St. Petersburg Tree Canopy Analysis

Office of Sustainability and Resilience

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Overview

As part of enhancing the many tree-related services that the City of St. Petersburg provides, the Office of Sustainability & Resilience (OSR) recently began coordinating with various city departments to improve collaboration and develop a city-wide approach to urban forestry. Working with those departments, OSR has completed an initial tree canopy analysis to help provide the larger picture, set tree canopy goals, and track gains and losses. This information can be used as part of the overall urban forestry program to inform decision-making and investments.

Why Study the Tree Canopy?

Maintaining a healthy urban forest provides a variety of long-term benefits to cities including environmental enhancements, stormwater uptake, economic savings, climate resilience, neighborhood character, wildlife habitat, and much more. By studying the urban forest and tracking tree canopy coverage over time, cities gain an understanding of benefits and challenges, set tree canopy goals based on data, and invest in trees and green infrastructure for areas most in need.

What's in This Report?

This Tree Canopy Analysis Technical Report provides historical context leading to the tree canopy existing in St. Pete today, details about the urban forest composition, a comparison of tree canopy analysis case studies, results from an historical vegetation analysis (1982-2007), city-wide and city council district-specific results from a 2017 land classification using i-Tree Canopy, ecosystem benefits calculations, and goals for future urban forest management.

Summary of Results

St. Petersburg's tree canopy covers 27% of the city's land area according to the 2017 analysis included in this report. This result is an increase of 3 – 5% from the City's 1975 analysis. For a densely populated city that has seen a lot of redevelopment, tree canopy gain is an encouraging result. However, it is important to consider the composition of the tree canopy, the age of the canopy, and how development patterns are impacting existing canopy. The historical vegetation analysis included in this report reveals major loss of vegetation since the 1980s in the north end of the city, now known as the Gateway Activity Center. City-wide, many Laurel oak trees that were planted during the post-WWII development boom are now at the end of their lifespan. Planned removal of these trees is a reality of urban forestry management, where the safety of human life and property is prioritized. The analysis also reveals that mangroves and wetland species along the northeast end of St. Petersburg register extremely high for dense biomass, illustrating the great value they provide to our city's ecosystem.

St. Petersburg's tree canopy is valued at nearly $11 million annually, plus an additional $53 million over the course of the trees' lifetime. This value is based on the ecosystem services provided by the trees, including air quality improvements, pollution mitigation, storm water run-off reduction, carbon sequestration and storage and more. The tree canopy results, including valuation, were also examined by City Council district to help illustrate potential areas for future canopy investments. Moving forward, it is recommended that St. Petersburg's tree canopy is assessed at least every five years.

St. Pete's History of Tree Canopy

St. Petersburg incorporated as a city in June of 1903 with goals of becoming a resort town rich with parks and leisure activities. From the beginning of the city's incorporation, environmental conservation efforts were highly prioritized. Section 1.02 of the City of St. Petersburg Municipal Charter reads:

> *"The purpose of this section is to protect City-owned park and waterfront property. Except as provided herein, no waterfront or park property owned by the City may be sold, donated or leased without specific authorization by a majority vote in a City-wide referendum."*

Because of this dedication, St. Petersburg offers a seven-mile waterfront park system that is open to the public today. However, many of the other plans to create a lush, green, and parkway-filled city were not executed due to economic pressures for increased development.

William Straub moved to Florida from North Dakota in 1899, acquired the St. Petersburg Times newspaper in 1902, and as the city grew, he felt compelled to preserve its natural landscape. He convinced the Pinellas County Chamber of Commerce to hire the Olmstead Brothers to design Florida's first park plan. While the County refused to implement the plan, Straub turned to the St. Petersburg City Council to establish Florida's first city planning board. Straub then hired John Nolen to produce the Florida's first comprehensive plan utilizing zoning as a tool for both regulation and incentive for a tourism-based economy. The city was planned to cater to recreation and leisure, with parks within a half of a mile from all residents. Parkways and preserves were designed along coast lines and between tourist districts to encourage outdoor activity while mitigating flooding in this hurricane-prone area. Many Florida cities adopted Nolen's plans for growth with parks, but a burgeoning real estate market pivoted the priorities in St. Petersburg.

The city grew from 1,575 residents in 1900 to 14,237 in 1920, 20,000 in 1923, and 60,000 in 1926. Land was subdivided and quickly sold, with property values rising. However, the real estate market began to falter, the recession began, and the Great Depression hit Florida hard. Much of Florida was planned for tourism and seasonal living that people could no longer afford. Unwilling to slow development, city leaders devised the Harland Bartholomew Plan in 1943 to encourage and guide development without a greenbelt, neighborhood centers, and tourist districts as Nolen originally planned. The post-WWII development boom of the late 1940s and 1950s graced us with an era of shade trees that we see today as an established canopy. The City of St. Petersburg began to study the tree canopy in the 1970s with a canopy analysis and street tree inventory. While they did not have access to the technology we have today, these documents provide valuable insight into the evolution of St. Petersburg's urban tree canopy.

Timeline of Trees & Land Conservation Efforts

Year	Key Event	Impact, Goals, or Rules Established
1903	City of St. Petersburg, Florida Municipal Charter	Section 1.02 of the City Charter protects City-owned park and waterfront property. No waterfront or park property owned by the City may be sold, donated or leased without specific authorization by a majority vote in a City-wide referendum.
1923	Nolan Plan	Planned parks, parkways, and preserves within ½ mile from all residents.
1943	Bartholomew Plan	Deprioritized parks and encouraged development without a greenbelt.
1945	Post-WWII Housing Boom begins	A new generation of shade trees is planted.
1955	Zoning Ordinance	Use designations were established which include forests, public parks, conservation projects, parkways, and playgrounds.
1961	City Beautiful Commission	The City's oldest commission leads the community in beautifying and protecting our natural resources.
1976	Gizella Kopsick Palm Arboretum est.	Today, the arboretum is a collection of more than 500 palms and cycads representing more than 150 species from around the world.
1977	Canopy Analysis and Street Tree Inventory	St. Petersburg canopy cover estimated at 22.1% - 23.56%. Street tree inventory provides data on species diversity.
1982	Boyd Hill Forest Resource Plan	Recommendations for prescribed burning techniques in forest management
1986	First Year as a Tree City USA	The criteria for this award are: "maintaining a tree board or department, having a community tree ordinance, spending at least $2 per capita on urban forestry and celebrating Arbor Day." No canopy goals are identified.
2002	Vision 2020 Plan	Adopted with Natural Environment Theme
2002	Comprehensive Plan	Adopted with Conservation Element
2002	Lake Maggiore Park Master Plan	Identified stewardship measures to conserve, protect, and improve the Lake Maggiore Park property. Primary goal: place all environmentally sensitive areas within the limits of an expanded Boyd Hill Nature Preserve.
2010	Street Tree Inventory	USDA grant received by City Parks Department to inventory trees on federally managed corridors serving as evacuation routes. Species diversity and ecosystem benefits estimated.
2015	Update to Tree and Landscape Code	Robust tree protection standards added to the city's Land Development Regulations. Protection added for Grand and Signature Trees.
2015	EO 2015-07 (updated w/ EO 2017-01)	Mayor Kriseman established Executive Order 2015-07 that calls for the "protection and enhancement of shade, urban forest, and green space."
2017	BP Settlement Funds Awarded and Corridors Identified	Mayor Kriseman and City Council approved $500,000 for tree plantings on corridors city-wide. Tree Czar, and former Mayor, Dave Fischer identified the corridors in each City Council District and the community participated in engagement meetings.
2019	Conservation easement on Boyd Hill Nature Preserve	Includes "…to allow for an exception to the referendum requirement for permanent dispositions of Charter park property when there is a conservation or preservation purpose, such as this Agreement (and others like it in the future)."
2019	House Bill 1159	State bill prohibits local gov. from requiring a notice, application, approval, permit, fee, or mitigation for pruning, trimming, or removal of a tree on residential property if the tree presents a danger to persons or property, as documented by a Certified Arborist or Licensed Landscape Architect.
2020	City mitigates effects of HB1159	City requires tree removal permit numbers or certified arborist numbers on Brush Site Consent Form to mitigate negative impacts of HB1159.

1977 Street Tree Inventory and Canopy Analysis

The City of St. Petersburg worked with the Pinellas County Urban Forester to publish an urban tree canopy cover analysis and street tree survey. For the canopy analysis, 56 aerial photographs from 1975 at a scale of 1" = 300' were used with an 18" x 12" dot grid for generating sample points. It was estimated that St. Petersburg's tree canopy covered 22.1% - 23.56% of the city's land area, and impervious surface covered 45%. The report does not show how many points were recorded city-wide, but percentages were given for the four study areas (study area boundaries were not provided):

Division	Canopy Cover	Observations
1: Coastal Areas	15.39%	heavy coastal development and dredge and fill operations
2: Downtown-Central Plaza	9.23%	heavy commercial and industrial development
3: Old Northeast	34.47%	older residential areas with established trees
4: Lakewood-Pinellas Point	18.21%	newer residential area with canopy cover close to the city's average

Additionally, the study examined school grounds and recreation areas. This revealed that school properties are significantly lacking in tree canopy cover, while recreational areas such as golf courses and city parks are shaded with an impressive canopy.

	Total Acres	Acres of Canopy Cover	% Canopy Cover
School Grounds	2,753.16	170.97	6.21%
Recreation Areas	3,058.62	1,190.41	38.92%

A street tree survey was conducted on eight major thoroughfares in St. Petersburg: Tyrone Boulevard, 1st Avenue North, 1st Avenue South, 9th Street North, 22nd Avenue South, Park Street, 38th Avenue North, and 49th Street North. No mileage or maps were included for geographic reference. Trees were tallied in six different tree classes, but no total species-counts were recorded.

Order of Frequency (most to least)	Tree Class	Species Noted/Observed
1	Palm	Queen palm, cabbage palm, Washingtonia palm, etc.
2	Evergreen	Live oak, Laurel oak, cherry laurel, magnolia, etc.
3	Flowering	Orchid tree, golden raintree, jacaranda, etc.
4	Conifer	Slash pine, Norfolk Island pine, cypress, cedar, etc.
5	Miscellaneous	Brazilian pepper, melaleuca, Australian pine, eucalyptus, various fruit trees, etc.
6	Deciduous	Rosewood, turkey oak, hickory, ear tree, etc.

The rest of the report outlines a Street Tree Planting Program, including goals, species selection and use, planting specifications, and a list of recommended trees for planting. An illustrated guide was published in 1977 using the data from this canopy analysis and street tree survey.

2010 Street Tree Inventory

The City of St. Petersburg's Parks and Recreation Department completed a street tree inventory as part of Florida Forest Service's Urban and Community Forest Grant Program in 2010. Primary evacuation routes (federally maintained) were chosen for the study, totaling 120.12 miles of street rights-of-ways and medians. The inventory includes detailed information for 6,676 total trees, including tree measurements and calculation of ecosystem benefits using the i-Tree Streets software. No GPS locations were included with the report.

Species	# of Trees	% of Total Trees	Leaf Area (ft^2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Live oak	2,227	33.4%	5,285,977	62.4%	1,738,391	58.3%	51.4
Crapemyrtle	1,197	17.9%	121,284	1.4%	72,562	2.4%	7.3
Mexican fan palm	618	9.3%	150,259	1.8%	107,715	3.6%	4.9
Cabbage palmetto	543	8.1%	281,360	3.3%	108,520	3.6%	5.0
Queen palm	447	6.7%	165,717	2.0%	137,541	4.6%	4.4
Laurel oak	330	4.9%	1,144,562	13.5%	365,268	12.3%	10.2
Yew podocarpus	250	3.7%	157,462	1.9%	28,394	1.0%	2.2
Slash pine	149	2.2%	164,018	1.9%	65,773	2.2%	2.1
Date palm	144	2.2%	75,005	0.9%	28,854	1.0%	1.3
Chinese elm	110	1.6%	43,900	0.5%	22,114	0.7%	1.0
Holly	81	1.2%	48,692	0.6%	23,514	0.8%	0.9
Other Trees	580	8.7%	834,691	9.9%	281,644	9.5%	9.3
	6,676	100%	8,472,927	100%	2,980,290	100%	100

2015 Update to Tree and Landscape Code (Ordinance 195-H)

The City of St. Petersburg's Development Review Commission brought together a working group of community tree experts for a series of workshops in 2015 to provide input for updating the Tree and Landscape code in the Land Development Regulations. Revisions were made to enhance the protection of certain native species and to encourage the removal of exotic species like Brazilian Pepper and the Carrotwood Tree. A select group of non-native trees were given protective measures with a new designation as "signature trees." These non-native signature trees are protected because the size, prevalence, and history in the community warrant recognition and protection. The new code was adopted by City Council as Ordinance 195-H in 2015.

2017 Tree Planting Program: BP Settlement and Weeki Wachee Funds

As part of the settlement of the 2010 Deepwater Horizon oil spill in the Gulf of Mexico (BP Settlement), Mayor Kriseman and City Council approved an allocation of $500,000 for tree plantings on corridors city-wide. These one-time funds were approved for implementation of a new Tree Planting Program which began in fiscal year 2017 and is continuing into fiscal year 2022 with funds appropriated from the City's Weeki Wachee Fund. Former Mayor Dave Fischer, also known as the "Tree Czar" at that time, and the St. Petersburg Sustainability Council initiated the identification of the corridors in each City Council District at the program's inception, and a series of community meetings were conducted to gather input on program implementation. This one-time allocation of program funds will be utilized for a final corridor tree planting in 2022. The map below provides an update on the planting program as of February 2021.

Urban Forest Composition

St. Petersburg's tree canopy is comprised of a representation of Florida's subtropical climate. A mix of pines, oaks, and palms comprise the bulk of the city's native canopy. The 2010 street tree inventory revealed that Live Oak and Crape Myrtle trees are by far the most prevalent street trees. A wide variety of trees exist throughout the city on private land. Many of the shade trees planted on private property during the development boom of the 1950s were oak trees. Laurel oaks have a lifespan of 50 to 70 years generally, and many of these trees hollow out at the end of their lives. As a result, many Laurel oaks are being removed throughout St. Petersburg today. However, it is the intent of the City to protect healthy trees through their maturity, and to plant native and Florida-friendly species as replacements when urban trees must be removed. The Tree and Landscape code committee that convened in 2015 produced lists of recommended shade trees, understory trees, and palm species, as well as unprotected and prohibited species based on their non-native, invasive, exotic, or nuisance status. The lists below include 2022 revisions to the 2015 lists based on peer review comments. These matrices help guide decision-making for tree planting and removals city-wide and will also inform Land Development Regulation (LDR) updates as appropriate.

Shade Trees

All required shade trees shall measure a minimum of 10' in height and 2" DBH at the time of planting. All shade trees shall be rated Florida Grade No. 1 and selected from the following list.

Common	Scientific	Native	Light requirements			Water requirements		
			sun	*mix*	*shade*	*low*	*med*	*high*
Cypress, Bald	*Taxodium distichum*	X	X	X		X	X	X
Elm, Chinese (Drake)	*Ulmus parvifolia*			X		X		
Elm, Florida	*Ulmus Americana, var. spp. floridana*	X		X		X	X	
Elm, Winged	*Ulmus Alata*	X	X				X	
Loblolly Bay	*Gordonia lasianthus*	X		X				X
Magnolia, Southern*	*Magnolia grandiflora*	X	X				X	X
Magnolia, Sweetbay*	*Magnolia virginiana*	X		X				X
Maple, Florida	*Acer saccharum,* "Floridanum"	X		X			X	
Maple, Red	*Acer rubrum*	X		X				X
Mulberry, Red*	*Morus rubra*	X	X				X	
Oak, Live	*Quercus virginiana*	X	X			X	X	
Pine, Long-Leaf	*Pinus palustris*	X	X			X		
Pine, Slash	*Pinus elliottii*	X	X			X		
Sand Pine	*Pinus clausa*	X	X			X		
Sugarberry*	*Celtis laevigata*	X	X				X	

Sweetbay Magnolia	*Magnolia virginiana*	X		X			X	
Sweetgum*	*Liquidambar styraciflua*	X	X				X	
Sycamore	*Platanus occidentalis*	X	X				X	X

**Tree produces berries or seed pods, which make it an unsuitable choice for locations near parking or sidewalk spaces. Other shade trees identified as Florida Friendly by the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Extension, Environmental Horticulture Department will be considered.*

Understory Trees

All required understory trees shall measure a minimum of 8' in height and 1.5" DBH at the time of planting. All understory trees shall be rated Florida Grade No. 1 and selected from the following list.

Common	Scientific	Native	Light requirements			Water requirements		
			sun	*mix*	*shade*	*low*	*med*	*high*
Bay, Red	*Persea borbonia*	X		X		X		
Bay, Swamp	*Persea palustris*	X		X			X	
Buttonwood, Green	*Conocarpus erectus*	X	X				X	
Buttonwood, Silver	*Conocarpus erectus* "sericeus"	X	X				X	
Crape Myrtle	*Lagerstroemia indica* and any disease resistant varieties		X			X	X	
Cedar, Southern Red	*Juniperus virginiana*	X	X			X		
Holly, American	*Ilex opaca*	X		X		X		
Holly, Dahoon	*Ilex cassine*	X		X			X	X
Holly, East Palatka	*Ilex attenuata* "East Palatka"	X	X			X	X	
Holly, Weeping Yaupon	*Ilex vomitoria* "Pendula"	X		X			X	
Holly, Yaupon	*Ilex vomitoria*	X		X		X		
Magnolia	*Magnolia grandiflora*, and other dwarf varieties that have a max height of 15 feet			X			X	X
Oak, Sand Live	*Quercus virginiana* "Geminata"	X	X			X		
Plum, Flatwoods	*Prunus umbellata*	X		X			X	
Plum, Pigeon	*Coccoloba diversifolia*	X	X			X		
Plum, Saffron	*Bumelia celastrina*	X		X			X	
Podocarpus (tree form)	*Podocarpus macrophyllus*			X			X	

Seagrape (tree form)	*Coccoloba uvifera*	X	X			X		
Sweet Acacia	*Acacia farnesiana*	X	X			X		
Wild Olive	*Cordia boissieri*		X				X	
Other understory trees identified as Florida Friendly by the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Extension, Environmental Horticulture Department will be considered.								

Palms

*All required palm trees shall measure a minimum height of 8' of clear trunk. Palm trees identified with an * may be substituted on a one for one basis with shade tree planting requirements. Palm trees identified with a + may be substituted on a three for one basis with shade tree planting requirements. No more than 50% of required shade trees may be substituted for palms in vehicular use areas. All palm trees shall be credited on a one for one basis towards understory tree planting requirements. All palms trees shall be rated Florida Grade No. 1 and selected from the following list.*

Common	Scientific	Native	Light requirements			Water requirements		
			sun	*mix*	*shade*	*low*	*med*	*high*
Bismarck Palm*	*Bismarckia nobilis*		X				X	
Buccaneer Palm	Pseudophoenix sargentii			X			X	
Cabbage Palm+	*Sabal palmetto*	X	X			X	X	
Date Palm, Medjool*	*Phoenix dactylifera*							
Date Palm, Pygmy	*Phoenix roebelenii*							
Date Palm, Silver	*Phoenix sylvestris*							
Fan Palm, Ribbon	*Livistona decipiens*		X				X	
Florida Silver Palm	*Coccothrinax argentata*			X			X	
Foxtail Palm	*Wodyetia bifurcata*		X				X	
Paurotis Palm	*Acoelorrhaphe wrightii*	X	X				X	
Pindo Palm	*Butia odorata*			X			X	
Royal Palm, Cuba*	*Roystonea regia*			X			X	
Royal Palm, Florida*	*Roystonea elata*	X		X			X	
Triangle Palm	*Thrinax radiata*	X	X			X		
Windmill Palm	*Neodypsis decaryi*		X				X	
Other palms identified as Florida Friendly by the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Extension, Environmental Horticulture Department will be considered.	*Trachycarpus fortunei*			X		X		

Mangrove and Wetland Species

Mangroves are an extremely vital piece of Florida's wetlands. Our wetlands provide direct ecological benefits to our environment. Particularly within highly urbanized areas, the preservation of mangroves and other wetland species such as Buttonwood assists with buffering and absorbing water influx from extreme weather events. White, red, and black mangroves grow in St. Petersburg. Mangroves are protected by the State of Florida's Mangrove Trimming and Preservation Act of 1995 (amendments in 1996). To trim or remove mangroves within the city of St. Petersburg, a permit is required. The permits are administered by the Pinellas County Environmental Management Division.

Grand, Protected, and Signature Trees

Grand Trees

Any protected tree which is 30 inches dbh or larger. Grand trees do not include laurel oaks (Quercus lurifolia). Grand trees shall be considered a "specimen" tree as that term is used in Florida Statutes.

Protected Trees

Protected tree shall mean any shade tree which is four inches or larger diameter at breast height (dbh) and any understory tree which is eight inches or larger in diameter at breast height (dbh) and which is not identified in this section as an unprotected or prohibited tree.

Signature Trees

Jacaranda and Royal Poinciana Trees over 8" DBH and Banyan, Kapok and Red Silk Cotton Tree over 30" DBH are "signature trees" and therefore may be required to obtain a permit before removing.

Unprotected Trees

Due to their status as non-native species or invasive species, any unprotected or prohibited trees may be removed from private property and the abutting right-of-way without a permit unless they are part of an approved landscape plan, or otherwise required by code section 16.40.060.2.1.6 and shall not be used to meet the vegetation requirement.

Common	Scientific	Place of Origin
Avocado	*Persea americana*	Central America
Cherry laurel	*Prunus caroliniana*	North America
Citrus	All species.	Eastern Asia
Ear	*Enterolobium cyclocarpum*	Central America
Eucalyptus	*Eucalyptus spp.* except silver dollar variety	Australia
Ficus[1]	*Ficus spp.*	South America
Italian cypress	*Cupressus sempervirens*	South Europe
Jacaranda[1]	*Jacaranda acutifolia*	Brazil
Jerusalem thorn	*Parkinsonia aculeata*	Central America
Kapok[1]	*Ceiba pentandra*	South America
Lead Tree	*Leucaena leucocephala*	Mexico and Central America
Loquat	*Eriobotrya japonica*	China
Mango	*Mangifera indica*	India
Mimosa	*Albizzia julibrissen*	Tropical Asia
Monkey puzzle tree	*Araucaria Araucana*	Australia
Norfolk Island pine	*Araucaria excelsa*	Norfolk Island
Orchid Tree	*Bauhinia spp.*, except *Bauhinia variegata*	Eastern Asia (India, China)
Royal Poinciana[1]	*Delonix regia*	Madagascar
Silk oak	*Grevillia robusta*	Australia
Toog	*Bischofia javanica*	Tropical Asia, Pacific Islands
Woman's tongue	*Albizia lebbeck*	Tropical Asia, Northern Australia

Prohibited Trees		
It is unlawful to plant or cause to be planted, or to sell or offer for sale, within the City limits the following exotic and nuisance plant species. Any development or redevelopment which is required to obtain a landscaping permit or file a landscape plan shall remove all prohibited trees on the property and abutting right-of-way and shall include a plan to prevent re-growth prior to approval of a certificate of occupancy.		
Common	Scientific	Place of Origin
Acacia, earleaf	*Acacia auriculiformis*	Australia, New Guinea, Indonesia
Australian pines, all	*Casuarina spp.*	South Pacific, SE Asia (Australia)
Brazilian pepper	*Schnius terebinthifolius*	Brazil, Argentina, Paraguay
Carrotwood	*Cupaniopsis anacardioides*	Australia
Chinaberry	*Melia azederach*	Asia
Chinese tallow	*Triadica sebifera*	China, Japan
Lead tree	*Leucaena leucocephala*	Central America
Punk	*Melaleuca quinquenervia*	Australia, New Guinea, Solomon Isle
Strangler fig	*Ficus aurea*	North America

Tree Canopy Analysis

The USDA Forest Service, the National Urban and Community Forestry Advisory Council (NUCFAC), American Planning Association (APA), and American Forests are just a few of the agencies that have assisted in creating standards for best practice when planning an urban forest. American Forests is a non-profit organization that was created in 1875 to protect and restore a healthy tree canopy in the United States. In 1997, American Forests published an article calling for a benchmark goal for cities to strive for 40 percent tree canopy cover. However, after twenty years of research, analysis, and progress with incredible advancements in technology, the Urban Forest Programs Director said in 2017 that the research no longer supports a universal recommendation of 40 percent tree canopy. Each city should have unique tree canopy cover goals to accommodate their density, climate, and variety of land uses[1]. Goals for canopy cover are most effective when established after studying the status of the urban forest and determining objectives for the future of the urban forest.[2] It is recommended that St. Pete set a citywide 30% tree canopy benchmark goal and expand tree canopy cover in each neighborhood when feasible. Further tree canopy analyses are needed to evaluate what areas of the City may be able to achieve higher levels than the goal and possibly what areas may be lower due to water bodies, development, and conflicts with utilities.

[1] Leahy, I. (2017). Why we no longer recommend a 40 percent urban tree canopy goal. *American Forests*.
[2] Nowak, D. J., Appleton, N., Ellis, A., & Greenfield, E. (2017). Residential building energy conservation and avoided power plant emissions by urban and community trees in the United States. *Urban Forestry & Urban Greening*, *21*, 158-165.

Case Studies Comparison

A comparison of five urban tree canopy studies was conducted to assist in choosing methods and compare results. These studies were chosen from areas inside and outside of Florida and outline a variety of available data analysis methods. As highlighted in the chart below, some studies were conducted at the city level and some at the county level. The City of St. Petersburg is exceeded in population by the City of Tampa, Sarasota County, and Miami-Dade County, but St. Petersburg has the highest population density of these municipalities.

	Population 2010	Est. Population July 1, 2016	Land Area (sq. mi.) 2010	Population Density (per sq. mi.) 2010	Urban Tree Canopy Coverage
Vancouver, Washington	161,791	174,826	46.46	3,482.70	18.60%
Chattanooga, Tennessee	167,674	177,571	137.16	1,222.50	22.50%
St. Petersburg, Florida	244,769	260,999	61.74	3,964.40	27%
Tampa, Florida	335,709	377,165	113.41	2,960.20	32%
Sarasota County, Florida	379,448	412,569	555.87	682.6	35%
Miami-Dade County, Florida	2,496,435	2,712,945	1,897.72	1,315.50	12.20%

While each city is encouraged to set targets and goals for a healthy canopy taking into consideration local characteristics, there are advantages to using similar methods for comparison and collaboration across municipal boundaries. There are two basic approaches to studying the urban tree canopy[3]: field-based assessments that collect data on physical characteristics of the urban forest such as species diversity, tree size, tree condition, and more; and desktop assessments that analyze aerial or satellite images to determine amount and distribution of tree cover.

25-Year Historic Vegetation Analysis: 1982-2007

Satellite images of St. Petersburg from 1982 and 2007 were used to illustrate changes in vegetation over a 25-year span. Over this time, 1.9% of the city's land area experienced major loss of vegetation and 0.5% experienced major gain in vegetation. Most of the major change was concentrated at the north end of the city, which today is called the Gateway Activity Center.

Data & Methodology

Multi-spectral images of the earth's surface obtained from satellite sensors provide analysts with data that can be classified into land cover types. National Aeronautics and Space Administration (NASA) launched the first Landsat satellite in 1972, and the most recent one in 2013. As technologies advance, so do the sensors on these satellites. When conducting studies of change over time, the images will vary based on the sensors in orbit. For this study, images were downloaded from the United States Geological Survey's Earth Explorer tool, from 1982 and 2007. Both images are projected in the Universal Transverse Mercator (UTM) in the WGS84 datum (World Geodetic Survey, 1984). Each came resampled with a cubic convolution and in GeoTIFF format.

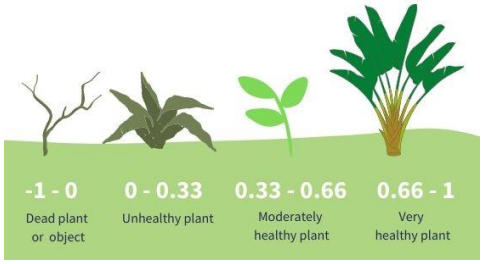
[3] Nowak, David. 2013. A Guide to Assessing Urban Forests. NRS-INF-24-13 Revised. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.

Image	# of Bands	Landsat Sensor	Date of Image	Resolution
L4-5 TM C1 Level-1	7	Landsat 4-5 Thematic Mapper (TM)	1982-12-18 at 06:00:00	30.0m
L4-5 TM C1 Level-1	7	Landsat 4-5 Thematic Mapper (TM)	2007-01-29 at 06:00:00	30.0m

The images are "Collection 1" images, meaning that they have been preprocessed at the highest level and are appropriate for pixel-level time series analysis. These images are terrain-corrected (radiometrically calibrated and orthorectified using ground control points and digital elevation model data to correct for relief displacement). However, they are not corrected for atmospheric corrections such as cloud cover, precipitation, and other weather.[4] Images were chosen during the winter months, when cloud cover and atmospheric noise are at a minimum in Florida.

Normalized Difference Vegetation Index (NDVI) is a widely used index that utilizes the red and near infrared bands of the multi-spectral images to detect vegetation density, or biomass. It is calculated as:

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$



NDVI does not specifically measure tree canopy, but rather all plant life containing biomass or nitrogen (N) content. NDVI values range from -1 (water, dead plants, or inanimate objects) to 1 (very healthy and dense plant life). Mangroves are extremely dense ecosystems, and therefore register very high on the NDVI scale.

ENVI, or Exelis Visual Information Solutions, Inc., is a software produced by Harris Geospatial Solutions that is available to the public for image processing. Prior to running any processes on these images, they must be pre-processed to account for differences between varying conditions. The Landsat Calibration tool was implemented on each image for radiance. Next, the images were spatially subset using a vector shapefile of the St. Petersburg land boundary. This masked out excess land and water which would skew the processing results. The masked values were set to NaN, or "not a number" to omit these pixels from statistical results. A "Dark Subtract" was then applied to remove atmospheric scattering from the images, subtracting a background pixel value from each band. At this point, the NDVI transformation was run on each image with a "Floating Point" data output.[5]

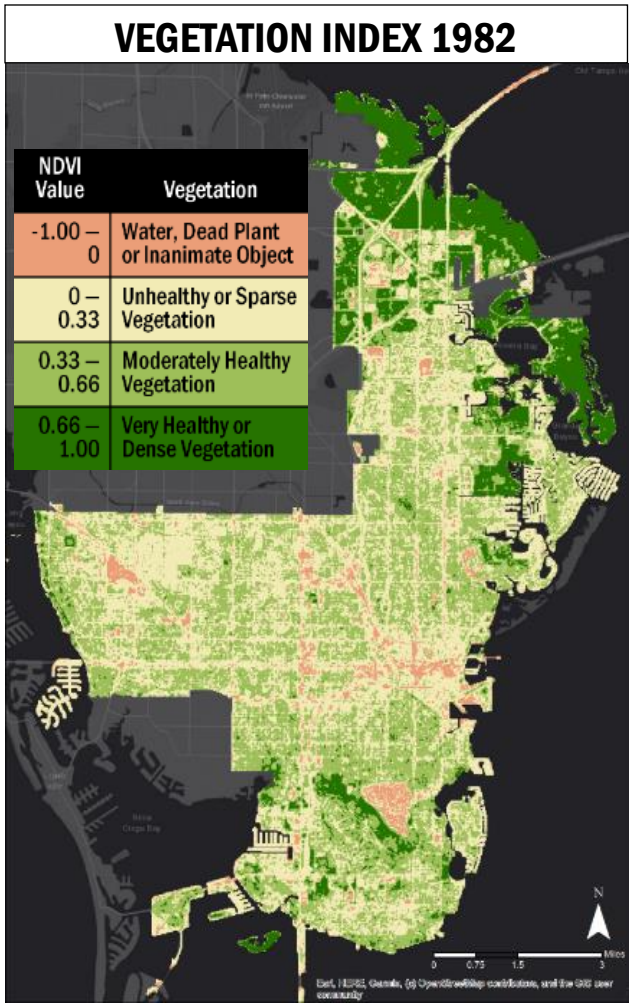
Interpreting the Results

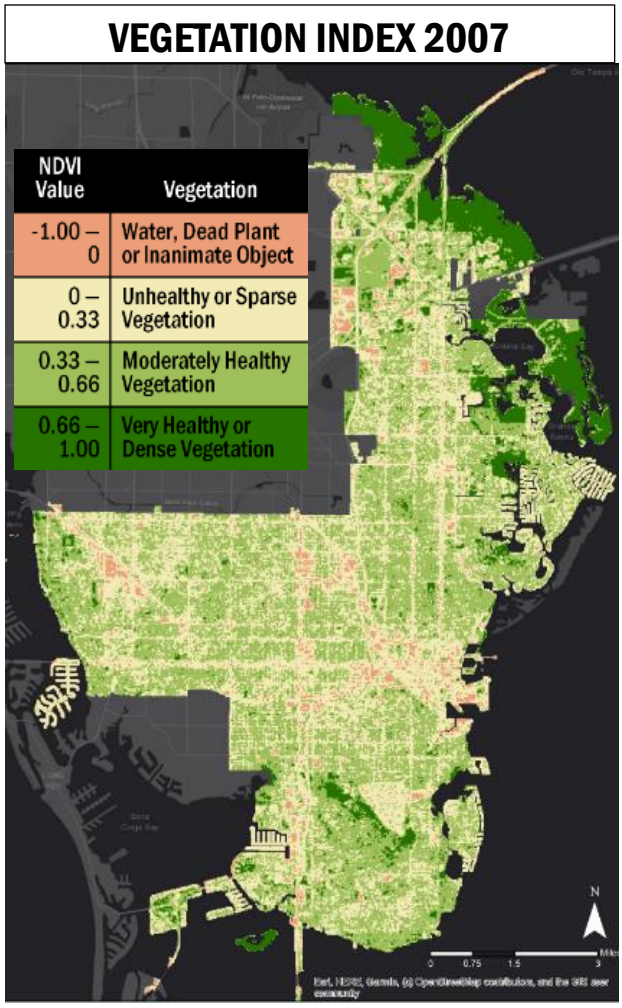
It is important to note that this NDVI study compares one day in 1982 to one day in 2007. Annual rainfall levels, temperatures, and many other variables contribute to an image's vegetation index, so this method is most effective for understanding differences in large tracts of vegetation and development over rather than granular time differences.

[4] Song, C., Woodcock, C. E., Seto, K. C., Lenney, M. P., & Macomber, S. A. (2001). Classification and change detection using Landsat TM data: When and how to correct atmospheric effects?. Remote sensing of Environment, 75(2), 230-244.

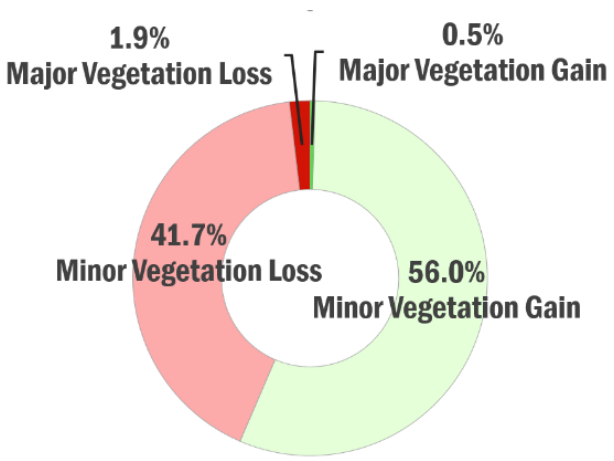
[5] Al-doski, J., Mansor, S. B., & Shafri, H. Z. M. (2013). NDVI differencing and post-classification to detect vegetation changes in Halabja city, Iraq. IOSR Journal of Applied Geology and Geophysics, 1(2), 01-10.

The maps below reveal the amazingly dense mangrove ecosystems at the northeast edge of St. Petersburg. These are indicated in dark green, as they register very high on the NDVI scale. Street corridors and commercial districts tend to register the lowest on the NDVI scale, shown in orange.





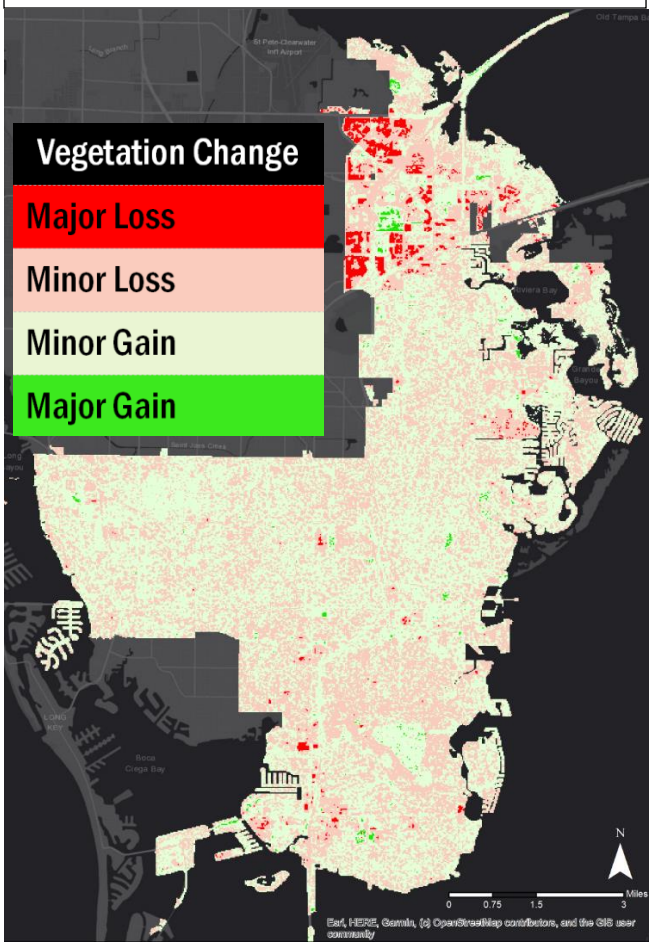
The method used in the two images below is called D-NDVI, which calculates the difference between two NDVI images to illustrate change in vegetation over time. This reveals a scale of vegetation loss to gain. In total, the area of vegetation gain outweighs the area of vegetation loss, however the area of major loss outweighs the area of major gain. It is helpful to view the areas of major loss and major gain in vegetation to highlight the most dramatic changes in the landscape.



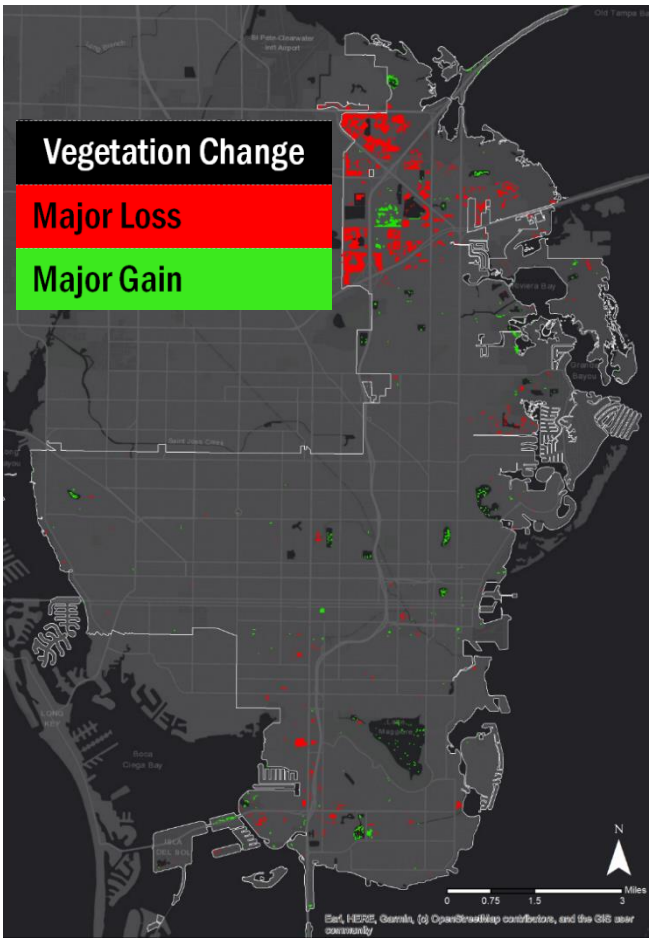
The north end of St. Petersburg experienced intensive development during the 1980s. This area today is a major employment center known as the

Gateway Activity Center. The area of major vegetation gain within that north end is the county's landfill. Areas of vegetation gain in bodies of water can indicate a few things, such as algae blooms, increase in nitrogen, or actual vegetation growth in and around the body of water.

CHANGES IN VEGETATION 1982-2007



MAJOR CHANGES IN VEG 1982-2007



Tree Canopy Analysis: 2017

St. Petersburg's tree canopy covers 27.2% of the city's land area according to our 2017 study of 4,000 data points using *i-Tree Canopy*. This is an increase of 3.4% - 4.9% from the City's 1975 analysis that provided a tree canopy cover estimate of 22.1% - 23.56%. Tree and vegetation classes when combined represent 52.4% of the city, and impervious surfaces represent 36.8% in 2017 compared to 45% in 1975. For a densely populated city that has seen a lot of redevelopment, tree canopy gain is an encouraging result.

Data & Methodology

The USDA Forest Service's i-Tree Canopy is a web-based application used to conduct random point sampling within a specified area. The program randomly selects and presents points for the user to identify and categorize into one of the previously determined land cover classes. The most basic analysis is distinguishing "tree" from "non-tree," but the user may prefer to conduct a more detailed land classification. There are limitations to the software, based on the images being sourced from different dates and the varying spatial resolutions of those images. Shadows and other environmental factors can contribute to poor image quality, which can make classification challenging. Much of the accuracy depends on the user to correctly determine the class of each point. Data points were gathered in August of 2017.

Prior to starting the random point sampling, the study area boundaries needed to be re-projected to latitude and longitude coordinates to be compatible with the i-Tree Canopy software. Because St. Petersburg is on the Pinellas peninsula, it was important to bring the city area boundary line as close to the land as possible, to ensure that an excess of water would not skew the results. Based on a combination of case studies and research, the following land classes were decided:

TREE:	tree canopy (trees, large shrubs, and woody plants providing shade)
VEGETATION:	non-tree vegetation (small shrubs, grasses, and understory plants)
BARE EARTH:	ground, soil, and earth
WATER:	Water
IMPERVIOUS:	roadways, sidewalks, pavement, and buildings

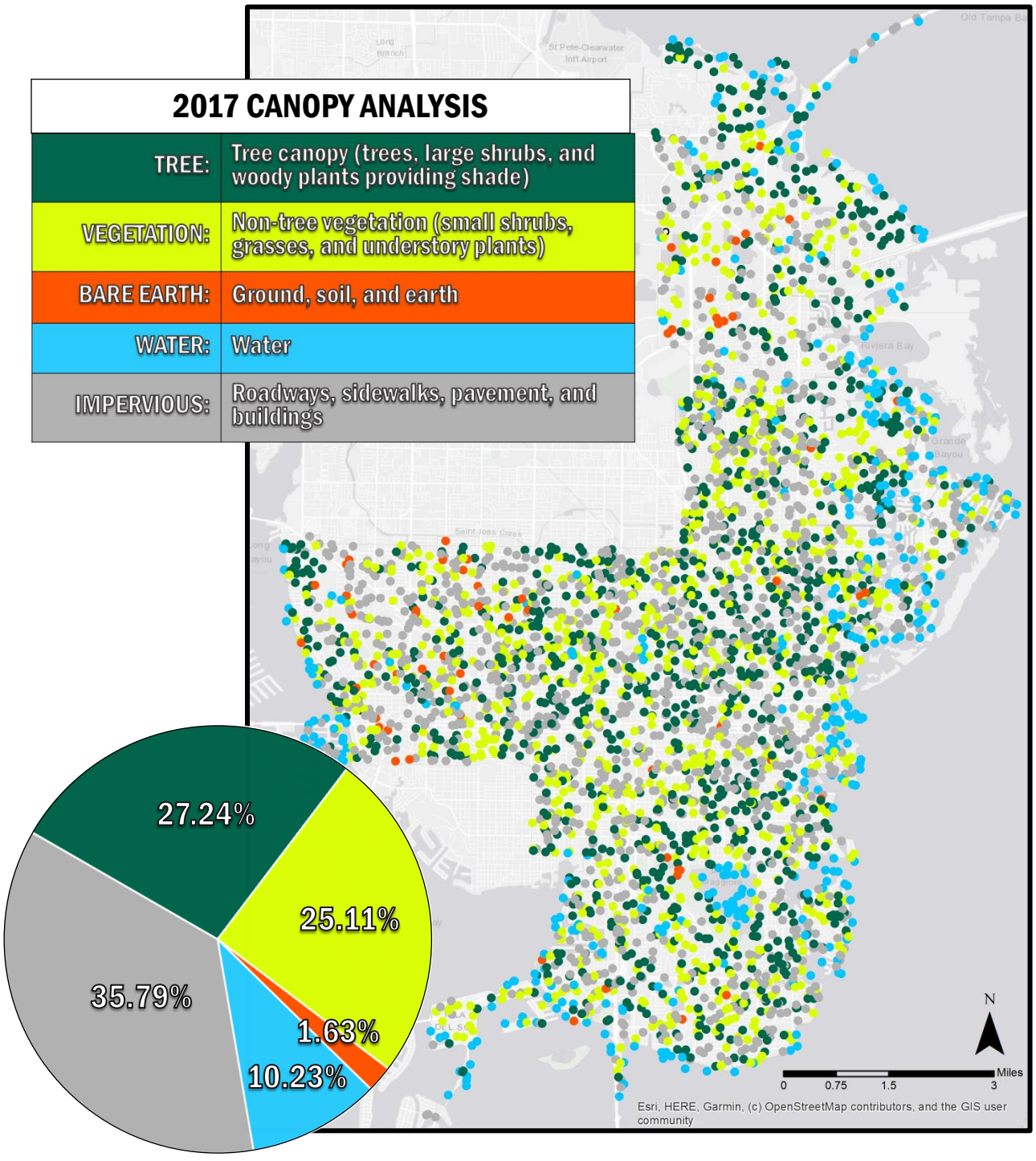
i-Tree recommends 500-1,000 points per study area. If too few points are classified, the land classification estimates will not be accurate enough. To help alleviate this issue, the program accounts for a standard error (SE). The SE of n number of tree points and N total number of points can be calculated, where p = n/N. The bigger the SE, the less accurate the result. Random point sampling results are estimations, and the SE provides the "plus or minus" for the mean of our sample. This study uses 500 points per council district, and 4,000 points city-wide. The standard error achieved in this report is consistent with the quality of other reports, +/- 2%. At the end of the random point sampling, the program produces a report of the land cover assessment and the estimated ecological services provided by the tree canopy[6]. After completing the random point

[6] U.S. Forest Service. (2013) "i-Tree Canopy Technical Notes". United States Department of Agriculture: Forest Service. Web. August 5, 2013. http://www.itreetools.org/canopy/resources/iTree_Canopy_Methodology.pdf

sampling with i-Tree Canopy, the points were then imported into ArcGIS for further analysis. A demonstration of the program's land classification process is provided on the next page.

Interpreting the Results

The random point sampling provided a result of 27% urban tree canopy cover for St. Petersburg. Tree and vegetation classes when combined represent 52% of the city, and impervious surface represents 36% in 2017 while impervious surface in 1975 represented 45% of total land area. For a densely populated city without room for sprawl, these are encouraging results. However, the city is experiencing rapid redevelopment and should plan accordingly to preserve, increase, and diversify the canopy as an asset.



To show the true ecological benefits of an urban tree canopy, the i-Tree Canopy program produces monetary values based on specific ecological services that the trees are providing. The following are the city-wide values from this land classification study. St. Petersburg's tree canopy is valued at nearly $11 million annually, plus an additional $53 million over the course of the trees' lifetime. These dollar values are based on the ecosystem benefits provided by the trees, as shown in the chart below.

Benefit Description	Abbr	Value ($)	SE ±	Amount (T)	SE ±
Annual Benefits					
Carbon Monoxide removed	CO	$13,967.76	$98.34	21,028.86	148.06
Nitrogen Dioxide removed	NO2	$19,095.88	$134.45	30.13	0.21
Ozone removed	O3	$2,241,703.29	$15,783.37	362.96	2.56
Particulate Matter <2.5 microns removed	PM2.5	$4,863,110.50	$34,240.16	14.74	0.10
Sulfur Dioxide removed	SO2	$1,780.36	$12.54	16,382.38	115.34
Particulate Matter >2.5 and <10 microns removed	PM10*	$577,588.66	$4,066.68	92.45	0.65
Carbon Dioxide sequestered annually in trees	CO2seq	$3,280,409.70	$23,096.69	93,047.07	655.13
		$10,997,656.15	**$77,432.23**		
Lifetime Benefit					
Carbon Dioxide stored in trees	CO2stor	**$53,108,107.37**	**$373,923.22**	1,506,383.23	10606.13
Total Benefits					
		$64,105,763.52	**$451,355.45**		

Calculated using the following rates:

	lbs/acre/ year	USD/T/year
CO	0.902	85.08 USD
NO2	4.917	26.86 USD
O3	48.968	140.47 USD
PM2.5	2.379	5,975.67 USD
SO2	3.098	7.45 USD
PM10*	16.403	304.43 USD
CO2 sequestered	9,970.817	35.38 USD
CO2 stored (total)	251,395.359	35.38 USD

Note: Currency is in USD
Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

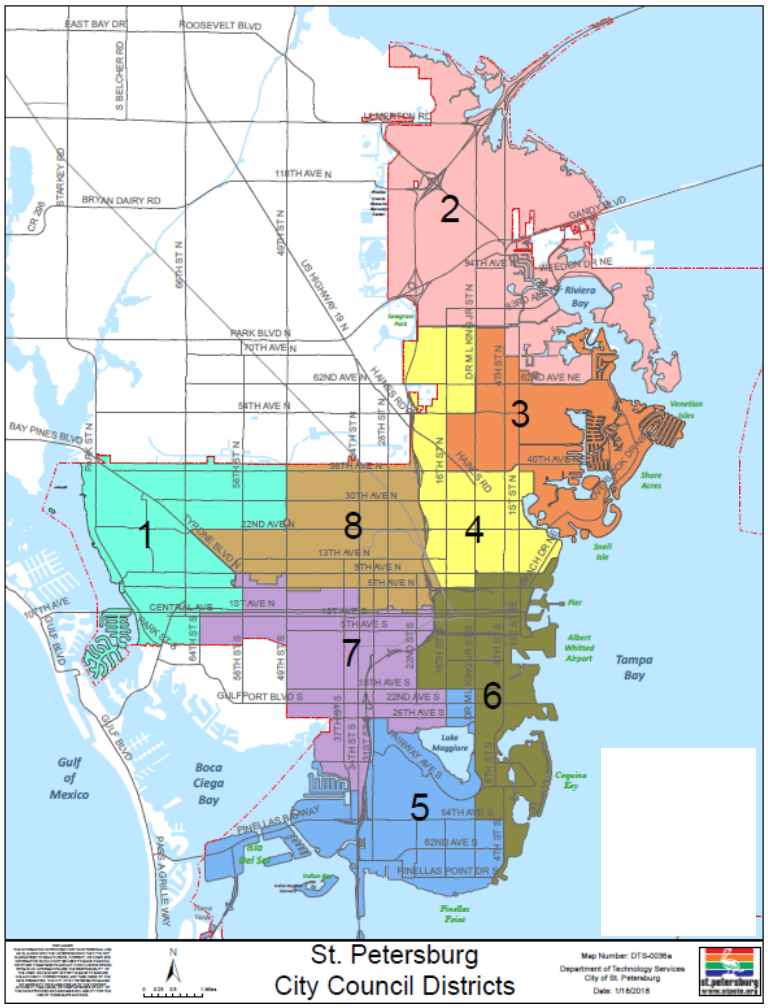
Results by City Council District

Land Classification results in this section are displayed for each City Council district. This provides a basis for gauging which areas of St. Petersburg may need more investment in tree plantings and canopy enhancements. Tree canopy coverage in city council districts 2, 4, 7, and 8 exceeded the city-wide canopy of 27.2%, while districts 1, 3, 5, and 6 had results less than the city-wide average.

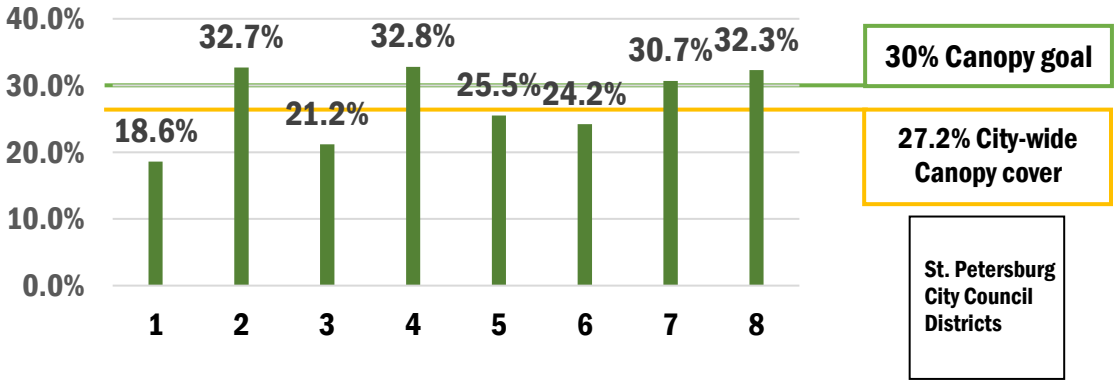
While District 2 experienced the most vegetation loss from 1982-2007, as shown in the last section, this district has the second-highest canopy coverage of any council district, and this is due to its impressive mangrove areas.

Tree canopy coverage is lowest in District 1 due to the heavy commercial development in the Tyrone area.

The following pages provide in-depth analysis for each district, including land classification results and ecosystem services provided by the tree canopy in each district.



Tree Canopy Coverage by City Council District

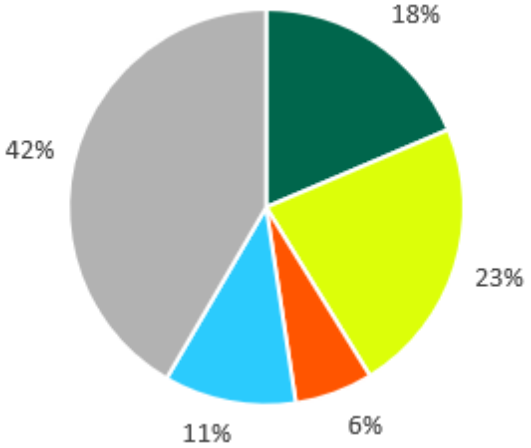


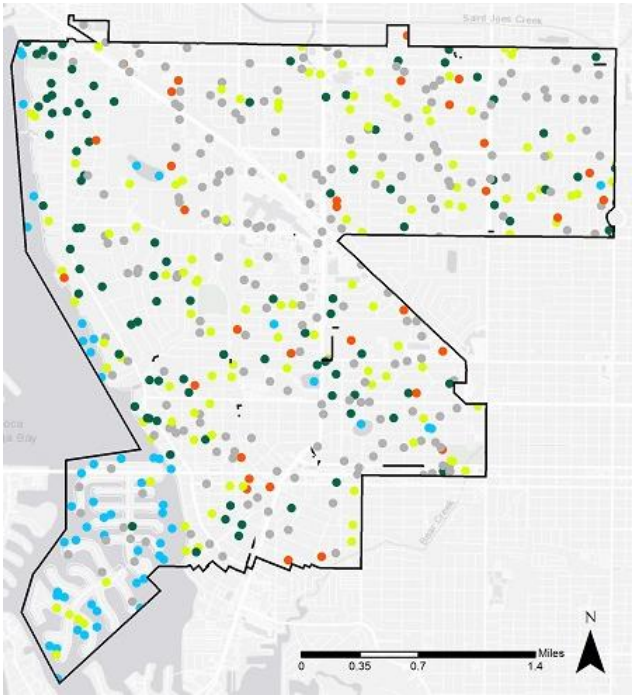
RESULTS BY CITY COUNCIL DISTRICT

Council District 1

City Council District 1					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$1,192.50	111.57	0.81	167.92
NO2	Nitrogen Dioxide removed	$1,630.32	152.53	2.57	0.24
O3	Ozone removed	$191,386.11	17,905.28	30.99	2.90
PM2.5	Particulate Matter < 2.5 microns removed	$415,189.56	38,843.39	1.26	0.12
SO2	Sulfur Dioxide removed	$152.00	14.22	0.63	130.73
PM10*	Particulate Matter > 2.5 microns and > 10	$49,311.81	4,613.41	7.89	0.74
CO2seq	Carbon Dioxide sequestered in trees	$280,065.99	26,201.80	7,943.92	743.20
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$4,534,121.04	424,193.33	128,607.93	12,032.02
		$5,473,049.33	$512,035.53	136,596.00	13,077.87

Cover Class	Points	% Cover
TREE:	93	18.6±1.74
VEGETATION:	113	22.6 ±1.87
BARE EARTH:	32	6.40 ±1.09
WATER:	54	10.8 ±1.39
IMPERVIOUS:	208	41.6 ±2.20



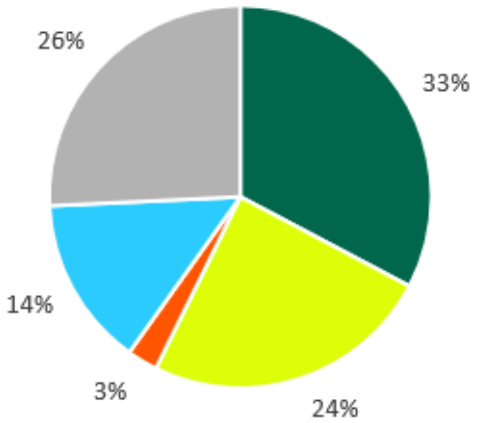


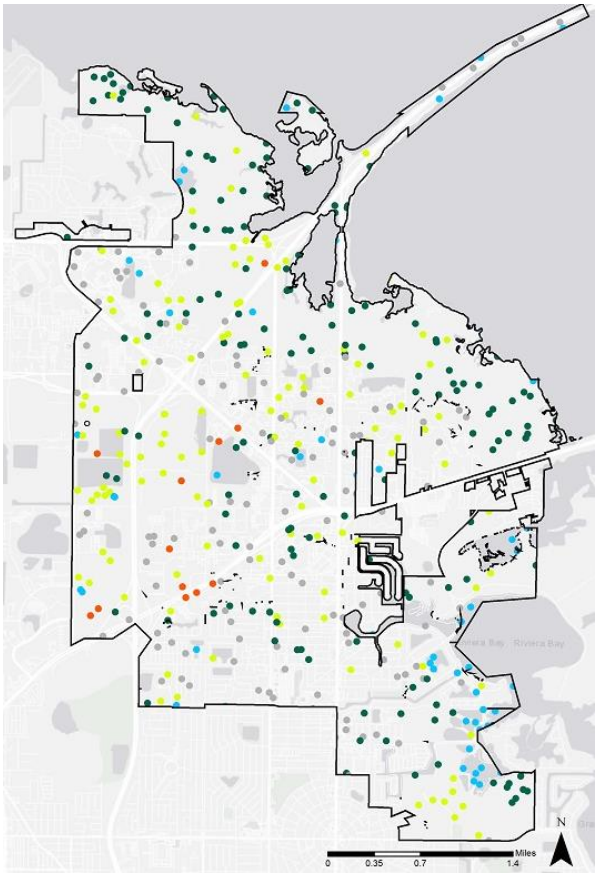
RESULTS BY CITY COUNCIL DISTRICT

Council District 2

City Council District 2					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$3,560.99	228.06	2.68	0.17
NO2	Nitrogen Dioxide removed	$4,868.37	311.79	7.68	0.49
O3	Ozone removed	$571,507.59	36,601.27	92.53	5.93
PM2.5	Particulate Matter < 2.5 microns removed	$1,239,818.21	79,402.13	3.76	0.24
SO2	Sulfur Dioxide removed	$453.89	29.07	2.09	0.13
PM10*	Particulate Matter > 2.5 microns and > 10	$147,252.45	9,430.54	23.57	1.51
CO2seq	Carbon Dioxide sequestered in trees	$836,319.00	53,560.69	23,721.74	1,519.22
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$13,539,564.59	867,119.32	384,042.55	24,595.38
		$16,343,345.09	$1,046,682.87	407,896.60	26,123.07

Cover Class	Points	% Cover
TREE:	164	32.7 ±2.10
VEGETATION:	123	24.6 ±1.92
BARE EARTH:	13	2.59 ±0.71
WATER:	72	14.4 ±1.57
IMPERVIOUS:	129	25.7 ±1.95



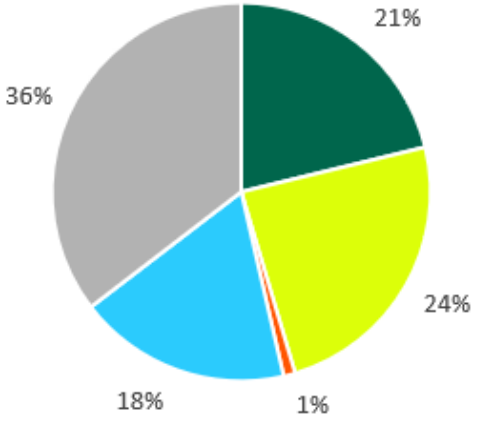


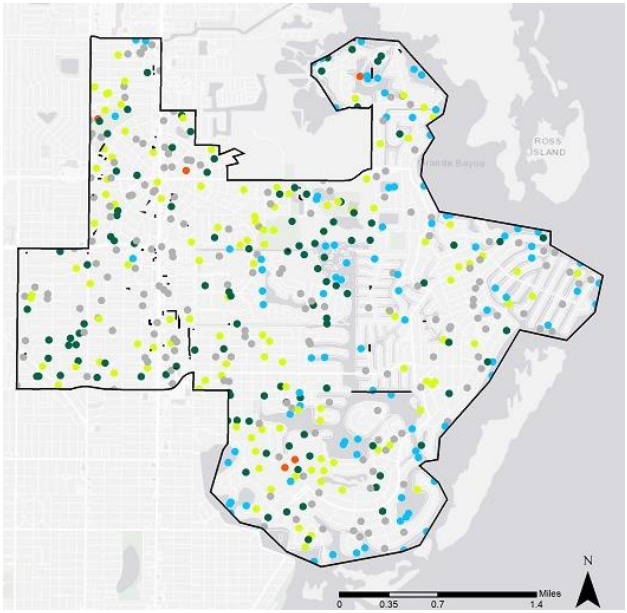
RESULTS BY CITY COUNCIL DISTRICT

Council District 3

City Council District 3					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$1,308.28	112.8	0.89	0.08
NO2	Nitrogen Dioxide removed	$1,788.60	154.21	2.82	0.24
O3	Ozone removed	$209,967.32	18,103.47	34.00	2.93
PM2.5	Particulate Matter < 2.5 microns removed	$455,499.29	39,273.34	1.38	0.12
SO2	Sulfur Dioxide removed	$166.76	14.38	0.70	0.06
PM10*	Particulate Matter > 2.5 microns and > 10	$54,099.37	4,664.47	8.66	0.75
CO2seq	Carbon Dioxide sequestered in trees	$307,256.91	26,491.82	8,715.18	751.43
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$4,974,327.71	428,888.67	141,094.16	12,165.20
		$6,004,414.24	$517,703.16	149,857.79	12,920.81

Cover Class	Points	% Cover
TREE:	106	21.2 ±1.83
VEGETATION:	121	24.2 ±1.92
BARE EARTH:	5	1.00 ±0.45
WATER:	91	18.2 ±1.73
IMPERVIOUS:	177	35.4 ±2.14



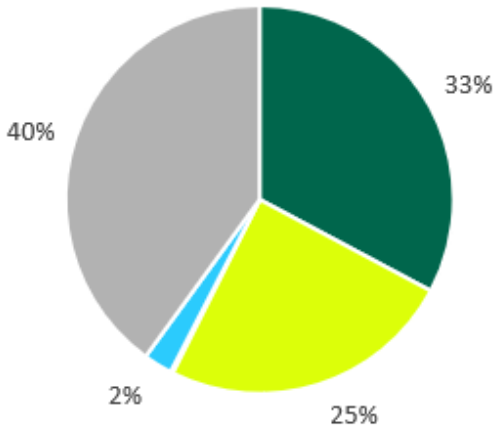


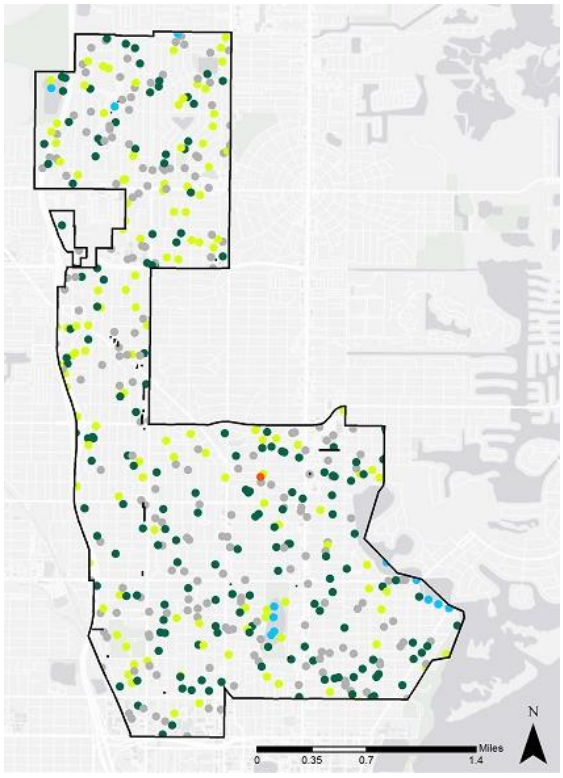
RESULTS BY CITY COUNCIL DISTRICT

Council District 4

City Council District 4					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$1,459.78	93.44	1.10	0.07
NO2	Nitrogen Dioxide removed	$1,995.72	127.75	3.15	0.20
O3	Ozone removed	$234,281.94	14,996.90	37.93	2.43
PM2.5	Particulate Matter < 2.5 microns removed	$508,246.99	32,534.00	1.54	0.10
SO2	Sulfur Dioxide removed	$186.07	11.91	0.78	0.05
PM10*	Particulate Matter > 2.5 microns and > 10	$60,364.19	3,864.04	9.66	0.62
CO2seq	Carbon Dioxide sequestered in trees	$342,837.85	21,945.80	9,724.41	622.48
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$5,550,364.44	355,291.01	157,433.14	10,077.64
		$6,699,736.98	$428,864.85	167,211.71	10,703.59

Cover Class	Points	% Cover
TREE:	164	32.8 ±2.10
VEGETATION:	123	24.6 ±1.93
BARE EARTH:	1	0.20 ±0.20
WATER:	12	2.40 ±0.68
IMPERVIOUS:	200	40.0 ±2.19



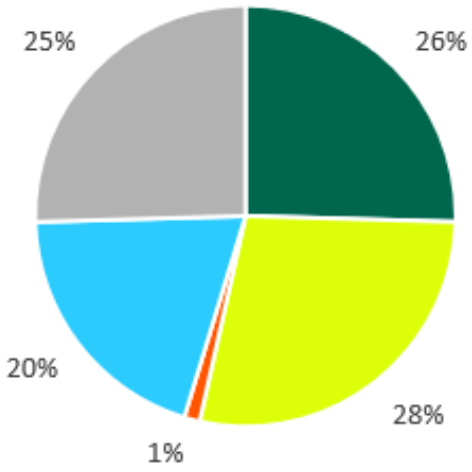


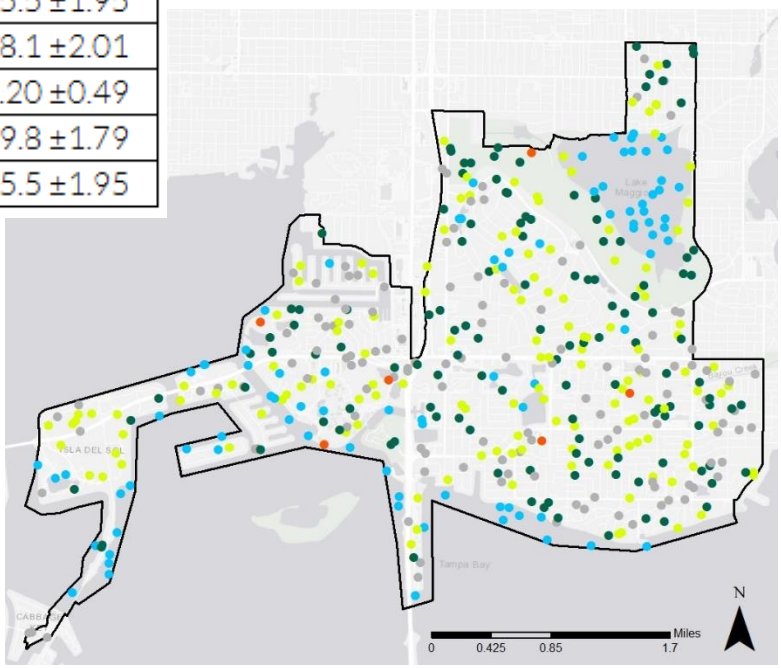
RESULTS BY CITY COUNCIL DISTRICT

Council District 5

City Council District 5					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$1,792.44	137.33	1.35	0.10
NO2	Nitrogen Dioxide removed	$2,450.52	187.75	3.87	0.30
O3	Ozone removed	$287,671.80	22,040.26	46.58	3.57
PM2.5	Particulate Matter < 2.5 microns removed	$624,069.99	47,813.73	1.89	0.15
SO2	Sulfur Dioxide removed	$228.47	17.5	1.05	0.08
PM10*	Particulate Matter > 2.5 microns and > 10	$74,120.41	5,678.81	11.87	0.91
CO2seq	Carbon Dioxide sequestered in trees	$420,966.22	32,252.74	11,940.48	914.83
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$6,815,221.67	522,154.86	193,310.14	14,810.64
		$8,226,521.52	$630,282.98	205,317.23	15,730.58

Cover Class	Points	% Cover
TREE:	127	25.5 ±1.95
VEGETATION:	140	28.1 ±2.01
BARE EARTH:	6	1.20 ±0.49
WATER:	99	19.8 ±1.79
IMPERVIOUS:	127	25.5 ±1.95



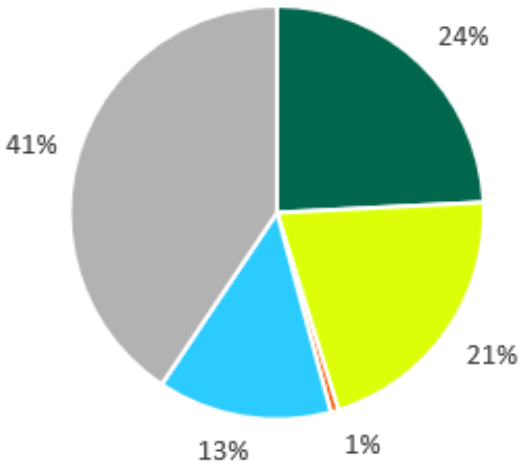


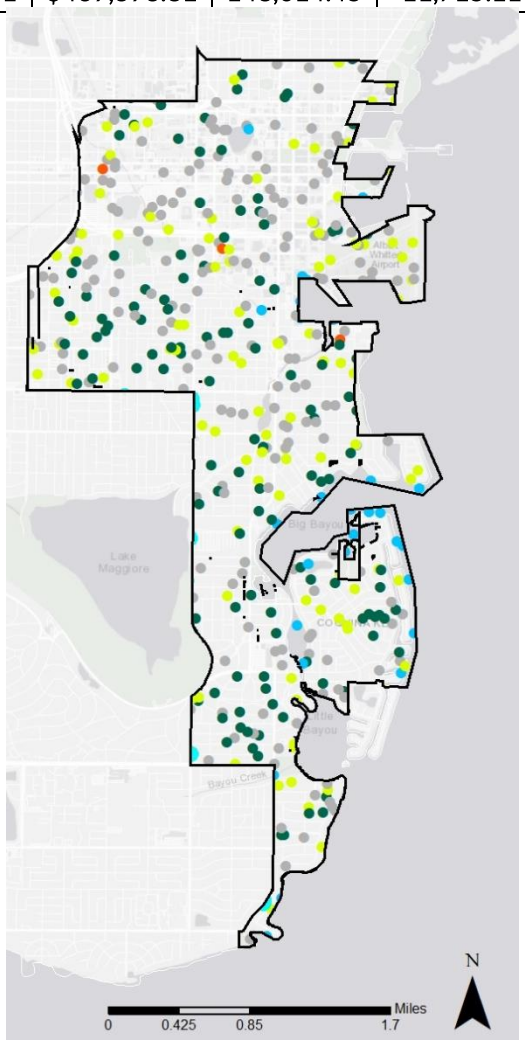
RESULTS BY CITY COUNCIL DISTRICT

Council District 6

City Council District 6					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$1,292.19	102.27	0.88	0.07
NO2	Nitrogen Dioxide removed	$1,766.60	139.82	2.79	0.22
O3	Ozone removed	$207,384.60	16,414.15	33.58	2.66
PM2.5	Particulate Matter < 2.5 microns removed	$449,896.39	35,608.56	1.36	0.11
SO2	Sulfur Dioxide removed	$164.70	13.04	0.69	0.05
PM10*	Particulate Matter > 2.5 microns and > 10	$53,433.92	4,229.21	8.55	0.68
CO2seq	Carbon Dioxide sequestered in trees	$303,477.47	24,019.74	8,607.98	681.31
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$4,913,140.64	388,867.02	139,358.62	11,030.01
		$5,930,556.51	$469,393.81	148,014.45	11,715.11

Cover Class	Points	% Cover
TREE:	121	24.2 ±1.92
VEGETATION:	105	21.0 ±1.82
BARE EARTH:	3	0.60 ±0.35
WATER:	68	13.6 ±1.53
IMPERVIOUS:	203	40.6 ±2.20



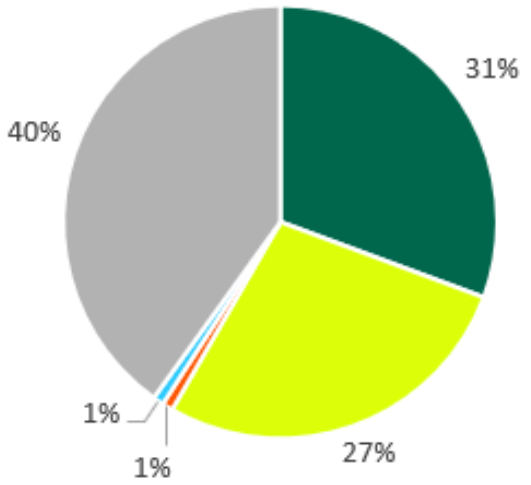


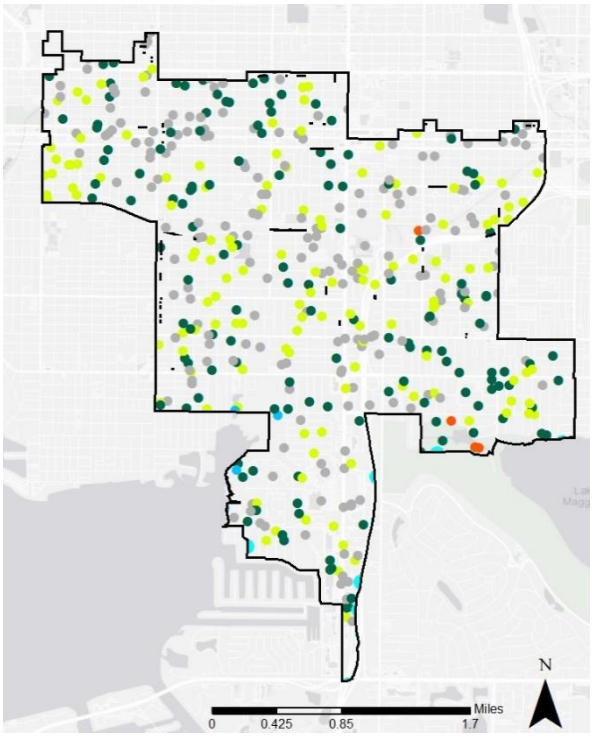
RESULTS BY CITY COUNCIL DISTRICT

Council District 7

City Council District 7					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$1,716.67	115.57	1.29	0.09
NO2	Nitrogen Dioxide removed	$2,346.93	157.99	3.70	0.25
O3	Ozone removed	$275,510.70	18,547.29	44.61	3.00
PM2.5	Particulate Matter < 2.5 microns removed	$597,687.93	40,236.16	1.81	0.12
SO2	Sulfur Dioxide removed	$218.81	14.73	1.01	0.07
PM10*	Particulate Matter > 2.5 microns and > 10	$70,987.03	4,778.82	11.36	0.77
CO2seq	Carbon Dioxide sequestered in trees	$403,170.21	27,141.29	11,435.71	769.85
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$6,527,113.61	439,403.22	185,138.11	12,463.44
		$7,878,751.89	$530,395.07	196,637.60	13,237.59

Cover Class	Points	% Cover
TREE:	153	30.7 ±2.06
VEGETATION:	138	27.7 ±2.00
BARE EARTH:	4	0.80 ±0.40
WATER:	4	0.80 ±0.40
IMPERVIOUS:	200	40.1 ±2.19



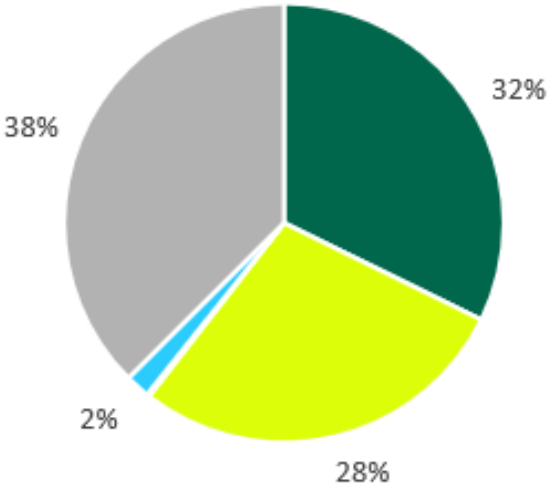


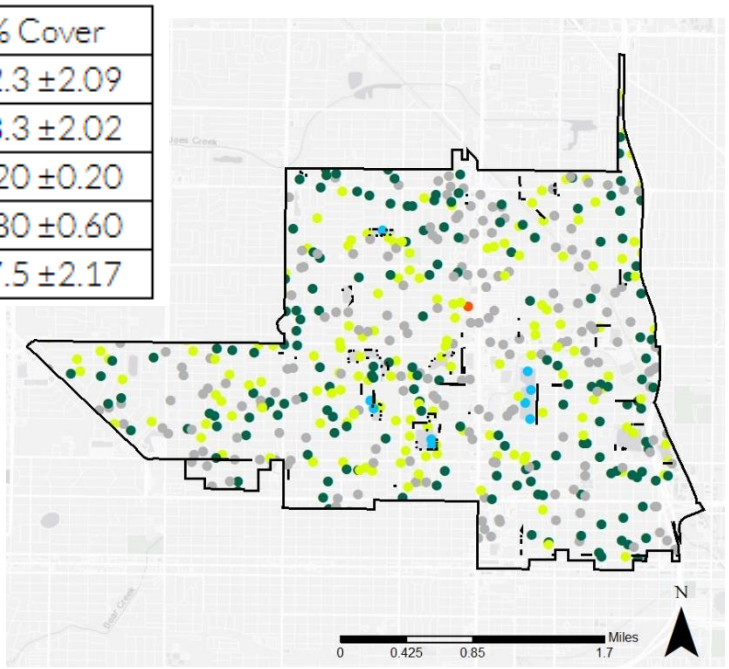
RESULTS BY CITY COUNCIL DISTRICT

Council District 8

City Council District 8					
Abbr.	Annual Benefit Description	Value ($)	±SE	Amount (T)	±SE
CO	Carbon Monoxide removed	$1,644.91	106.69	1.24	0.08
NO2	Nitrogen Dioxide removed	$2,248.82	145.86	3.55	0.23
O3	Ozone removed	$263,993.23	17,123.32	42.74	2.77
PM2.5	Particulate Matter < 2.5 microns removed	$572,702.14	37,147.02	1.74	0.11
SO2	Sulfur Dioxide removed	$209.66	13.6	0.87	0.06
PM10*	Particulate Matter > 2.5 microns and > 10	$68,019.48	4,411.93	10.89	0.71
CO2seq	Carbon Dioxide sequestered in trees	$386,316.05	25,057.51	10,957.65	710.74
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$6,254,253.67	405,667.89	177,398.58	11,506.55
		$7,549,387.96	$489,673.82	188,417.26	12,221.25

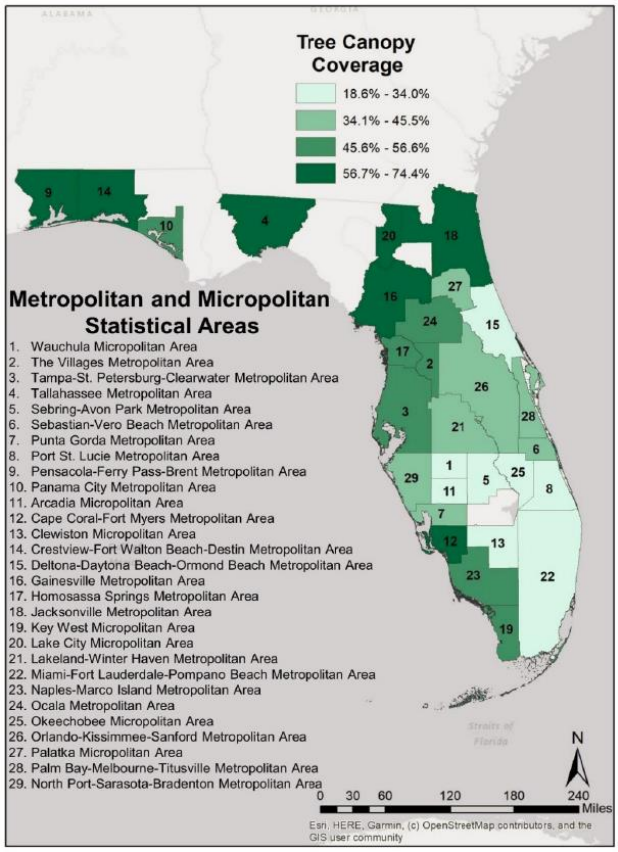
Cover Class	Points	% Cover
TREE:	161	32.3 ±2.09
VEGETATION:	141	28.3 ±2.02
BARE EARTH:	1	0.20 ±0.20
WATER:	9	1.80 ±0.60
IMPERVIOUS:	187	37.5 ±2.17





Florida-Wide Study

In November 2020, a team from the University of Florida published results of a state-wide urban tree canopy study entitled *Florida's Urban Forest: A Valuation of Benefits*[7]. The study compares Florida's 29 metropolitan and micropolitan census-designated areas[8], totaling 98% of Florida's population. The team used a desktop analysis approach of generating random point samples within each study area using satellite imagery and designating the points as "Tree/Shrub" or "No-Tree." The results produced a percent canopy cover of the metropolitan/micropolitan areas with 95% confidence interval. This approach is extremely beneficial for comparing tree canopy of urbanized areas because the same parameters, methodology, and 2019 imagery are used across Florida. The ecosystem benefits were calculated using the rates obtained from the i-Tree Canopy software[9].



A summary of results for the five most populated areas are included here, which includes ecosystem benefit results for all 29 metropolitan and micropolitan areas in Florida. The chart below is in order of population top to bottom, and the gradient from green to light green indicates percent canopy cover.

Overview of Canopy Cover

Map #	Area	2019 Population	Percent Canopy Cover with 95% Confidence Level	Canopy Area (ac)	Canopy Area SE (ac)
22	Miami-Fort Lauderdale-Pompano Beach	6,166,488	25.6% ± 1.9%	820,294	31,686
3	Tampa-St. Petersburg-Clearwater	3,194,831	46.2% ± 2.2%	733,931	18,052
26	Orlando-Kissimmee-Sanford	2,608,147	45.5% ± 2.2%	1,046,163	26,673
18	Jacksonville	1,559,514	67.8% ± 2.0%	1,367,161	22,678
29	North Port-Bradenton-Sarasota	836,995	35.9% ± 2.1%	296,465	8,950

[7] McLean, Drew & Koeser, Andrew & Hilbert, Deborah & Landry, Shawn & Abd-Elrahman, Amr & Britt, Katie & Lusk, Mary & Andreu, Michael & Northrop, Robert. (2020). Florida's Urban Forest: A Valuation of Benefits. EDIS. 2020. 10.32473/edis-ep595-2020.
[8] Metropolitan areas have one city or town with more than 50,000 people. Micropolitan areas have one city or town with a population between 10,000 and 50,000 people.
[9] i-Tree Canopy software version 7.0 (https://canopy.itreetools.org/benefits/).

Goals and Next Steps

This Tree Canopy Analysis serves as a contributing document in planning for future tree planting programs and urban forestry management initiatives. St. Petersburg's Comprehensive Plan and the Integrated Sustainability Action Plan include the following city-wide goals and targets related to urban forestry and tree canopy cover. Notes are included to discuss if St. Petersburg is meeting these goals, based on current knowledge.

City of St. Petersburg Comprehensive Plan	
Objective C4	The City of St. Petersburg shall protect green open space areas and the native vegetation and wildlife in St. Petersburg in the manner identified in the Recreation/Open Space Element of the Comprehensive Plan so as to maintain a citywide total of 50% green permeable open space.
Notes	*The results of this Tree Canopy Analysis show that 27% of the city has tree canopy cover and 25% is non-tree vegetative cover. While these two land classifications total 52% when combined, it is important to keep in mind that many urban trees are planted in small planting islands within parking lots and streetscapes, which do not equate to permeable open space. An additional assessment of permeable open space is needed to confirm if the city meets this objective (potential to use Pinellas County's LIDAR data for this analysis).*
Policy C4.1	The City shall preserve and increase vegetation (trees, shrubs, herbaceous plants) through enforcement of the existing Land Development Regulations and promote further restoration of native vegetation to produce oxygen and filter air pollutants.
Notes	*Land Development Regulation Code Section "16.40.060 Landscape and Irrigation" addresses this policy.*
Objective C8	The City shall implement the Urban Forestry Plan and other existing programs to replant a specified number of new trees in rights of way and other public property, and in an annual amount to equal or exceed the hardwood trees removed per year from rights of way areas, through implementation of the Environmental Enhancement Fund.
Notes	*Currently, no Urban Forestry Plan exists to guide the goals set out in this objective. Funds from the Environmental Enhancement Fund are not being used for this purpose.*

Integrated Sustainability Action Plan	
3.8 Natural Systems Targets & Objectives	Determine city's current green infrastructure acreage and set goal for percentage of land area designated green stormwater infrastructure
Notes	*St. Petersburg does not currently have a green infrastructure analysis or goals for green stormwater infrastructure.*
3.8 Natural Systems Targets & Objectives	Demonstrate that 85% of the population lives within 1/3 mile of green infrastructure features that provide localized cooling through tree canopy or vegetative surfaces.
Notes	*In the 2019 STAR Communities certification process, it was determined that St. Pete met and exceeded this target (using Pinellas County's LIDAR data). This target should be reassessed as new data becomes available.*
3.8 Natural Systems Priority Action	Assess the state of the urban forest. The City should conduct a tree canopy analysis and an assessment of tree health to determine a base year and goals for tree canopy and other urban vegetation. Results should be incorporated with continued improvements for tree protection and green infrastructure investments.
Notes	*This Tree Canopy Analysis fulfills this ISAP priority action. Many cities reassess the canopy every five years or as new/improved data becomes available.*

Additional Targets for Consideration

3-30-300 Rule

In May 2021, Cecil C. Konijnendijk (Nature Based Solutions Institute) introduced the 3-30-300 Rule, which states "Everybody should be able to see 3 trees from their home, live in a neighbourhood with at least 30% tree canopy (or vegetation) cover, and be no more than 300 metres from the nearest green space that allows for multiple recreational activities." This rule provides very personal metrics that aim to enhance the experience of living in an urban environment, while promoting tree canopy that provides many public health and climate benefits to the community as a whole.

10-20-30 Rule

Common guideline for diversity in an urban forest, stating that densities shall not exceed 30% from a single plant family, 20% of a single genus, and 10% of a single species. This diversity rule strives to create a resilient urban forest that will fare better against pests, diseases, and additional threats from the impacts of climate change.

Conclusion

St. Petersburg should continue to strive to meet the above goals and objectives, including the creation of an Urban Forestry Plan, green infrastructure goal setting, and continued analysis of the urban forest and green permeable open space. Goals and recommendations should be incorporated into planning documents and processes for the City's Comprehensive Plan, Land Development Regulations, Stormwater Master Plan, ISAP progress reports and updates, and other relevant visioning like StPete2050. Collaboration among city departments and the community is imperative to ensuring that these goals are achieved, and that the tree canopy continues to grow.