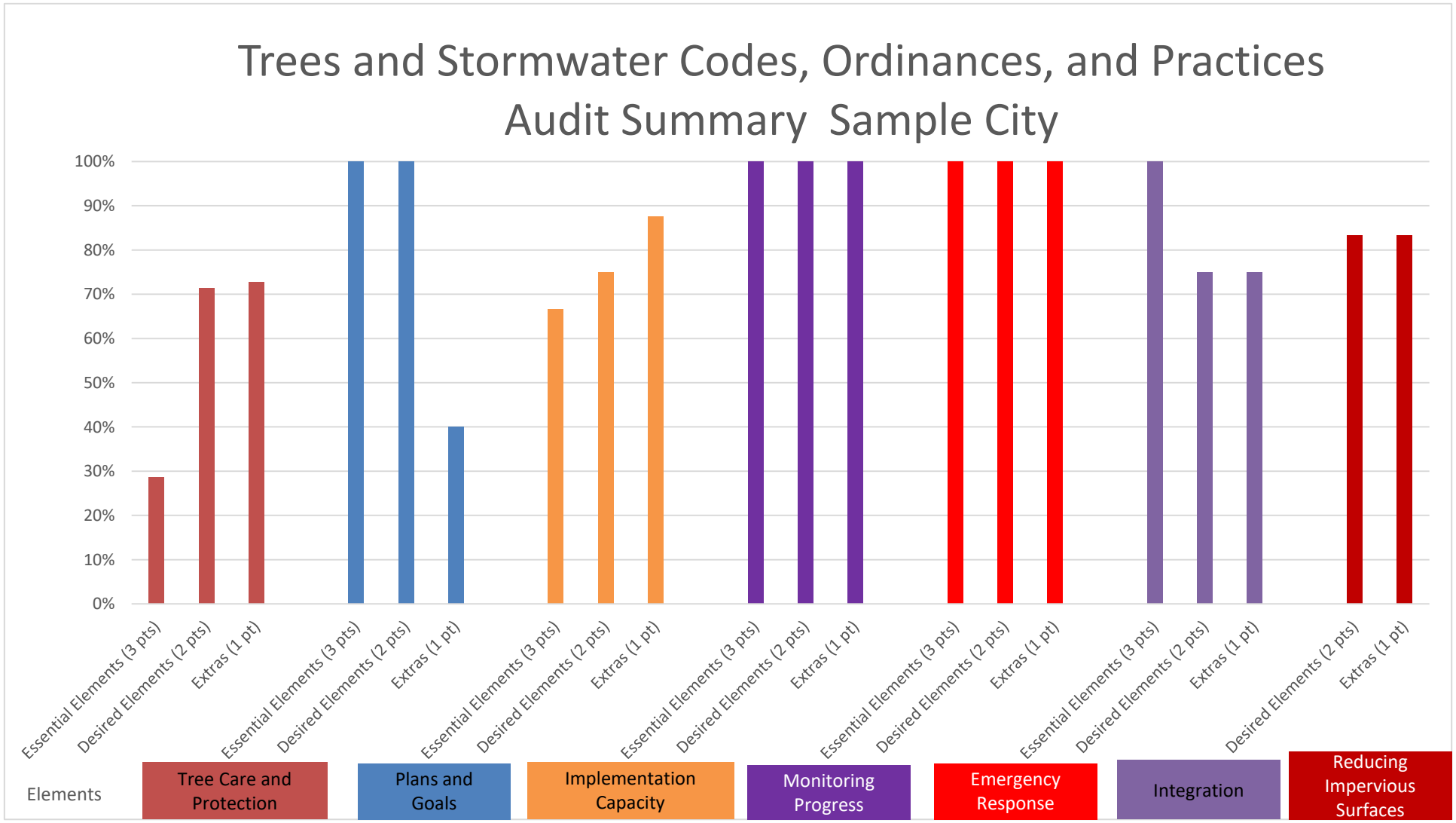
Breakdown by Urban Forest Priority

Essential Urban Forestry Element Score	**67%**
Desired Urban Forestry Element Score	**88%**
Urban Forestry Extras Element Score	**78%**



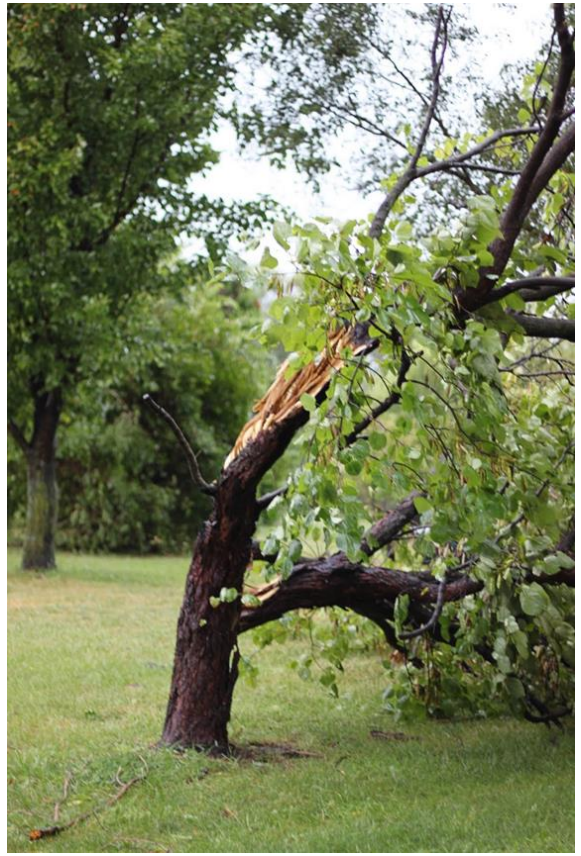
Total Audit Breakdown

Tree Care and Protection	**Scored**	**Total Points**		
Essential Elements (3 pts)	6	21	29%	Percent
Desired Elements (2 pts)	10	14	71%	Percent
Extras (1 pt)	8	11	73%	Percent
Total Score	24	46	52%	Percent
Plans and Goals				
Essential Elements (3 pts)	3	3	100%	Percent
Desired Elements (2 pts)	6	6	100%	Percent
Extras (1 pt)	2	5	40%	Percent
Total Score	11	14	79%	Percent
Implementation Capacity				
Essential Elements (3 pts)	6	9	67%	Percent
Desired Elements (2 pts)	6	8	75%	Percent
Extras (1 pt)	7	8	88%	Percent
Total Score	19	25	76%	Percent
Monitoring Progress				
Essential Elements (3 pts)	3	3	100%	Percent
Desired Elements (2 pts)	6	6	100%	Percent
Extras (1 pt)	1	1	100%	Percent
Total Score	10	10	100%	Percent


Trees and Stormwater Codes, Ordinances, and Practices
Audit Summary Sample City
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Essential Elements (3 pts)
Desired Elements (2 pts)
Extras (1 pt)
Elements
Tree Care and Protection
Plans and Goals
Implementation Capacity
Monitoring Progress
Emergency Response
Integration
Reducing Impervious Surfaces

Project Findings from 12 Trees and Stormwater Communities - Problems

- Most cities do not use their urban forests to manage stormwater (Pacific Northwest cities use trees as BMPs)
- Most cities do not assess trees for risk before storms (TRAQ)
- Most cities do not have a spatially defined map of the urban canopy (not random sampled data but actual locations of the trees)
- Most cities' tree planting campaigns are limited to public property (but **80%** of the land is privately owned!)
- Many cities lack canopy goals or budgeting tools (we made one!)
- Developments begin with lot line to lot line clearing and over-paving the remaining landscape (excessive parking and road width standards)

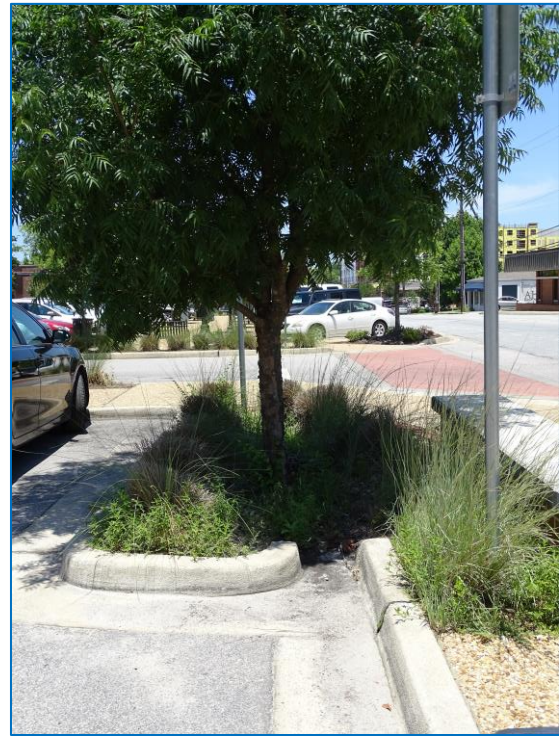


Project Findings from 12 Trees and Stormwater Communities - Solutions

- Trees can be used as BMPs (e.g. Portland) but state standards may need changing
- Trees can be assessed for risk prior to storms (e.g. Houston)
- Cities can set canopy goals and planting strategies (e.g. Norfolk, VA)
- Some cities enlist community groups as planting partners (e.g. Alpharetta, GA)
- Some cities help citizens track city tree planting projects and request trees for their communities (e.g. Jacksonville, FL and Norfolk, VA)
- Some cities prohibit lot line to lot line clearing and have minimum canopy requirements (e.g. Alpharetta, GA and Norfolk, VA)
- Some cities use structural technologies to help trees survive urban conditions (e.g. Auburn, AL)

Biggest question – how to use trees as a BMP?

- Center for Watershed Protection has tools to calculate vol. benefits per tree: https://www.cwp.org/making-urban-trees-count/
- Pine Lake, GA: 10 gallons of water credit per inch of the diameter at breast height (DBH) for preserving existing trees under 12” DBH, and 20 gallons of credit per inch of DBH for preserving existing trees over 12” DBH.
- Washington D.C.: 20 cubic feet for each preserved tree, and 10 cubic feet for each planted tree. Trees planted as part of BMP, e.g. bioswale get 10 cubic feet water credit. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6134866/
- Portland: ‘tree credit’ can be used to offset 10 percent of a site’s impervious surface as stormwater management and they also use trees in BMPs. https://www.portlandoregon.gov/bes/article/582102>



This tree in a bioswale helps filter and evaporate parking lot runoff in Auburn, AL

Larger landscape credits for trees as a BMP …

The Chesapeake Bay Program (CBP) developed BMPs for Chesapeake Bay Watershed Phase III Watershed Improvement Plan (WIP) targets.

Credit based on type of planting:

- Urban Canopy Expansion: 300 newly planted trees = 1 acre of urban tree canopy expansion.
- Urban Forest Planting: Converting turf grass to trees and must have contiguous planting and maintenance plan.
- Urban Forest Buffer: Contiguous planning of 100’ to 35’

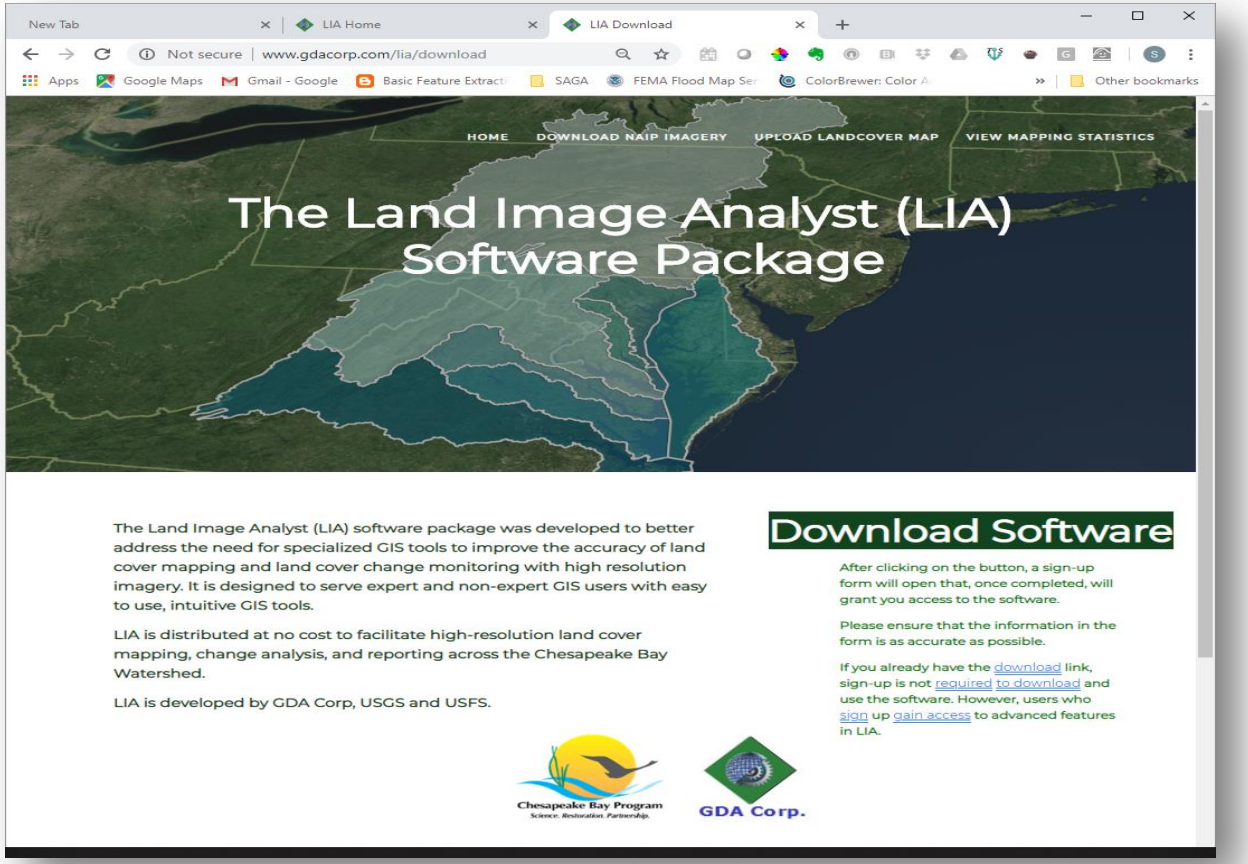
To get credit to remove N, P, Sed = trees planted/300 * reduction coefficient.

Jurisdiction	BMP	Nitrogen Average reduction per acre, Edge of tide (lbs/ac)	Phosphorus Average reduction per acre, Edge of tide (lbs/ac)	Sediment Average reduction per acre, Edge of tide (lbs/ac)
Virginia	Forest buffer	8.77	1.61	854
	Forest planting	7.33	1.16	451
	Tree planting - canopy	1.82	0.15	223

Tree planting.

A new tool to map your land cover…

Land Image Analyst

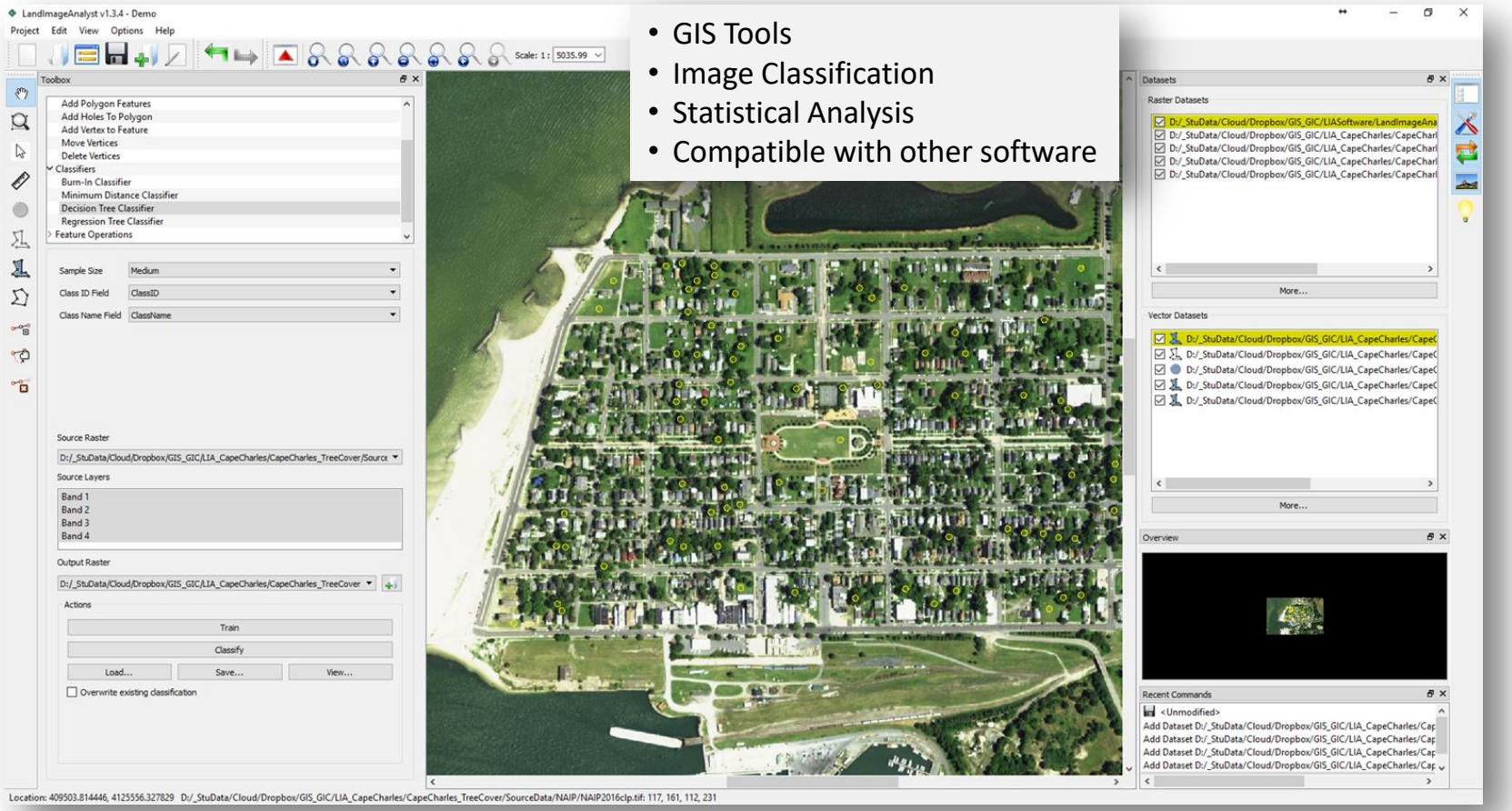


The Land Image Analyst (LIA) software package was developed by the USDA Forest Service Chesapeake Bay Program with technical support from GDA Corporation to provide land cover mapping and land cover change monitoring.

- FREE!
- Can be used stand-alone, OR
- Compatible formats to use with ArcGIS or QGIS.

http://www.gicinc.org/land_image_analyst.htm

The Green Infrastructure Center has tested the **LIA** tool and has provided guidance for its development. http://www.gicinc.org/land_image_analyst.htm



Supervised Classification

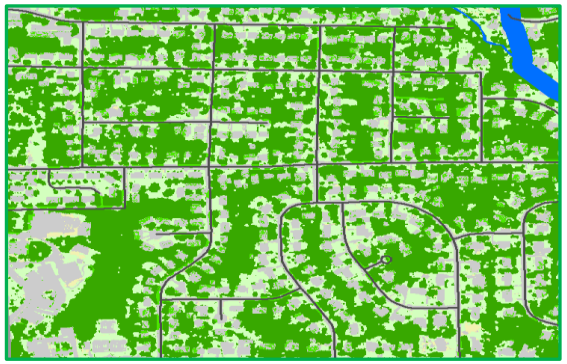
Involves carefully selecting ‘training samples’ from the imagery.

Each training sample contributes to building a ‘spectral signature’ for each land cover class.

The spectral signatures are used in the classification algorithms to predict the probability that a pixel is part a class (e.g. how well does a pixel match up with the spectral signature for the ‘tree’ class?)

Therefore, a number of techniques should be used to increase the probability that a pixel is put in the correct class, including field verifying the training samples, as well as the output classification

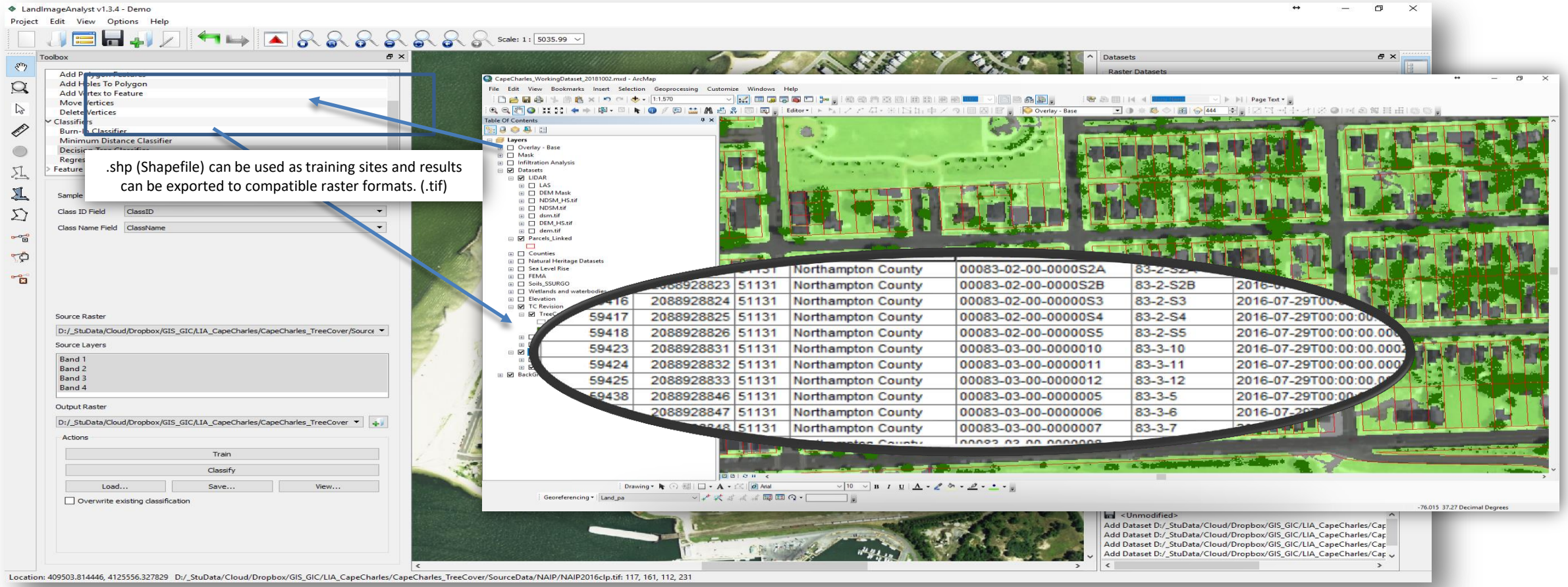
What to use LIA for



- Land cover recognition tool that uses digital aerial imagery (Satellite and Aircraft) to create land cover data layer and calculate basic statistics for spatial planning purposes.
- Can be integrated with more advanced GIS software and used as a primary remote sensing tool.
- Determine how impervious your watershed is! Where is open space to plant in? How well vegetated are your streams etc.? Create n urban forest plan with the data!

Quickly create tree canopy and integrate with existing datasets.

http://gicinc.org/land_image_analyst.htm

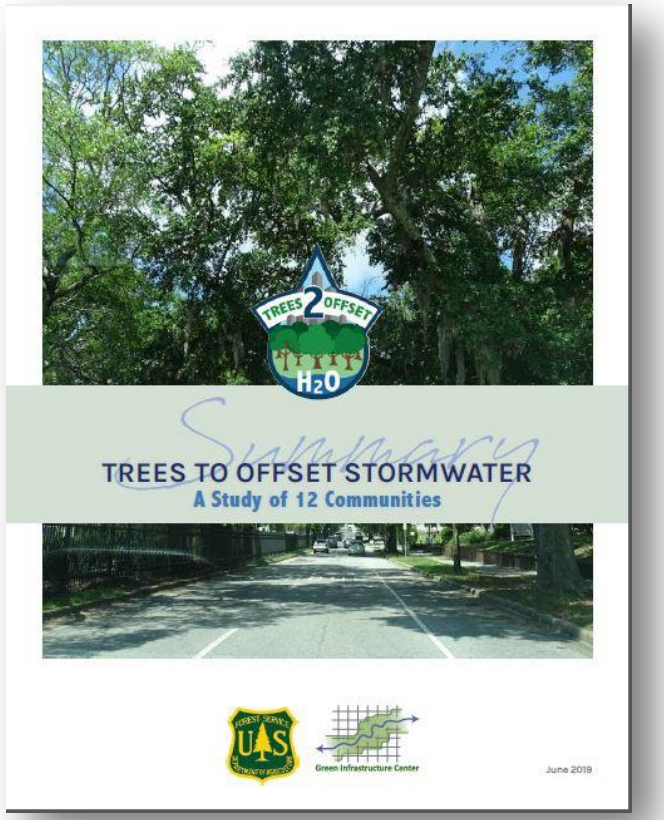


Available State Land Cover at 30 meters resolution

Urban Tree Canopy Added Using **LIA**

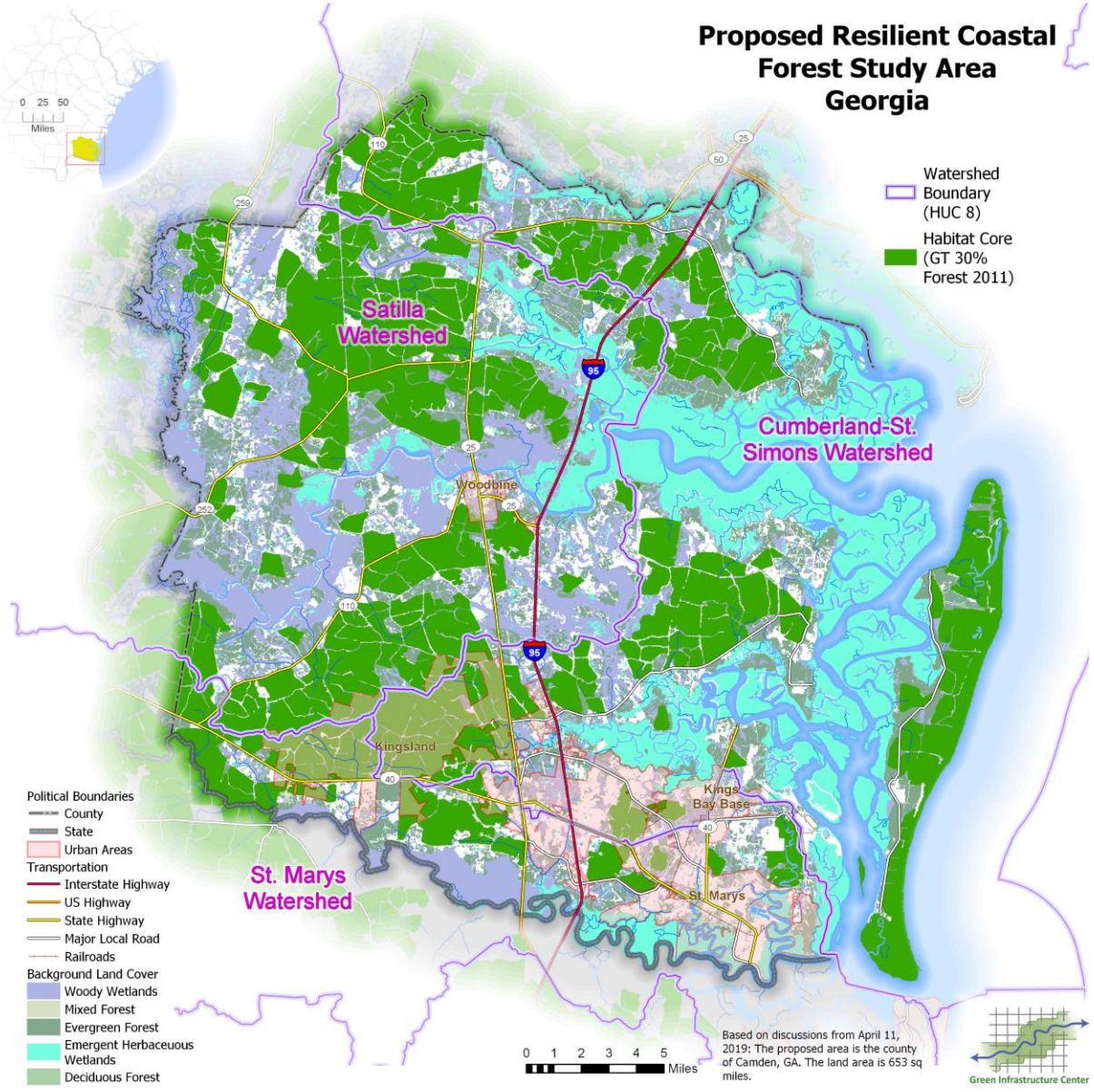
Products you can use …http://www.gicinc.org/trees_stormwater.htm

- ✓ **Trees and Stormwater Codes Ordinances and Practices Audit Tool:** Anyone can fill it out and a city can self-score or an intern can do it!
- ✓ **Trees and Stormwater Calculator Tool:** Requires tree canopy map and adding in other data are added such as roads, buildings etc. Then plantable area can be calculated and data can be added to the calculator spreadsheet. Technical instructions for GIS users on line!
- ✓ The **12 case booklets** can be shared as examples – they are all on line!
- ✓ A **final summary report** provides key findings –is posted to above website.



New… southern project

Resilient Coastal Forests: A study of all the factors that influence forest health, longevity, uses and extent. We are looking at Fire, Pests, Storm Surges, Zoning, Development Pressures etc. – what is happening to our forests and what can we do to better protect them for the future? In VA, SC, and GA! Two year project begun in 2019. Will develop a plan and model process that can be followed in the south and beyond.



Hope you've made it this far…

Because … we're done!

Comments,
Questions?

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