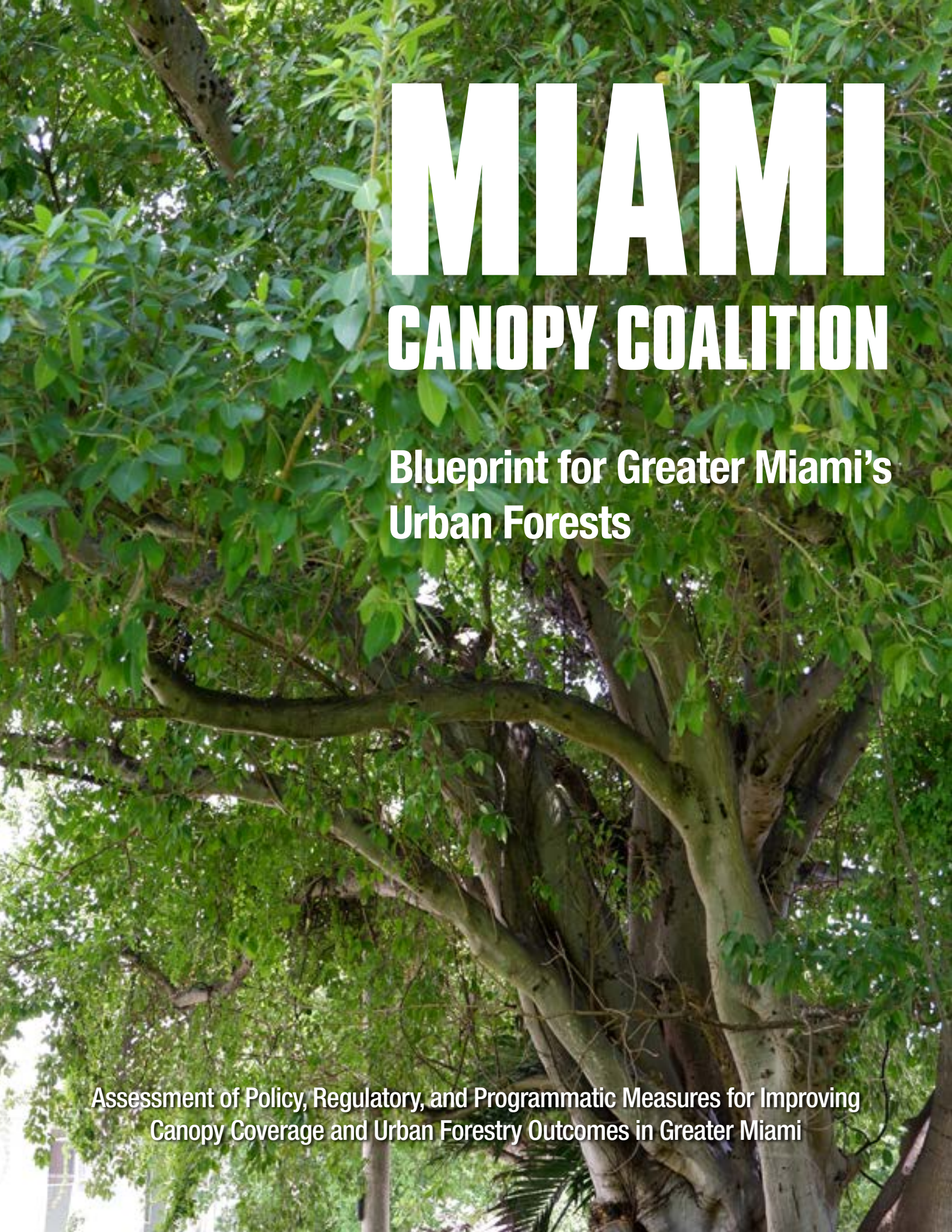

MIAMI CANOPY COALITION

Blueprint for Greater Miami's Urban Forests

Assessment of Policy, Regulatory, and Programmatic Measures for Improving Canopy Coverage and Urban Forestry Outcomes in Greater Miami

About the Miami Canopy Coalition

In 2019, Dade Heritage Trust invited several concerned organizations and individuals to a meeting to discuss the increased loss of tree canopy in our community. The turnout was overwhelming, and it was clear that some action had to be taken to demand better from our decision makers regarding tree preservation and protection policy and procedures. The directive from the group was that we needed thorough research on current tree policies and trends, and education and outreach to the community to teach about the wonderful benefits of trees. The Miami Canopy Coalition was formed.

With a clear vision of next steps, Dade Heritage Trust received a grant from the Miami Foundation and a contribution from then District 8 County Commissioner, and now Miami-Dade Mayor, Daniella Levine-Cava which provided funding for in-depth research and outreach which became the basis for this report.

The Miami Foundation
For A Greater Miami

MIAMI-DADE COUNTY

JULIE DICK LAW, P.A.

Celebrating Fifty Years
DADE HERITAGE TRUST
Preservation. Education. Advocacy.
Founded 1972

Dade Heritage Trust, founded in 1972, is Miami-Dade County's largest historic preservation organization with a mission to preserve Miami-Dade County's architectural, environmental and cultural heritage through education and advocacy.

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Assessment of Policy, Regulatory, and Programmatic Measures for Improving Canopy Coverage and Urban Forestry Outcomes in Greater Miami

I. Introduction

This report evaluates potential actions at the local level to support healthy and abundant urban forests throughout Miami-Dade County ("County") and its municipalities (collectively referred to as "Greater Miami"). The County set a tree canopy cover target of 30% recognizing the importance of the urban forest in the region's resilience to climate impacts. Despite recurring tree give-away events, expanded tree planting programs on public land, and the fact that tree ordinances are in place at the County and among the municipalities within it, the county-wide tree coverage has remained largely unchanged over the last five years—at or around 20%.[1]

American Forests, a conservation non-profit founded in 1875,[2] has had a decades-long stance that cities should have a 40% canopy coverage goal.[3] Today, members of the American Forests' science advisory board suggest that 40-60% urban tree canopy coverage is attainable and could be used to achieve specific objectives related to heat control and stormwater runoff.[4] This report recommends increased canopy cover targets for Greater Miami consistent with American Forests recommendations, along with a variety of strategies for meeting such targets.

In the ever-changing reality of climate change and the successional nature of municipal code and ordinance revisions, this work proposes recommendations to promote new and protect existing tree cover. We consider mechanisms for preservation of the oldest and largest trees that define the history and character of communities in Greater Miami, along with community planning and design criteria that provide the infrastructure and space for a growing and thriving urban forest into the future. The analysis and solutions proposed herein address the policies, rules, and programs that can serve to support healthy and vibrant urban forests throughout the region.

We recommend a panoply of policy, regulatory, and programmatic solutions. This document also serves to flag levers and decision points where integrating trees will facilitate improved urban forestry management. Different strategies will be applicable depending on the specific environmental conditions, geography, and the position of a specific municipality or unincorporated area of Miami-Dade County.

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1 Hochmair, H. H., Benjamin, A., Juhasz, L., Olivas, P., Gann, D., & Fu, Z. J. (2021). Miami-Dade County urban tree canopy assessment. https://www.miamidade.gov/parks/library/urban-tree-canopy-assessment-2021.pdf

2 American Forests. (n.d.) https://www.americanforests.org/

3 Leahy, I. (2017, January 12). Why we no longer recommend a 40 percent urban tree canopy goal. American Forests. https://www.americanforests.org/cities/why-we-no-longer-recommend-a-40-percent-urban-tree-canopy-goal/

4 Leahy, 2017 (no. 3).

A. Scope and Purpose

The opportunities and strategies recommended herein may serve as tools for preserving and enhancing the region's urban tree canopy. This document is designed to be a resource and reference for policy makers and advocates seeking to improve tree canopy cover in Florida communities, with a focus on Greater Miami. After describing of the benefits of tree canopies in the urban landscape in part B of this introduction,

SECTION II talks about the role of comprehensive urban forestry planning, including the role of tree canopy assessments, neighborhood tree master plans, urban forestry master plans, protected tree designations, and standards for maintenance, along with a discussion of ongoing forestry management in and around Greater Miami through case studies.

SECTION III demonstrates the inextricable link between trees and resilience in managing the impacts of climate change, in addition to considerations for preparing the region's urban forests for ongoing climate change impacts.

SECTION IV frames this work in the context of environmental justice, showing how the principles above present opportunities to improve the quality of life, public health, sense of place, and character of Greater Miami's most under-served communities.

SECTION V discusses relevant state statutes, case law, and state regulations pertaining to the regulation of tree cover. Here, the interplay between municipal decision-making and state rules are important considerations when making municipal policies.

SECTION VI shows how land use, zoning, and land acquisition can be applied as tools to ensure that continued development maintain invaluable tree resources and provides for future canopy growth.

SECTION VII introduces tree ordinances as a management tool and synthesizes existing guidelines detailing what makes for an effective tree ordinance.

SECTION VIII discusses innovations in the training and licensing of professionals involved in code enforcement, landscaping, development, and tree removal—and penalties if these professionals do not follow appropriate protocols, along with public outreach and engagement in connection with urban forestry goals.

Followed by the conclusion in **SECTION IX**.

Sections after the introduction are organized to include a discussion of the subject matter, presentation of relevant case studies, recommendations for policy, and model code language. Model language includes examples of language in cities and counties, as well as model language developed by the authors. Any such model language may or may not be a fit for a specific municipality.

It is important that urban forestry goals are integrated into land use, zoning, development, stormwater, sustainability, and resilience components throughout the code and not just within the context of tree removal regulations in a tree ordinance for several reasons. For one, through integrating these priorities into broader decision-making and development activities, trees and green infrastructure can be better enmeshed in the fabric of the urban and suburban landscapes. Further, policy and code amendments can be written to reflect the costs of tree removal and the benefits of preserving and enhancing tree canopy more accurately in development decisions, hence better capturing the value of canopy cover in market decisions. Consideration of urban forests and greening across municipal policies outside of tree ordinances' tree removal provisions is particularly important considering the home rule limitations the State of Florida has placed on local governments in connection with tree removal, among other aspects of growth management and planning. Through integrating trees more broadly in municipal code and policies, local governments may be able to regain some agency over decisions impacting trees in their communities.

Stewardship of Greater Miami's urban forests requires comprehensive forestry management, along with the support of engaged and educated stakeholders. This paper is designed to provide tools and strategies that can be applied expanding canopy cover and building upon the benefits that healthy urban forests deliver.

B. Benefits of Tree Canopy Cover

The urban treescape is the habitat hosting the vibrance, character, and quality of life in Greater Miami. Trees, green space, and canopy cover provide vital and irreplaceable services to the built environment, and together coexist as an urban ecosystem. The combination of aesthetics, air quality, water quality, shading, temperature moderation,[5] flood management,[6] pollution control,[7] public health,[8] energy cost savings,[9] and climate change resilience[10] benefits that a healthy tree canopy provides are well-documented. Native and exotic tree species alike are central to Greater Miami's local ecosystem and flourishing assemblage of flora and fauna, providing food, habitat, breeding grounds, roosting sites, and protection from predators, for year-round wildlife as well as seasonally migratory species.[11]

Tree canopy is also correlated with better public health outcomes. For example, increased tree canopy has been found to correspond with lower rates of hospitalization.[12] The air filtering properties of trees improve air quality, and studies have confirmed the benefits of green space to reduce stress, improve mood, increase energy levels, and even boost the immune system.[13]

5 Einhorn, C. (2021, July 2). What technology could reduce heat deaths? Trees. The New York Times. https://www.nytimes.com/2021/07/02/climate/trees-cities-heat-waves.html

6 Swann, C. (2017, December 28). Review of the available literature and data on the runoff and pollutant removal capabilities of urban trees. Center for Watershed Protection, Inc. https://owl.cwp.org/mdocs-posts/review-of-the-available-literature-and-data-on-the-runoff-and-pollutant-removal-capabilities-of-urban-trees/

7 Swann, 2017 (no. 6).

8 Wolf, K. L., Lam, S. T., McKeen, J. K., Richardson, G., van den Bosch, M., & Bardekjian, A. C. (2020). Urban trees and human health: A scoping review. International Journal of Environmental Research and Public Health, 17(12), 4371. https://doi.org/10.3390/ijerph17124371

9 U.S. Environmental Protection Agency. (n.d.). Using trees and vegetation to reduce heat islands, as cited in Akbari, H., et al. (1997). Peak power and cooling energy savings of shade trees. Energy and Buildings, 25, 139-148. https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands#2

10 Zeng, H., Chambers, J. Q., Negron-Juarez, R. I., Hurtt, G. C., Baker, D. B., & Powell, M. D. (2009). Impacts of tropical cyclones on U.S. Forest tree mortality and carbon flux from 1851 to 2000. Proceedings of the National Academy of Sciences of the United States of America (PNAS), 106(19), 7888-7892. https://doi.org/10.1073/pnas.0808914106

11 Roman, L. A., Conway, T. M., Eisenman, T. S., Koeser, A. K., Ordóñez Barona, C., Locke, D. H., Jenerette, G. D., Östberg, J., & Vogt, J. (2021). Beyond 'trees are good': Disservices, management costs, and tradeoffs in urban forestry. Ambio, 50(3), 615–630. https://doi.org/10.1007/s13280-020-01396-8

12 Wolf, et al., 2020 (no. 8).

13 Wolf, et al., 2020 (no. 8).

In the 2016 Miami-Dade Urban Tree Canopy Assessment,[14] researchers compared urban tree canopy coverage to rates of hospitalization for asthma by zip code, finding that those areas with greater tree cover were correlated with lower rates of hospitalization for asthma per resident. Recent studies have shown exposure to tree canopy is also associated with better mental health and lower incidence of heart disease, hypertension, and diabetes.[15] Some studies have even shown a connection between urban forests and higher birth weights, faster recovery from surgery, and greater life expectancy.[16]

Researchers have found correlations between the urban tree canopy and various social factors including social cohesion, student performance, and crime rates.[17] Trees in public spaces like parks and outdoor common areas serve as gathering spaces for neighbors of all ages, strengthening neighborhood cohesion and social ties. For example, spending time in nature helps people to rebuild focus from attention fatigue and can be especially helpful for children diagnosed with Attention-Deficit/Hyperactivity Disorder.[18] This may explain why exposure to green space in schools has been associated with improved academic performance.[19]

A 2001 study noted that although there is a long-standing belief that the presence of vegetation facilitates crime due to the possibility of hiding criminal activity from view, its analysis found that views of greenspace and trees may deter crime within inner-city neighborhoods.[20] Apart from criminality, the study shares broader implications that vegetative and canopy cover help people to recover from mental fatigue, which also mitigates psychological precursors to violence that include irritability, inattentiveness, and decreased control over impulses.[21] Other research cites reduced violence and crime when residents have a view of trees.[22]

Intact trees, especially those of advanced size and age, act as carbon sinks and have measurable impacts on the energy and carbon footprint of adjacent buildings from natural cooling, diminishing the need for resource-intensive air conditioning. As climate change brings hotter temperatures to some of Miami's most vulnerable areas, trees are able to counteract dangerous urban heat island effects that put people at risk, especially during hot summer months.

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14 Hochmair, H. H., Gann, D., Benjamin, A., & Fu, Z. J. (2016). Miami-Dade County urban tree canopy assessment. GIS Center. 65. https://digitalcommons.fiu.edu/gis/65

15 Wolf, et al., 2020 (no. 8).

16 Wolf, et al., 2020 (no. 8) at p. 4.3.1.

17 Wolf, et al., 2020 (no. 8) at p. 4.1.5, 4.2.2 and 4.2.4.

18 Kuo, F. E., & Taylor, A. F. (2004). A potential natural treatment for attention-deficit/hyperactivity disorder: Evidence from a national study. American Journal of Public Health, 94(9), 1580–1586. https://doi.org/10.2105/ajph.94.9.1580

19 Kuo, M., Klein, S. E., HEM Browning, M., & Zaplatosch, J. (2021). Greening for academic achievement: Prioritizing what to plant and where. Landscape and Urban Planning, 206, 103962. https://doi.org/10.1016/j.landurbplan.2020.103962

20 Kuo, F. E., & Sullivan, W. C. (2021). Environment and crime in the inner city: Does vegetation reduce crime? Environment and Behavior, 33(3), 343-367. https://doi.org/10.1177/0013916501333002

21 Kuo, & Sullivan, 2021 (no. 20) at p. 347.

22 Kuo & Sullivan, as cited in Robbins, J. (2015). The man who planted trees: A story of lost groves, the science of trees, and a plan to save the plant. Random House. at 54, 55, 56 (In a study of public housing residents in Chicago, "[f]ourteen percent of residents living in buildings without tees threatened violence against their family with a knife or gun, while just 3 percent did so in in buildings surrounded by trees and other greenery." A second "study found that the highest crime statistics for residences at Ida B. Wells correlated with places where there was no view of, or access to, nature.")

Trees provide oases of shade, limiting "temperature hotspots" that often occur in commercial or warehouse areas of sparse tree cover.[23] In the urban and suburban settings of Miami-Dade County, trees help block noise and counteract the heating effects of hardscape and concrete.

Further, trees serve as critical resilience infrastructure in Greater Miami to protect against the impacts of climate change and sea level rise. Tree canopy is a component of green infrastructure ("GI") because trees can act as natural barriers to extreme weather and rising seas. Root systems protect against soil erosion, in addition to hard infrastructure like pumps and seawalls, "living shorelines" formed from trees and shrubs, which may include mangroves, can be used to mitigate against coastal flooding risks. By absorbing stormwater and controlling surface runoff,[24] trees and other vegetative ground cover are the first line of defense to protect communities against flooding and pollution of surface water.

Preserving the urban tree canopy, planting new trees, and facilitating development that values trees, requires integrating trees into a vast array of public policy and design decisions. Greater Miami faces unique threats from climate change that can be effectively addressed, at least in part, from strategies that include trees.

23 Hochmair, et al., 2021 (no. 1). Miami Urban Tree Assessment, incidence of cooler surface temperature areas was correlated with water bodies, grassland, and residential areas with high canopy cover.

24 City of Miami Code of Ordinances, Ch. 17, acknowledging the tree canopy benefits of "stabilizing the soil, preventing erosion and excessive runoff."

II. Comprehensive Urban Forestry Management, Protected Tree Designations, and Native Landscaping

This section evaluates mechanisms for managing the urban forest to identify, protect, maintain, and value beloved trees and tree stands, while succession planning for an expanding urban tree canopy. Forestry management involves inventorying, urban forestry planning, tree planting, pruning, and when needed, tree removal. Identifying and defining the types of trees that define communities as heritage or champion trees, as well as the services and benefits certain trees and tree stands deliver, is vital to being able to support the preservation of such trees. The maintenance and management of trees prioritized for preservation can be determinative of the services trees deliver, as well as the health and vitality of individual trees.

In 1993 and 2014, Researchers at University of Wisconsin conducted a census of tree activities using data from 667 communities across the United States. Researchers noted over the period between the two census reports municipal urban forestry evolved. People working in urban forestry were "more professional, paid better, use[d] recognized standards of work and [were] more systematic in their management."[25] While "[communities continued] to diversify how programs get funded in addition to general funding monies."[26] The results showed communities apply "[a] variety of policy tactics and plans […] to manage the urban forest."

A. Discussion

1. Potential for expanded canopy cover in Greater Miami

The results of the Municipal Tree Care and Management Census provide a baseline of comparison for urban forestry management activities across municipalities in the United States. Canopy goals were in place or being developed by 25% of census respondents. Of the cities surveyed, 100% of those cities with a population over 1 million had canopy cover goals. The average goal was to go from 32% to 44% canopy cover over the next 13 years.[27] While American Forests' science advisory board recommends 40-60% urban tree canopy cover to mitigate heat and stormwater impacts.[28]

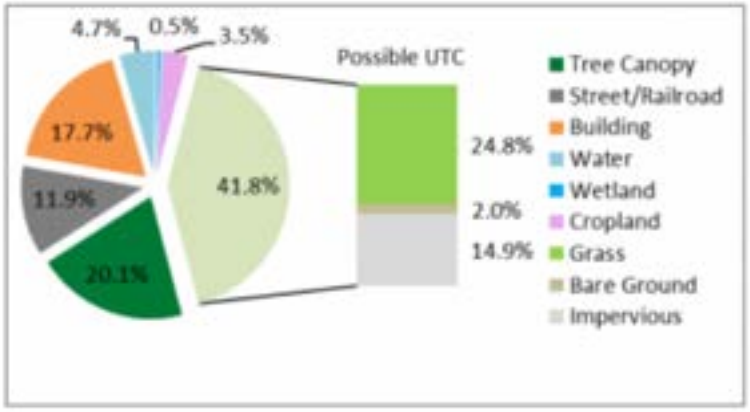
25 Hauer, R. J., & Peterson, W. D. (2016). Municipal tree care and management in the United States: A 2014 urban & community forestry census of tree activities. Special Publication 16-1, College of Natural Resources, University of Wisconsin, Stevens Point. https://www3.uwsp.edu/cnr/Documents/MTCUS%20%20Forestry/Municipal%202014%20Final%20Report.pdf

26 Hauer & Peterson, 2016 (no. 25).

27 Hauer & Peterson, 2016 (no. 25) at p. vii.

28 Hauer & Peterson, 2016 (no. 25).

Miami-Dade County's 30% canopy cover target is below both numbers. Miami-Dade's actual canopy coverage of 20.1%, based on the County's 2021 Tree Canopy Assessment, is less than Los Angeles's 21% canopy coverage and New York City's 24% canopy coverage.[29] Miami-Dade County's 2021 Urban Tree Canopy Assessment identified 41.8% of "[total additional [potential urban tree canopy (]PUTC[)], which includes grass, bare ground, and impervious surface (e.g., paved parking lots, but not buildings, streets, or railroads)."[30] This is in addition to the existing 20.1% of canopy coverage in the County. As the pie chart below from the County's 2021 Urban Tree Canopy Assessment shows, Miami-Dade has the potential for up to 60% canopy coverage. [31]



2. Urban forestry management, data, tree Inventories, tree canopy assessments and tree master plans

Urban forestry management spans landscape types through coordinated activities and ongoing monitoring of tree resources. "Urban forestry is the art, science, and technology of managing trees and forest resources in and around urban communities for the environmental, social, and economic benefits trees provide to people."[32] Comprehensive urban forestry management includes inventories, assessments, forestry planning, care, and maintenance. Broadly speaking, urban forestry entails a management system that spans municipal watersheds, habitat for wildlife, outdoor recreation, landscape design, recycling and waste disposal, tree care and maintenance, and the raw material production of wood fiber.[33] Ongoing assessments regarding best practices for tree survival, "are critical in assessing the effectiveness of forestry programs to retain trees intended to be preserved, particularly when development occurs."[34]

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29 Fracassa, D. (2019, June 28). SF's budget for new trees surges, but city falls far short of planting goal. San Francisco Chronicle. https://www.sfchronicle.com/bayarea/article/SF-s-tree-planting-budget-surges-but-removals-14056408.php

30 Hochmair, et al., 2021 (no.1) at p. 9.

31 Hochmair, et al., 2021 (no.1) at p. 9.

32 Miller, R. W., Hauer, R. J., & Werner, L. P. (1997). Urban forestry: Planning and managing urban greenspaces. Waveland Press. (As cited in Konijnendijk, C. C. (2003). A decade of urban forestry in Europe. Forest Policy and Economics, 5(2), 173-186. doi:10.1016/S1389-9341(03)00023-6)

33 Miller, R. W., Hauer, R. J., & Werner, L. P. (2015). Urban forestry: planning and managing urban greenspaces (3rd ed.). Waveland press.

34 Pike, K., O'Herrin, K., Klimas, C., & Vogt, J. (2021). Tree preservation during construction: An evaluation of a comprehensive municipal tree ordinance. Urban Forestry & Urban Greening, 57, 126914. 10.1016/j.ufug.2020.126914

Tree inventories have historically been used as a management tool since the 1800s.[35] Tree inventories, including electronic databases with species, diameter, location, and maintenance information are used by 72% of communities for "directing work for identifying tree planting locations" and by 53% of communities for scheduling pruning, as part of an ongoing process. Experts note that "[t]ree inventory data should be used to direct urban forest management and report information to the community."[36] Florida International University developed an ArcGIS map that provides detailed information regarding land cover in Miami-Dade, Broward, and Palm Beach Counties.[37] The land cover information displayed identifies land classifications on the map that include impervious, road/rail, bare ground, buildings, grass, trees, wetland, water, and cropland. This information provides valuable insights regarding areas of the County that would benefit from increased tree canopy, as well as identifying areas where urban tree canopy should be preserved. Miami-Dade County's 2016 and 2021 Urban Tree Canopy Assessments discussed in the case study of this section below provide further data on the County's urban forest. Additionally, more detailed tree inventories have been developed by the City of Miami within the context of street tree master plans, as discussed in more detail in the case study of this section. Miami-Dade County's Street Tree Master Plan, discussed in the case study section as well, has not been updated for 15 years, since 2007. Continuous development of tree inventory information is helpful to support urban forestry management and decision-making. This includes more robust tree databases and ArcGIS systems with specific information regarding species, maintenance needs, size, and protected tree status.

A comparative study of management plans notes that mature systems utilize an "action plan," as defined by the American Public Works Association, that bestows public work agencies with "detailed information, recommendations and resources" needed for the effective management of urban trees.[38] Notably, the City of Miami Beach took a similar approach in developing an urban forestry master plan in 2021,[39] which compliments additional efforts undertaken to integrate trees into stormwater management systems. This effort is addressed in more detail in the case study below.

Continuous integration of tree data to identify tree species, health, canopy coverage, maintenance needs, and tree diameter at breast height ("DBH") can be a valuable tool to inform management, maintenance, code enforcement, and policy decisions (such as protected tree designations and therefore applicability of connected policies).

3. Maintenance and standards for the care for trees

Effective maintenance of urban forests ensures the measurable benefits that well maintained trees provide are delivered to communities. The urban treescape provides measurable benefits when properly maintained, but the societal cost of poor tree maintenance remains poorly understood.[40] Forestry management requires resources to support ongoing maintenance of the urban forests. "Mismanaged urban forests can cause ecosystem disservices such as invasive species, pests, disease, decreased property value, and risk of damage to property or human life."[41]

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35 Hauer & Peterson, 2016 (no. 25).

36 Hauer & Peterson, 2016 (no. 25).

37 Map available at http://dpanther2.fiu.edu/itis/index.html.

38 American Public Works Association, (2015), as cited in, Suzanne, R. (2016). A comparative study of urban forest management programs for three major cities in Santa Clara County: A benchmarking study. Master's Projects, 469. San Jose State University. DOI: https://doi.org/10.31979/etd.5en3-v98

39 City of Miami Beach. (2020). Miami Beach rising above: Miami beach urban forestry master plan. https://www.mbrisingabove.com/wp-content/uploads/2020-CMB-UFMP-Final-compressed.pdf

40 Lyytimaki & Faehnie, 2009; von Dohren & Haase, 2015 & Vogt et al., 2015 (as cited in Pike, et al., 2021) (no. 34)

41 Lyytimaki & Faehnie, 2009 (as cited in Pike, et al., 2021) (no. 34).

Successful management of urban forests requires following best practices for the care and maintenance of trees. In 1991, government agencies, tree care providers and green industries agreed to develop a standardized scientific approach that would "take authoritative precedence over previously existing tree care industry standards."[42] As a result of this consensus, the Tree Care Industry Association developed an Official American National Standard for the management of trees, known as ANSI 300.

Among the Municipal Tree Care and Management Census respondents, more than half incorporate industry standards in their tree maintenance procedures. In Miami-Dade County, "tree removal permits are not required for the selective pruning of trees, provided the pruning is done according to the most recent American National Standards (ANSI) A300 Standard Practices for Tree Care Operations. However, excessive pruning (i.e., hat racking, topping, etc.) which results in the effective destruction of a tree constitutes a violation of Section 24-49 of the environmental Code of Miami-Dade County."[43] Lack of training and licensing requirements leaves uncertainties about overall compliance with these regulations, ANSI 300, and other best practices and standards among private landscaping firms in Southeast Florida. Training and licensing requirements are addressed in more detail in Section VIII.

The extent to which these standards are followed carries consequences for the survival of individual trees and the overall status of the canopy. As Greater Miami is continuously developed and redeveloped, along with concurrent public infrastructure and capital projects, the treatment of trees in the planning and construction processes can be determinative of tree survival. For example, a 2021 study of the implementation of tree protection zones during construction (Part of the ANSI 300 standard) in Highland Park, Illinois "provided valuable evidence that tree protection zones are effective in protecting the soils surrounding trees intended to be preserved during construction."[44] Where standards and best practices are followed, trees can fare well in the construction process. Responsibility for tree maintenance for trees in the rights-of-way ("ROW") can be determinative of whether maintenance needs are met for a large fraction of urban tree canopy. Following the 2014 urban forestry census, approximately one-third of U.S. adjacent property owners were solely (16%) or jointly (16%) responsible for trees located on municipal ROW while the municipality was responsible in approximately two-thirds of cases.[45] "Regardless, […] a duty is owed to the community's people for their safety."[46] Hauer and Peterson recommend identifying responsibilities and defining the level and standards of care. The study notes that "[d]eferred tree maintenance will likely lead to future tree structural issues. Some communities report challenges to adequately fund a program to identified needs."[47]

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42 TCIA. (n.d.). History. Tree Care Industry Association. https://www.tcia.org/TCIA/Build_Your_Business/A300_Standards/History.aspx

43 Miami-Dade Country. (2021). Tree removal permit application package. https://www.miamidade.gov/permits/library/tree-removal.pdf at p. 2.

44 Pike, et al., 2021 (no. 34) at p. 11. ("In a study that surveyed soil compaction levels on suburban construction sites, the authors recommended dividing lots into specific zones, i.e., building activity areas vs. tree preservation areas, in order to limit unintended soil compaction due to factors such as construction site traffic (Randrup, 1997; Randrup and Dralle, 1997)."

45 Hauer & Peterson, 2016 (no. 25) at p. 6-7. ("Communities in the Western states place greater responsibility upon adjoining property owners with 28% solely and 21% jointly with the municipality responsible").

46 Hauer & Peterson, 2016 (no. 25) at p. 6-7.

47 Hauer & Peterson, 2016 (no. 25) at p. V.

In Miami-Dade County and the City of Miami property owners are responsible for trees planted in the ROW or swale by their property. Permits are often required for tree maintenance activity. Conducting tree maintenance on the ROW often requires a complex coordinated process involving the property owner, the municipality or the County, service provider, an arborist, and oftentimes the electric utility.

Streamlined processes that confer responsibility on cities and the County for tree maintenance in the ROW may serve to ease the burden on residents and improve the viability and health of street trees. Identification of an annual budgetary mechanism to pay for maintenance of ROW trees would be needed prior to transferring the responsibility.

Understanding the return on investment that local governments achieve from money spent in caring for and expanding urban forests can help to demonstrate the real benefit to society in investing in urban forests. One rationale for calculating the annual dollar value of benefits conferred by street trees is to offer comparison to the annual cost of maintenance, thereby establishing a "benefit investment ratio" ("BIR"), as advocated by the U.S. Forest Service i-Tree tool.[48] BIR calculations from two cities in California indicate returns between $3.22 and $5.43 for every dollar spent on trees.[49] Tree disease as well as "the reallocation of money from maintenance to tree removal and replanting" are challenges that affect municipal budgets across the country.[50]

4. Protected trees

Greater Miami's oldest and largest trees provide significant values and benefits warranting protection. "Larger trees provide the most social, economic, and ecological benefits."[51] However, protections that rely largely on tree size can have unintended consequences of incentivizing owners to remove trees prior to being of sufficient size to garner protections under the ordinance, effectuating destructive failure of future tree resources.[52]

There are clear economic benefits to tree protection as mature trees and canopy cover translate to increases in property value.[53] Nevertheless, studies have shown uncertainties on the precise valuation of these benefits, and some homeowners exhibit preferences that favor smaller ornamental trees, preemptively removing trees that have larger growth patterns.[54] These studies indicate that the homeowners' preferences may be skewed towards low maintenance trees, which may be at odds with and hinder the sustainability goals of municipalities.[55]

Various tree designations may define trees in a manner that distinguishes trees based on the benefits a tree provides, while facilitating policies that incentivize—and at times require—the preservation of the most valued trees to ensure continued delivery of such benefits. Protected trees often provide significant tree canopy, flood management, ecosystem services, and carbon sequestration benefits that cannot be readily replaced by new tree plantings.

Identifying trees based on specific criteria in a municipal code can be used to support the most

48 Suzanne, 2016 (no. 38).
49 Suzanne, 2016 (no. 38) at p. 20-21.
50 Hauer & Peterson, 2016 (no. 25).
51 Lindenmayer & Laurance, 2017 (as cited in Pike et al., 2021) (no. 34).
52 Pike et al., 2021 (no. 34) at p. 70.
53 Morales, 1980; Dombrow et al., 2000 & François et al., 2002 (as cited in Pike, et al., 2021) (no. 34) at p. 2.
54 Dilley & Wolf, 2013; Andrew & Slater, 2014 (as cited in Pike et al., 2021) (no. 34) at p. 2.
55 Conway, 2016 (as cited in Pike et al., 2021) (no. 34).

effective policy decision-making and management of those resources. Distinction of trees and how they are treated within a municipal code can be used to improve tree resources and prioritize preservation and care of the most treasured trees. Comprehensive Development Master Plan (hereinafter "CDMP" or "comprehensive plan"), and in prioritizing maintenance and programmatic resources.[56] The term "protected tree" is used hereinafter to refer generally to any number of potential tree designations, including those listed in the subsections below.

a) Heritage Trees

Multiple studies identify cultural heritage as impacting the reasons residents value urban trees.[57] Heritage and Champion Tree designations have been used effectively by municipalities as mechanisms to identify and protect highly valued tree resources. Code language creates the designation and identifies trees that qualify as Heritage Trees. A Heritage Tree designation would designate which trees need to be prioritized for preservation, due to their size, age, or historical value.

While a heritage tree may be a native species, this protection could also be afforded to an exotic species with longstanding benefits to the community or of exceptional size. Loss of greenspace, even if such greenspace includes exotic tree species, none-the-less represents loss of the stormwater capacity, shading, heat reduction, human health benefits, and habitat that green space provides. However, in some situations concerning invasive species, it is a preferred option to replace with native vegetation. In many cases, the contributions many exotic trees supply cannot be easily replaced, including significant shading, carbon sequestration, and infiltration benefits, in addition to creating a sense of place marking a location's history and heritage.

Many trees, while not an indigenous part of the Florida landscape, nonetheless contribute to the heritage of the region. "Cultural and aesthetic benefits are a recognized, but understudied, component of urban ecosystem services. Urban tree planting efforts in Western countries in the late 18th and early 19th centuries were tied to civic beautification movements, and today, aesthetic benefits are sometimes a central motivation for residents to plant trees."[58] A heritage tree designation can be written to provide local governments with the flexibility to recognize the aesthetic and heritage importance of certain trees in the community.

Establishing criteria for and identifying heritage trees throughout the region can help preserve those trees. The heritage tree designation is often used as the most protective designation for existing trees and tends to supply flexibility and discretion by the decision-maker to make the designation based upon a combination of characteristics. These characteristics often include size, age, species, historic significance, ecological value, aesthetics, and other criteria. Heritage trees growing on private property and at risk for development pressure can be prioritized for conservation, acquisition into the public trust, or subjected to other policy measures to reduce the risks posed to a given tree's viability.

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56 Protected tree designations can be defined both in a municipal tree ordinance and the land development code.

57 Clark et al. 1997; Heimlich et al. 2008; Jones, Davis, & Bradford 2012, as cited in, Goldman, E. (2017). Seeing community through the trees: Characterizing resident response to urban-tree planting initiatives. International Development, Community and Environment (IDCE). Master's Projects. Clark University. https://commons.clarku.edu/cgi/viewcontent.cgi?article=1168&context=idce_masters_papers

58 Lohr et al. 2004; Roy et al. 2012; Locke et al. 2015; Roman et al. 2018; & Dronova 2019 (as cited in Roman et al., 2021) (no. 11) at p. 5.

b) Champion Trees

The Champion Tree program was started by American Forests almost a century ago. It maintains a National Register of the largest trees of their species annually.[59] Additionally, the State of Florida has maintained its own champion tree registry since 1975, which includes both native and non-invasive naturalized species. The Florida Department of Agriculture and Consumer Affairs ("FDACS"), Florida Forest Service maintains a list of trees registered as the largest of their species in the state.[60]

The Florida Champion Tree nominations may be any native or exotic species of tree growing in Florida, except for invasive exotic species that are listed by the Florida Exotic Pest Plant Council; however, certain Florida-eligible species may not be eligible for National Champion Tree status.[61] FDACS provides procedures for measuring tree trunk circumference or DBH, tree height and average crown spread.[62] Exceptions to circumference measurement procedures are in place for Ficus sp. trees. Alternative measuring methods allow for measuring within aerial roots that may obscure the trunk of such trees. Notably, several municipalities include champion trees as designated heritage trees by default in their code definition of heritage trees. Others distinctly recognize champion trees and provide specific protections to such trees in the code.

c) Specimen Trees

Specimen trees are often characterized by a DBH of greater than a certain amount for an individual tree species. Defining specimen trees in municipal code by DBH and often species distinguishes trees that supply sufficient levels of public benefits that protections are appropriate to encourage their preservation and ensure mitigation of any benefits lost through removal. Many municipal codes distinguish between specimen and heritage trees to provide varying layers of protection responsive to qualities, value, and benefit of different trees.

d) Mangroves

Mangroves are subject to specific state rules and protections under the 1996 Mangrove Trimming & Preservation Act ("MTPA").[63] The MTPA protects the white mangrove (Laguncularia racemosa), red mangrove (Rhizophora mangle), and black mangrove (Avicennia germinans). Mangroves are critically important in coastal ecology, providing a nursery habitat for commercially and recreationally valuable fish and shrimp species.[64] The State of Florida Department of Environmental Protection (FDEP) delegated authority to regulate the trimming and maintenance of mangroves to Miami-Dade County. Special permits are required for mangrove maintenance through the County.

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59 American Forests. (n.d.). The national champion trees programs. https://www.americanforests.org/champion-trees/

60 City of Fort Lauderdale, FL. (n.d.). Florida's Champion Trees. https://gyr.fortlauderdale.gov/greener-government/natural-resources-preservation/growing-our-green-canopy/fort-lauderdale-s-urban-forest/florida-s-champion-trees

61 Florida Department of Agriculture & Consumer Services. (n.d). HYPERLINK "https://www.fdacs.gov/Forest-Wildfire/Our-Forests/Florida-Champion-Trees"Florida Champion Trees. https://www.fdacs.gov/Forest-Wildfire/Our-Forests/Florida-Champion-Trees

62 Florida Department of Agriculture & Consumer Services. (2018). Florida champion tree measuring procedures. https://www.fdacs.gov/content/download/4571/file/CTP_Measurin_%20Procedures_20180511.pdf

63 The 2021 Florida Statutes. §§ 403.9321-403.9333.

64 Heald, E. J., & Odum, W. E. (1970). The contribution of mangrove swamps to Florida fisheries. Proceedings of Gulf and Caribbean Fisheries Institute, 22, 130-135. https://aquadocs.org/bitstream/handle/1834/28165/gcfi_22-21.pdf?sequence=1.

e) Required Trees

Required Trees are those that are mandatory in a land development plan. These trees may be subject to covenants or other agreements to protect and maintain them.

f) Public Benefit Tree

A "Public Benefit Tree" designation is suggested here to identify the current and future contributions of specific trees that contribute to public benefits. Criteria for finding and designating Public Benefit Trees could include contribution to level of service for flood management, temperature moderation, carbon sequestration, shading, and water quality benefits that a given tree provides. The ecosystem services healthy urban forests provide are closely linked with the goals of initiatives to build resilience across Greater Miami.

Despite many documented benefits, the proposition that trees are always and only intrinsically good in all decision-making situations can be problematic for planning and designing urban landscapes. A broader consideration of urban trees for public policy and sustainability requires a balanced understanding of services and disservices.[65] Larger trees confer more services not feasibly replaceable via mitigation. Identifying and acknowledging the public benefits certain trees provide and have the potential to provide into the future in terms of improving the level of service for stormwater management, moderating temperatures, and improving air quality facilitates maintaining those ecosystem services.

Once trees that provide significant ecosystem services (or the potential to plant them) are identified, creating mechanisms to incentivize preservation, maintenance, and care for such trees within the code can follow. A Public Benefit Tree or "High Ecosystem Services Tree" designation, definition, and criteria in the code would establish a starting point for integrating the preservation, planting, and care of such trees into various policy mechanisms, in addition to prioritizing these tree resources, applicable programming and operations.

Following similar thinking to the Public Benefit Tree concept, Miami Beach's Urban Forestry Master Plan quantifies tree benefits for specific species and size (DBH) trees, including carbon dioxide sequestered, rainfall intercepted, ozone removed from the air, carbon dioxide stored, energy savings (primarily air conditioning costs), and energy savings value, along with providing a number for annual value of tree benefits.[66]

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65 Lyytimäki, J., & Sipilä, M. (2009). Hopping on one leg–The challenge of ecosystem disservices for urban green management. Urban Forestry & Urban Greening, 8(4), 309-315. DOI:10.1016/j.ufug.2009.09.003 | von Dohren, P., & Haase, D. (2015). Ecosystem disservices research: A review of the state of the art with a focus on cities. Ecological Indicators, 52, 490–497. DOI:10.1016/j.ecolind.2014.12.027

66 City of Miami Beach, 2020 (no. 39) at p. 15. (Using the i-Tree My Tree application, the City of Miami Beach estimates benefits from four tree species range from $17.80 to $87.46 per tree per year.)

5. Native habitat

The protection of existing native habitat has been a long-standing priority in Greater Miami, namely through the county's activities to conserve environmentally endangered lands ("EEL") and "Natural Forest Community" designated land. Native habitat is also found throughout State and Federal lands within Greater Miami.[67]

Natural Forest Communities include Pine Rocklands, Tropical Hardwood Hammock, which historically "covered approximately 180,000 acres in South Florida and today have been reduced to about 3,000 acres due to development and agriculture."[68] Natural Forest Community sites are designated by the Miami-Dade County Department of Environmental and Resource Permitting based upon evaluation of various factors, including the presence of endangered threatened, rare, or endemic species…, "overall plant species diversity of the site", and the "Size of trees", among other features. Designated Natural Forest Community within the County are subject to special permit requirements for any activities that may damage such a site. Natural Forest Community land can be dedicated for partial park impact fee credit under the code, as discussed in Section VI.

While the County has these programs for the conservation of native habitat, the creation of new native habitat and restoration of native habitat within developed areas, and distribution and use of Florida native species in residential landscaping has been largely voluntary. Even so, there are several documented success stories.

For example, the Connect To Protect Network ("CTPN") was established by the Fairchild Tropical Botanical Garden to provide property owners in Greater Miami with native plants, including tree species, for use in gardens and landscaping to create connectivity corridors between small fragments of native pine rockland habitat within the Miami-Dade urban matrix.91 The combination of plant distribution to local schools and property owners and education on the pine rockland ecosystem has extended the range of rare herbaceous plants and trees throughout Greater Miami and created the potential for habitat corridors for associated species. A 2016 study of EEL in Miami-Dade County found that even small preserves of pine rockland or hardwood hammock habitat host a range of rare plant species, which have persisted even within the urban matrix.92 These habitats, however small, may extend benefits to imperiled wildlife, as was the case of the once presumed-extinct Atala butterfly (Eumaeus atala), which is now rebounding in numbers in the urban environment of Miami due to the use of the Florida coontie cycad (Zamia integrifolia) and other similar cycads in the urban landscaping.93

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67 There are two National Parks (Biscayne National Park and Everglades National Park) and three state parks (The Barnacle Historic State Park, Oleta River State Park, and Bill Baggs Cape Florida State Park), along with the State's Marjory Stoneman Douglas House in Miami-Dade County. While these parks are beyond the jurisdiction of South Florida's local governments, the native landscaping and forest communities within these state and federal resources contribute vastly to the region's cherished forest communities. EEL lands are often dedicated to Everglades restoration related projects, which are largely undertaken through a partnership between the South Florida Water Management District and the federal government, including the United States Army Corps of Engineers and the United States Department of Interior.

68 Miami-Dade Country. (2014, November 20). Natural forest communities. https://www.miamidade.gov/environment/forests.asp#:~:text=Historically%2C%20these%20habitats%20covered%20approximately,due%20to%20development%20and%20agriculture

The urban landscape of Miami-Dade County features a vibrant assemblage of native and exotic plant species. Native species are noteworthy in that they are uniquely adapted to Miami-Dade's variable climate and often have associated assemblages of other plant species and wildlife. Often, once native species are established in landscaping, they do not require additional irrigation during the dry season, unlike many exotic species. Although landscaping decisions seldom exclude all exotic species unless the goal is native habitat restoration, the use of some native species in landscaping would confer significant benefits.

Non-native species that are also invasive may pose risks to the surrounding habitats, including overtaking habitats, fire risk, impairment of ecological function, and altered habitat for native wildlife; although these invasive species do generate ecosystem services, such as carbon sequestration or benefits associated with increased aesthetics benefits, the conservation concerns outweigh these benefits.[69]

B. Case Studies

1. Case Study: Tree initiatives in Greater Miami

Over the last two decades, officials at Miami-Dade County, individual municipalities, and local agencies have approached management of the urban forests through a variety of initiatives including commissioning multiple studies, canopy assessments, and master plans. In 2007, Miami-Dade County published its Street Tree Master Plan to provide a framework for design and to implement tree plantings in public rights of way throughout the county. The plan warns that Miami-Dade's urban forest is in "critical condition" due to the confluence of hurricane damages in recent decades, tree removal due to citrus canker, and increased urban development.[70] The Plan restates the county's goal to achieve a minimum 30% tree canopy coverage countywide and outlines a variety of strategies for improving street tree practices and expanding urban canopy, including planning policies/practices, tree plantings in low canopy coverage areas, species selection for wind tolerance, implementing a proper pruning schedule, and public outreach and education.[71] In conjunction with this Master Plan, Miami-Dade County also published a "Guide to Tree Planting and Maintenance,"[72] a compendium of best practices for trees on both public and private lands.

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69 Roman, et al., 2021 (no. 11).

70 Miami-Dade Country. (2007). A green print for our future: Miami-Dade Street Tree Master Plan. https://sfyl.ifas.ufl.edu/media/sfylifasufledu/miami-dade/documents/disaster-preparation/hurricane-and-disaster/Miami-Dade-County-Street-Tree-Master-Plan.pdf

71 Miami-Dade County Street Tree Master Plan, 2007 (no. 70) at p. 3.

72 Miami Dade County & Community Image Advisory Board. (n.d.) Guide to tree planting and maintenance. https://www.miamidade.gov/parks/library/guide_tree_book.pdf

In his 2006 State of the City address, City of Miami Mayor Manny Diaz announced his environmental policy platform, which included the formation of the Green Commission, a group of experts brought together to develop the City's "Green Policy." In 2007 the Green Commission's Urban Forestry Working Group developed the "City of Miami Tree Master Plan" for tree preservation and expansion of the tree canopy. The overarching goal of the plan was to achieve 30% tree canopy coverage citywide by 2020.[73] The 17-page plan includes strategies for preserving and expanding tree canopy, including data collection to track tree plantings, coordination of City-wide plantings on public land, funding sources, professional development for code enforcement, and public outreach and education.

Miami-Dade County and the City of Miami produced an Urban Ecosystem analysis with American Forests in 2008. This analysis quantifies loss of tree canopy and the resulting ecosystem impacts. The study area encompasses 447 square miles of Miami-Dade County, including the City of Miami, and looks at land cover changes between 1996 and 2006. Researchers found that tree canopy in Miami declined significantly between 1996 and 2004, and even more dramatically between 2004 and 2006, "due primarily to development and exacerbated by hurricane-related damage" during an especially active hurricane season in 2005.[74] The analysis also quantifies the ecological impact of tree canopy loss, such as reduced stormwater retention capacity, increased air and water pollution, and higher carbon emissions. As part of this project, American Forests also provided data and CITYgreen Geographic Information System ("GIS") software to the City of Miami and Miami-Dade County to use for planning purposes and to help public officials establish tree canopy goals. The software allows for the inclusion of storm water dynamics, energy savings, carbon sequestration, air quality, and wildlife parameters to enable economic analyses of urban ecosystem services.[75]

More recent Tree Canopy Assessments and Master Plans for the City of Miami, City of Miami Beach and Miami-Dade County establish frameworks to build upon in managing the urban forests in these communities today.

Miami-Dade County Urban Tree Canopy ("UTC") Assessments (2016 and 2021)

Miami-Dade County's Urban Tree Canopy Assessment was published in 2016 and updated in 2021. The assessments estimate existing urban tree canopy, areas for possible urban tree canopy, areas currently unsuitable for urban tree canopy based on land cover categories, and other demographic, as well as parcel level information.[76]

The 2016 Miami-Dade County Urban Tree Canopy Assessment is a detailed examination of the tree canopy conducted by GIS researchers at the University of Florida and Florida International University.[77] Using a combination of remote sensing and publicly available data, researchers created a detailed inventory of different land cover types across Miami-Dade County. The purpose of the assessment is to establish a baseline to guide future reforestation efforts by creating a visual map of areas that may be good candidates for additional tree canopy. The report breaks down existing and potential tree canopy based on land ownership (public vs. private), and examines other factors correlated with tree canopy, such as surface temperature and asthma rates.

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73 Miami-Dade County Street Tree Master Plan, 2007 (no. 70).
74 American Forests. (2008, May). Urban ecosystem analysis: Miami-Dade County UDB and City of Miami, Florida.
75 Local Location. (n.d.). CITYgreen. http://urbanwater-eco.services/project/citygreen/
76 Hochmair, et al., 2021 (no. 1).
77 Hochmair, et al., 2016 (no. 14).

The 2021 update of the Miami-Dade County Urban Tree Canopy Assessment showed an increase from 19.9% UTC in 2016 to 20.1% UTC in 2020.[78] The authors noted that while overall UTC remained largely unchanged across the county, existing UTC changed by as much as 10% in some municipalities in the same period, with some areas showing significant increases in UTC, while others experienced significant decreases in UTC. Miami-Dade County, City of Miami, and Miami Beach each have canopy goals below the average goal set from communities with canopy cover goals based upon the Urban & Community Forestry Census of Tree Activities and below American Forest's science advisory board's recommended 40-60%.

The hardscape percentages vary widely between different municipalities and areas of Miami-Dade County and increases in development in such areas including Coral Gables, Doral, Florida City, Hialeah, Kendall, Medley, Palmetto, Pinecrest, and South Miami have offset the increases in tree cover in Miami, Miami Beach, Miami Gardens, Miami Shores, and North Miami.[79]

The municipalities with the largest percent of existing urban tree canopy ("EUTC") are:
- Coral Gables (44.1%)
- Pinecrest (40.1%)
- Cutler Bay (36.5%)

The municipalities with the smallest percent of EUTC are:
- Medley (4.6%)
- Hialeah (7.4%)
- Opa-Locka (8.0%).[80]

Hurricane Irma, along with increasing development both contributed to tree canopy losses. Tree planting efforts have served to offset some such losses. Nonetheless, overall tree canopy coverage has remained largely static.

<u>City of Miami, Omni CRA Urban Forest Management Plan</u>

The Omni Community Redevelopment Agency's (CRA) Urban Forest Management Report, produced with the John Scott Dailey Florida Institute of Government at Florida Atlantic University, Earth Advisors, Inc., and PlanIt Geo LLC, provides an inventory, assessment, and maintenance recommendations for the tree canopy within the Omni CRA District. The inventory catalogues all trees found within the district and looks at characteristics like location by land use type, height, canopy spread, and condition. For each tree, arborists also performed an individual assessment of maintenance needs and identified additional areas for tree plantings. The report provides recommendations for implementing maintenance tasks, expanding tree canopy, and educating the public.

78 Hochmair, et al., 2021 (no. 1) at p. 4.
79 Hochmair, et al., 2021 (no. 1) at p. 23.
80 Hochmair, et al., 2021 (no. 1) at p. 17.

City of Miami, Southwest Streetscape & Street Tree Master Plan (2019)

This Master Plan aims to enhance the urban forest in several neighborhoods and commercial corridors in a 6.7 square mile area in the southwest portion of the City of Miami—one of the City's most densely populated areas with the greatest deficiency in tree cover.[81] The project aims to increase shade from tree canopies by 15% on the streets and sidewalks of its targeted areas.[82]

The plan encourages an asymmetric planting scheme—instead of a collinear single-species plantings.[83] The Plan has produced tree species palettes, consisting of tree species selection in large, medium, small, and palm categories, for selected neighborhoods.[84] It also includes replacing trees that have been lost, as well as planting new trees in areas lacking canopy cover. The neighborhoods identified to have the greatest need for increasing tree cover are: Latin Quarter, East Little Havana, Citrus Grove, and Auburndale.[85]

The report also illustrates how new trees can be given optimal placement, specific planting procedures, and best practices. This includes leaving sufficient space in swale areas to safely park cars without damaging trees, as well as ensuring that expected height of mature trees by species and placement given power lines, driveways, and other built features.[86]

City of Miami Beach Urban Forestry Master Plan

The City of Miami Beach's Urban Forestry Master Plan ("UFMP") published in 2020 "provides an overarching framework to guide the City […] in the sustainable and strategic preservation, management, maintenance and growth of a resilient urban forest." It "connects the city's vision of the urban forest with the goals and recommendations to achieve it."[87] The plan is organized around three goals: (1) "Tree Canopy (TC): Protect and increase shade tree canopy to maximize the environmental, economic, health and climate mitigation services trees provide to Miami Beach"; (2) "Plan & Manage (P&M): Sustainably plan and manage the urban forest to mitigate the effects of climate change and support Miami Beach's climate adaptation efforts"; and (3) "Connect & Engage (C&E): Connect, educate, and engage the Miami Beach community and stakeholders about the benefits of trees to support implementation of the UFMP and urban forestry initiatives."[88] Miami Beach sets out to increase its 17% canopy cover to 22% through implementation of its Urban Forestry Master Plan.

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81 City of Miami. (n.d.). Southwest (SW) streetscape and street tree master plan. Miamigov.com/My-Government/Departments/Planning/Project-Stories/Southwest-SW-Streetscape-and-Street-Tree-Master-Plan

82 City of Miami. (2021). Southwest (SW) streetscape and street tree master plan: Resiliency action forum presentation (1-18). https://www.miamigov.com/files/sharedassets/public/planning/sws-resiliencyaction-forum-presentation-ada-approved-version-4-30-21.pdf

83 City of Miami. (2019). Southwest (SW) streetscape and street tree master plan, tree planting coordination presentation [hereinafter, SW Streetscape Tree Planting Presentation].

84 SW streetscape tree planting presentation, 2021 (no. 82) p. 3-9.

85 Southwest streetscape & tree master plan, 2019 (no.83) at p. 22.

86 Southwest streetscape & tree master plan, 2019 (no.83) at p. 32-8.

87 City of Miami Beach, 2020 (no. 39) at p. 10.

88 City of Miami Beach, 2020 (no. 39) at p. 10.

2. Case Study: StreetTree SF—municipal street tree maintenance in the City of San Francisco

In 2017 voters in the City of San Francisco approved Proposition E. ("Prop. E") a ballot measure that approved a $19 million annual set-aside in the City's General Fund, adjusted annually based on City revenues to fund StreetTree SF's care of the city's 124,000-plus street trees and surrounding sidewalks. As part of the program, the City additionally repairs damage to sidewalks caused by tree roots.

Initial work through the StreetTree SF program meant that many trees were initially removed because of deferred maintenance. Importantly, the City was able to develop sufficient support to additionally fund tree planting. In 2019 the city budgeted $5.3 million for tree planting (in addition to the $19 million maintenance budget line item). This was "enough to put about 2,650 trees in the ground." However, the City of San Francisco expected to remove approximately 7,000 trees in the subsequent two years. According to that city's superintendent of the Public Works Urban Forestry Bureau "That's largely because the city [was] […] catching up on long-delayed maintenance work funded by Prop. E."[89] The San Francisco example shows the need for dedicated sources of annual funding for both tree maintenance and tree planting. It also shows that the period of years that street tree maintenance was the responsibility of adjacent property owners led to significant deferred maintenance needs.

C. Recommendations

1. Evaluate feasibility of meeting 40-60% canopy cover target and increase the urban tree canopy coverage target to the highest extent feasible between 40-60%.

Following the American Forests science advisory board, 40-60% urban tree canopy coverage is attainable and could be used to achieve specific objectives related to heat control and stormwater runoff.[90] As of 2021 Miami-Dade County's existing canopy cover totaled only 20.1%. However, the County's Urban Tree Canopy Assessment found an additional 41.8% of potential canopy cover based on land use assessments, together creating the potential for approximately 60% canopy cover in the County.[91]

2. Assume municipal responsibility for maintenance of street trees.

Evaluate transferring the burden of street tree maintenance to the municipal government, including mechanisms for dedicated funding for maintenance of ROW trees. Ensure that continued investments in tree planting and forestry planning are not reduced to cover the cost of tree maintenance.

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89 Fracassa, 2019 (no.29).

90 Leahy, 2017 (no. 3).

91 While the County has an overall canopy cover goal, individual municipalities within it can and should set their own ambitious goals to expand urban tree canopy.

3. Calculate the benefit investment ratio ("BIR") for maintaining the urban forest.

Assess measures to improve the BIR for urban forest investments. Use BIR number to justify tax base investment in urban forestry maintenance. Utilize BIR analysis to select the most beneficial level of investment in urban forests and to build support from the tax base for urban forestry priorities, including municipal responsibility for maintenance of street trees.

4. Establish Heritage, Champion, Public Benefit, and other protected tree designations and criteria in the municipal code.

Establishing criteria for identifying and designating trees that provide exceptional value, heritage, and ecosystem benefits can help preserve those trees. Protected trees that are on private property and at risk for development pressure could then be prioritized for acquisition into the public trust and given treatment favoring conservation in the land development code.

Miami Beach's Urban Forestry Master Plan quantifies tree benefits for specific species, diameter at breast height, carbon dioxide sequestered, rainfall intercepted, ozone removed from the air, carbon dioxide stored, energy savings (primarily air conditioning costs), and energy savings value, along with providing a number for annual value of tree benefits.[92] Here, we recommend building on this approach, using accounting practices that take into account the cumulative value of trees over time, applying the best scientific information available for the region, to preserve trees and build urban canopy as a means of improving level of service towards achieving resilience goals and targets. Tree ecosystem services related to resilience, stormwater, temperature moderation and climate mitigation are discussed in further detail in Section III.

5. Establish property tax benefits for designated protected trees.

As an analogue to the historic property designation and the reduced tax bill that owners enjoy in consideration for maintaining the historic character of their property, property owners could be incentivized to maintain and preserve heritage trees on their land under the same premise.

6. Regularly inventory existing trees and designate those meriting preservation as protected trees.

Regular and ongoing updates to tree inventories, including software integration that incorporates public input can be used to inform maintenance, tree planting, and conservation priorities.

Augmentation of tree inventories to identify the locations and status of protected and irreplaceable trees throughout the region could likely build on existing resources developed through Miami-Dade County Urban Tree Canopy Assessments and ArcGIS systems. Further integrating species, DBH, health, and maintenance information on ArcGIS tree canopy land use maps would help to improve upon existing data and inform better decision-making, including more comprehensive identification and classification of protected trees.

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92 City of Miami Beach, 2020 (no. 39) at p. 15.

7. Ensure best practices and standards in tree care are followed in caring for the urban forest, including ANSI 300.

Widespread adoption and use of best practices requires ongoing stakeholder engagement, as well as more robust licensing and education programs for those engaged with urban trees, as discussed further in Section VIII below.

8. Support an educated, trained, empowered, and well-funded Urban Forestry Division.

9. Make stakeholder education and engagement a central component of urban forestry management.

This is addressed further in Section VIII.

10. Incentivize preservation of protected trees.

Apply strategies in the municipal code and other policies as discussed in Sections V, VI, and VII towards conservation of protected trees. Engage with the public through public outreach efforts to advance preservation priorities as discussed in Section VIII.

11. Promote preservation, biodiversity, and native landscaping.

Design standards, development requirements, and other measures in municipal code can incentivize creation and preservation of native habitat and landscaping. The incorporation of code language that promotes diversification of tree species, such as the adoption of "alternating tree species" where "single tree species" are present, is recommended. Even marginal changes in tree diversity, especially the use of native species, has shown to increase urban biodiversity.[93]

We recommend regular reviews of prohibited species lists. Prohibition of new plantings of species listed as invasive by the Florida Fish and Wildlife Conservation Commission ("FWC") and prioritization of native species, or Florida friendly species that acclimate to the local climate without requiring supplemental irrigation and known to not invade local habitats. Existing forests and woodlands warrant a higher standard of conservation when compared to potential forest land due to the greater ecological value of existing forest resources.[94]

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93 Helden, A. J., Stamp, G. C. & Leather, S. R. (2012). Urban biodiversity: Comparison of insect assemblages on native and non-native trees. Urban Ecosystems, 15(3), 611-624. http://dx.doi.org/10.1007/s11252-012-0231-x

94 Giusti, G. A., McCreary, D. D., & Standiford, R. B. (Eds.). (2005). A planner's guide for Oak woodlands (2nd ed.). University of California, Division of Agriculture and Natural Resources. Publication 3491E. https://anrcatalog.ucanr.edu/pdf/3491E.pdf

D. Model Language

1. Protected tree designations model code language

Examples of protected tree designations found within municipal code in selected Florida jurisdictions are shown below.

Miami Beach, FL [95]
Heritage tree: A tree so designated by the environment and sustainability director after consultation with the urban forester because of its unique or intrinsic value to the community with regards to its historic value, size, age, location, distinctive form, exceptional characteristics, ecological value or other relevant criteria.

Specimen tree: A tree with an individual trunk that has a DBH of 12 inches or greater, or any multiple-trunk tree in which the sum of the diameters of all the trunks at DBH is 12 inches or greater. Includes palm trees with an overall height of ten feet or greater with multiple-trunks in which the sum of those trunks is 12 inches or greater.

Venice, FL[96]
Section 118-4. Definitions.

Heritage tree. Any 30-inch DBH single trunk or 45-inch DBH multi-trunk native tree that has been determined by the city arborist to have the characteristics as outlined in this chapter or any tree designated a Florida State Champion, United States Champion, or World Champion by the Florida Forest Service or the American Forestry Association.

Venetian tree. A tree of a native or non-native species that has significance, desirability, or utility to the community.

Orange County, FL[97]

Champion tree shall mean any tree that has been designated as the largest tree of its species in the state of Florida as measured by trunk diameter at breast height and crown diameter. These may include any species not listed on the restricted stock list.

Preserved trees shall mean trees that are designated to remain after construction and count toward replacement requirements per this article.

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95 Miami Beach, Florida. (2022). Code of ordinances. In Code of the city of Miami beach, Florida. Div. 2, §46-56. https://library.municode.com/fl/miami_beach/codes/code_of_ordinances?nodeId=SPAGEOR_CH46EN&wdLOR=c4C964C7D-94CF-0F48-8091-A9A46D6CF361

96 Municode Library. (2021). Code of ordinances city of Venice, Florida. Venice, Florida. Ch. 118, Art. I, Sec. 118-4. https://library.municode.com/fl/venice/codes/code_of_ordinances?nodeId=SPBLADERE_CH118TRPRPRRE_ARTIINGE_S118-4DE

97 Municode Library. (2020). Orange county code of ordinances. Ch. 15, Art. VIII, §15-277. https://library.municode.com/fl/orange_county/codes/code_of_ordinances?nodeId=PTIIORCOCO_CH15ENCO_ARTVIIITRPRRE

Protected tree shall mean any tree, on the recommended stock list, which is identified in the protection zones as described in section 15-301(e). Unless exempted, all of these trees are subject to a tree removal permit per this article.

Replacement trees are trees planted to replace existing trees as required by section 15-283.

Residential lot trees shall mean trees that are required to be planted on residential lots per section 15-306. These trees are required to be a minimum of eight (8) feet tall and have a minimum caliper of two (2) inches and are to be selected from the recommended stock list in section 15-283(a).

Model language drafted by authors.

Public Benefits Tree: A tree so designated by the [environment and sustainability director after consultation with the urban forester*] because of the public benefits and ecosystem services it provides or has the capacity to provide under appropriate care. Such benefits and services may include temperature moderation, carbon sequestration, carbon storage, shading, water filtration, water quality, and stormwater benefits. These contributions towards improving the level of service shall be measured in accordance with the best scientific information available and applicable to conditions in South Florida. Such contributions shall be calculated in accordance with the [Tree Public Benefits Table**] established in [Section XX]. Any tree meeting a level of contribution established in the Tree Public Benefits Table calculation shall be considered as a potential candidate for designation as a Public Benefits Tree.

*adjust to reflect appropriate position(s) in a given local government's staffing.
** The concept of an "Tree Public Benefits Table", which may also be called an "Urban Tree Ecosystem Services Table" is explored further in Section VII.

III. Trees, Climate Change, and Resilience

Trees are a crucial tool in South Florida's capacity to create resilience in the face of climate change. Urban forests store and sequester carbon and can be an important component of climate mitigation strategies. Healthy urban forests support both mitigation and adaptation aspects of resilient communities. Miami-Dade County's Resilient305 Strategy has taken an approach to resilience that "builds upon the challenges and strengths of the past to address the shocks and stresses of today and tomorrow." This approach to resilience evolved under the influence and support of the 100 Resilient Cities initiative. It "supports the adoption and incorporation of a view of resilience that addresses not just the shocks—hurricanes, economic crash, floods, etc.—but also the stresses that weaken the fabric of a city or a region on a day-to-day or cyclical basis. Resilience is what allows cities to adapt and transform in the face of these challenges, helping them to prepare for and respond in the face of both the expected and the unexpected."[98] Healthy and abundant urban forests are a key factor in determining overall community resilience.

Increased temperature, the urban heat island effect, sea level rise, flood risks from storms, including rain bombs and storm surge, and water quality impacts from urban runoff are some of the most significant climate change hazards facing South Florida now and into the future. Urban forests provide mitigate and reduce these impacts.

While trees are an important tool in solving climate change challenges, urban forests in South Florida have their own vulnerabilities that must be addressed to support their resistance to such impacts. Vulnerabilities in the urban forests need to be considered in resilience planning in terms of salt-water damage to tree root systems and tree losses from wind and weather events. The urban forest community will require some interventions to better prepare it to handle these impacts.

There are numerous cities and municipalities worldwide that aim to expand and enhance the urban tree canopy through resilience and sustainability planning.[99] Climate resilience programs often involve major capital projects, as well as amendments to comprehensive plans, land development codes, zoning, and other strategies. Each of these processes presents an opportunity to prioritize tree preservation and planting, along with incentives for developers to preserve trees through other incentives.

A. Discussion

1. Climate resilience: mitigating and adapting to the impacts of climate change with trees

98 Greater Miami & The Beaches. (n.d.) Resilient305 Strategy at p. 16. https://secureservercdn.net/198.71.233.159/9b8.215.myftpupload.com/wp-content/uploads/2019/05/Full-Strategy-2.pdf.

99 Schäffler & Swilling, 2013; Young & McPherson, 2013; Kimball et al., 2014; Young et al., 2014; Norton et al., 2015; Hauer & Peterson, 2016; Campbell, 2017, as cited in Roman, L. A., Campbell, L. K., & Jordan, R. C. (2018). Civic science in urban forestry: An introduction. Arboriculture & Urban Forestry, 44(2), 41-48 at 42. https://www.fs.fed.us/nrs/pubs/jrnl/2018/nrs_2018_roman_002.pdf

Climate resilience includes both actions to reduce emissions that cause climate change (climate mitigation) and actions to manage the risks of climate change (climate adaptation). Some actions, including complete communities, water conservation measures, education, and urban forests serve both to reduce climate change causing pollution and facilitate adaptation to its impacts. The American Planning Association's Climate Change Policy Guide recommends retrofitting "existing streets to incorporate green infrastructure elements that address stormwater management, wildlife passage, and urban heat island impacts" while incorporating "natural system best practices" to "improve air quality."[100] Supporting urban forests is also one of the strongest defenses in the arsenal to mitigate the impacts of climate change through sequestration and storage of carbon emissions.

Miami-Dade County's Climate Strategy sets various targets to reduce emissions from land use and transportation actions, such as fleet electrifications, EV adoption, expansion of transit, and port and airport emission reductions. However, the line item to "Expand and Protect Green and Blue Space" is left without a target, "pending data availability".[101] As the risks and opportunities associated with climate change are increasingly integrated into the global economic system, actions to store and sequester carbon have real economic benefits. Urban forestry management, including the handling of landscaping debris, are also factors that influence the climate emissions, storage, and sequestration profile of a community.

The Miami-Dade County Sea Level Rise Strategy establishes adaptation approaches to "build on fill", "build like the Keys, "build around transit", "expand green and blueways" and "create blue green neighborhoods".[102] It identifies the following to achieve the vision: "incorporat[ing] infill development and expand[ing] green spaces", "develop[ing] waterfront parks and mak[ing] room for water in our most flood-prone areas", "creat[ing] space for more trees and living shorelines", and "finding room in our communities for water, in our yards, streets and parks, to create rain gardens, with trees, gravel, shells and pavers that create a porous pavement".[103] Trees can be a central component of the regulatory and policy changes, investments, and planning efforts listed in the strategy. For example, enhanced flood protection by expanding greenways and blueways and integrating green infrastructure into County projects both present opportunities to improve canopy cover.

Trees can provide significant public benefits in the form of floodwater management and temperature moderation. These are climate risks that municipalities are spending significant resources to address. Adapting to climate change impacts requires developing and maintaining land use resources such as trees that facilitate water infiltration on both private and public land. The integration of tree preservation, maintenance, and planting, as well as urban forestry planning into resilience projects creates opportunities for significant co-benefits.

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100 American Planning Association. (2020). Climate change policy guide at p. 11. https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Climate-Change-Policy-Guide.pdf

101 Miami-Dade County. (2021). Miami-Dade Climate Action Strategy at p. 36. https://www.miamidade.gov/green/library/climate-action-strategy-final-draft.pdf

102 Miami-Dade County. (2021). Miami-Dade County Sea Revel Rise Strategy. Miami-dade-county-sea-level-rise-strategy-draft-mdc.hub.arcgis.com

103 Miami-Dade County. (2021). Our adaption vision. In Miami-Dade County Sea level Rise Strategy. https://storymaps.arcgis.com/stories/3f5b7c0c3db545e4a09dd421f43361a7

2. Trees and heat

Increasing temperatures are a significant risk to public health and quality of life for Greater Miami. The Miami Forever Climate Ready Strategy identifies the serious risk that elevated temperatures pose to public health in Miami. In 2000 Miami experienced 24 danger days with the heat index above 105 degrees, by 2030 that number is projected to be 126 days, and by 2050 it is projected to be 151 days.[104] Approximately 130 days a year exceed 90°F in Miami.[105] "Due to Miami's high humidity, the number of days with an extreme heat index (days where it feels over 90° F/32.2°C), is projected to grow and exceed any other city in the country by 2050."[106]

Extreme heat is the cause of more annual deaths than "hurricanes, lightning strikes, tornadoes and floods."[107] Miami-Dade County's Climate Strategy notes "excessive heat discourages the use of public transit, walking and biking and presents a public health risk to those that do use these modes of transportation. Internal combustion vehicles further contribute to urban heat island issues."[108] Heat increases the risk of heat exhaustion, heat stroke, chronic health conditions including asthma, and vector-borne diseases, while increasing the cost of cooling and exacerbating poor air quality.[109] As heat events become more frequent and more severe, trees—that have the potential to lower air temperature by "10 lifesaving degrees"—are all the more vital.[110]

Tree cover and vegetation both may decrease surface and air temperatures through shading and evapotranspiration. "Shaded surfaces, for example, may be 20–45°F (11–25°C) cooler than the peak temperatures of unshaded materials."[111] The combination of evapotranspiration and shading services provided by trees can reduce peak summer temperatures by 2–9°F (1–5°C).[112]

In 2021 Grove ReLeaf and the CoolTrees program[113] monitored 80 stations across 40 sites in Coconut Grove. The preliminary results suggest that individual trees can reduce temperature by 11 degrees Fahrenheit. Furthermore, the areas where trees provide the most cooling are also the hottest areas, indicating that even though there are few trees in an area, those that are present are important for achieving heat mitigation goals. The results underscore the importance of considering neighborhood context in tree removal and planting decisions. As the following images visually demonstrate, tree canopy cover correlates strongly to reduced heat Impacts

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104 Climate Central. (2015). Miami days above 90 degrees. http://ccimgs.s3.amazonaws.com/2016DaysAbove/2016DaysAbove_miami_en_title_lg.jpg

105 Miami-Dade Country. (2020). Miami Forever Climate Ready (p. 3). https://www.miamigov.com/files/sharedassets/public/miami-forever-climate-ready-2020-strategy.pdf

106 Miami Forever Climate Ready, 2020 (no. 105) at p. 3.

107 Miami-Dade County Climate Action Strategy, 2021 (no. 101) at p. 36.

108 Miami-Dade County Climate Action Strategy, 2021 (no. 101) at p. 36.

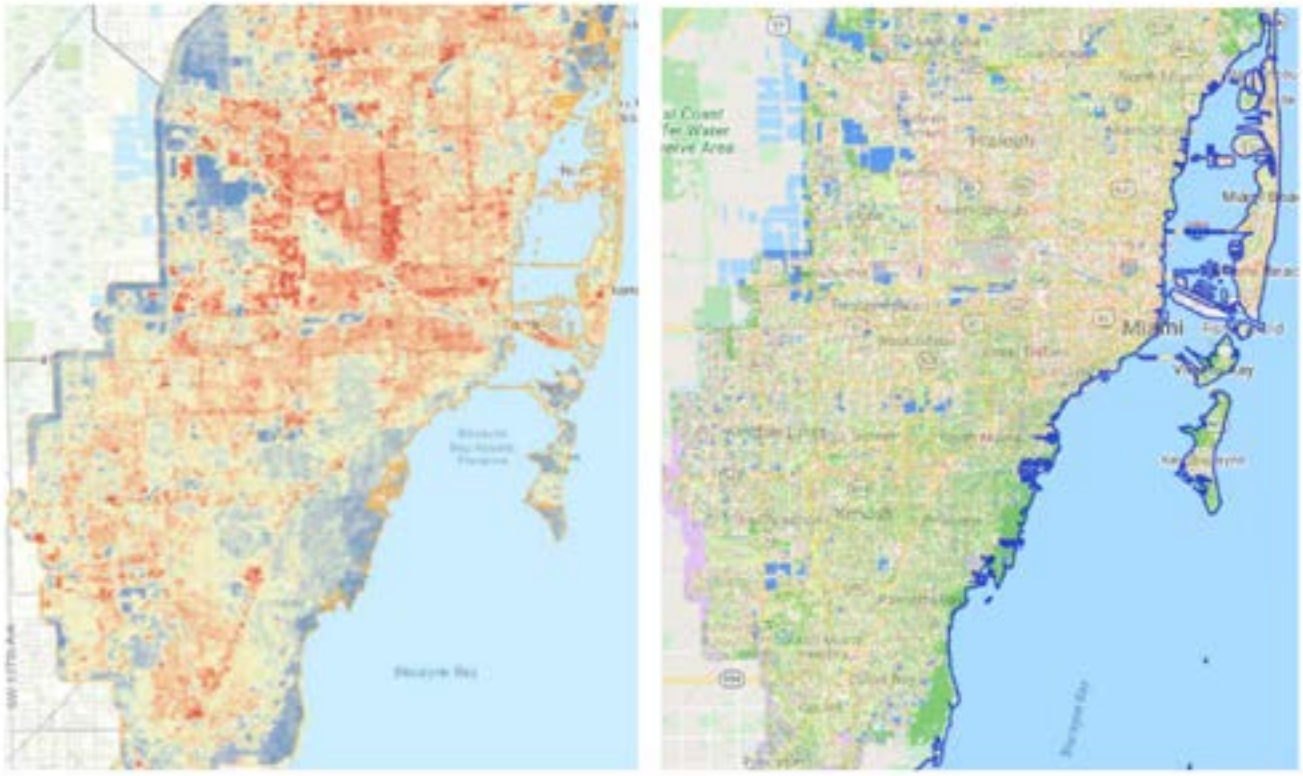
109 Miami-Dade County Climate Action Strategy, 2021 (no. 101).

110 Einhorn, 2021 (no. 3).

111 U.S. Environmental Protection Agency. (n.d.) (no.9).

112 U.S. Environmental Protection Agency (n.d.) (no.9).

113 Baraloto, G. (2021). Grove Releaf. Florida International University. https://environment.fiu.edu/what-we-study/projects/grove-releaf/ (Grove ReLeaf is a study through Florida International University and initiated the 2021 CoolTrees program to study the effects of trees on temperature mitigation in urban environments. The initiative uses small weather stations that measure short increments of temperature and humidity data. The group has distributed these stations in sites around Coconut Grove that represent a breadth of background temperatures due to conditions including proximity to the ocean, amount of pavement and buildings and overall canopy cover. Each site includes paired stations, one in open sun and one underneath a nearby tree.)



The above ARC GIS images show the variation of temperature across Miami-Dade (left) and the tree cover variability (right) across the county. Darker colors indicate higher values. The images demonstrate lower temperatures correlated with areas with greater percentage tree canopy.[114]

a) Energy use

The temperature mitigation that trees confer to surrounding areas has a significant impact on energy use. A study funded by the U.S. Department of Energy ran simulations that indicated 15.5% annual energy savings for a 1980s house in Miami in areas with 30% tree canopy cover, due to the shading and wind shielding effects of trees that benefit a building's cooling load.[115] Disparities in energy burden in connection with tree canopy cover in disadvantaged communities are discussed in Section IV.

b) Heat reduction ordinances

The City of Miami Beach adopted an Urban Heat Island Ordinance in 2019.[116] The City of Miami adopted "Heat Island Effect" ordinances in 2009 addressing both roof and non-roof measures mostly aimed at materials used for roads and surfaces, such as requirements for high albedo surfaces.[117]

~~Both ordinance~~s provide examples of municipalities utilizing design criteria to reduce heat island effect.

114 (On right) Image was generated using the Transportation Outreach Planner, land cover layer. http://dpanther2.fiu.edu/itis/index.html
(On left) Image was generated using Miami-Dade County ArcGIS temperature layer. https://mdc.maps.arcgis.com/apps/webappviewer/index.html?id=460e90afb4ce464581231031cc80c590

115 Huang, Y. J., Akbari, H., & Taha, H. (1990). The Wind-shielding and shading effects of trees on residential heating and cooling requirements. ASHRAE Winter Meeting, 96. https://escholarship.org/content/qt85g3s8xt/qt85g3s8xt.pdf

116 Urban Heat Island Ordinance. (2019). Ordinance No. 2019-4252, Miami Beach, FL. https://www.mbrisingabove.com/wp-content/uploads/Ordinance-2019-4252.pdf

117 Ordinance No. 13120, § 2, 10-22-09. Miami, Florida.

However, the opportunity to address heat through the urban tree canopy has been left untapped. An Urban Heat Island Ordinance focused on enhancing the role of trees in reducing the urban heat island effect could be an effective tool to deliver various policy and code amendments recommended herein targeted toward reducing urban heat risks through tree canopy proliferation.

3. Parks for resilience

The vast resilience benefits that trees, parks, and green space provide make these invaluable components of resilience programs, policies, and projects. There is room for greater use of parks, green space, and canopy cover to meet resilience goals in Greater Miami. As discussed further in Section VI, Miami-Dade County has existing code language in place providing for the dedication of park land as part of park and open space concurrency. When compared with other counties the Miami-Dade County's selected level of service for parks is low. For example, Pinellas County's level of service for parks is 14 acres of parks and environmental land per 1,000 residents, as compared to Miami-Dade County's level of service of 2.75 acres per 1,000 residents. Increasing the amount of park land containing urban forests contributing to canopy cover would create co-benefits with significant contributions towards resilience goals and targets.

Local governments often favor resilience strategies that emphasize improvements and expansion of parks and green space. In the Midwest, the cities of Cleveland and Sandusky, Ohio are working with The Trust for Public Land's Climate Smart Cities™ to improve stormwater management through investing in parks.[118] The program recommends "pilot projects such as green infrastructure basin parks; locations for future parks or recreation trails to decrease runoff to Lake Erie and area rivers, while improving public health, recreation, and native habitat."[119] In Scandinavia, the City of Copenhagen was able to achieve widespread support for its climate adaptation plan in part because it includes the addition of new parks in neighborhoods throughout the city. Parks and green space are a key component of the overall resilience approach. These initiatives include: "additional green areas, pocket parks, green roofs, and green walls [to] slow rainfall run-off, thus reducing the risk of flooding."[120] Copenhagen's plan commits to "at least two new attractive pocket parks for Copenhageners each year." The public park Enghaveparken was designed as a gathering space during the dry season, but the park can also accommodate 24,000 cubic meters of water during seasonal floods.[121]

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118 Trust for Public Land. (n.d.). Climate smart cities™ Cleveland and Sandusky. https://www.tpl.org/our-work/climate-smart-cities-cleveland-and-sandusky

119 Trust for Public Land (n.d.) (no. 118).

120 Climate Capital Copenhagen. (n.d.). Copenhagen climate plan: The short version (p. 27). http://www.energycommunity.org/documents/copenhagen.pdf

121 Grozdanic, L. (2016, January 13). Copenhagen's enghaveparken public park is designed to be flooded. In Habitat. https://inhabitat.com/copenhagens-enghaveparken-public-park-is-designed-to-be-flooded/

4. Storm surge and the Miami-Dade County Back Bay Study

Storm surge has long been a risk for South Florida. Sea Level Rise will exacerbate that risk, increasing the potential for higher surge if areas within the county are hurt by storm surge.[122] The United States Army Corps of Engineers ("ACE") proposed a $4.6 billion investment, with local cost sharing, to address storm surge risk in Miami-Dade County. The initial plan proposed by ACE focused primarily on grey infrastructure and a large wall dividing downtown Miami from the water. Public outcry against the wall and lack of green infrastructure led Miami-Dade County to decide to develop its own locally preferred plan. The process is ongoing at the time of this writing. The locally preferred plan is an opportunity to incorporate significant green infrastructure, including trees and mangroves as central components to the region's storm surge protection. Incorporation of trees, mangroves, and green infrastructure into the plan that is ultimately selected could amount to significant financial resources for trees and complimentary infrastructure in the region. At a minimum, projects should be consistent with necessary land use contributions to tree canopy to facilitate meeting the County's target canopy coverage targets.

5. Trees and groundwater

Trees protect the region's freshwater drinking resources by facilitating the infiltration of stormwater into the groundwater. Fresh water infiltration from precipitation and recharge from the Everglades wetlands provides hydrostatic pressure to work against the encroachment of saltwater intrusion into the Biscayne Aquifer.[123] The drinking water of Southeast Florida is sourced from the Biscayne Aquifer, which is one of the most permeable limestone aquifers in the world.[124] Trees help to filter stormwater runoff before it infiltrates the surface aquifer. Although studies have found that trees have a limited effect on the water table, tree cover, especially native trees, provide localized salinity management[125]—a crucial service in coastal areas where saltwater intrusion is a critical concern for drinking water resources.

6. Reducing impacts to urban forests from saltwater intrusion and storms

Sea level rise poses a threat to tree root systems from below. The geology of South Florida is porous limestone with groundwater that often reaches the surface, resulting in flooding, when water levels are high. As sea levels rise, the ocean is entering the groundwater. Freshwater recharge of the aquifer, including the freshwater lens directly below the surface in many parts of Miami-Dade County, plays a significant role in pushing the saltwater back. Freshwater recharge is an integral component of maintaining a healthy tree canopy in Southeast Florida in the face of sea level rise. Saltwater intrusion will negatively impact tree and vegetation root systems. Infrastructure designed to facilitate infiltration and expansion of tree root systems uses fresh water to push back on salt-water intrusion, protecting and supporting tree root systems.

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122 United States Environmental Protection Agency. (n.d.). Climate adaption and sea level rise. https://www.epa.gov/arc-x/climate-adaptation-and-sea-level-rise

123 Cunningham, K. J., & Florea, L. J. (2009). The Biscayne aquifer of southeastern Florida. Caves & Karst of America, 196-199. https://digitalcommons.wku.edu/geog_fac_pub/20/

124 Cunningham & Florea, 2009 (no. 123).

125 George, R. J., Nulsen, R. A., Ferdowsian, R., & Raper, G. P. (1990). Interactions between trees and groundwaters in recharge and discharge areas-A survey of western Australian sites. Agriculture Water Management, 39, 91-113.

The University of Florida Institute of Food and Agricultural Sciences ("UF/IFAS") extension and Miami-Dade County have developed multiple resources on preparing and recovering urban forests from hurricanes.[126] They recommend establishing and managing an "urban forest to improve wind resistance by selecting the right species, designing the right place, planting high-quality trees, choosing more wind resistant species, having a comprehensive tree management plan[, and] having a structural pruning program for young and mature trees".[127] Miami-Dade County has additionally addressed tree preparedness for hurricanes through policies in its comprehensive plan establishing ongoing tree maintenance to prepare trees along roadways for hurricanes.[128]

Poor maintenance and improper planting of trees can make them more susceptible to damage in a hurricane.[129] Hurricane vulnerability of poorly maintained trees creates another reason for governments to provide tree maintenance, at least for public street trees as discussed in Section II. Educating service providers regarding best practices for urban forestry, including hurricane preparedness, should be a component of licensing and education aspects of an urban forestry program as discussed further in Section VIII. Proper tree planting and maintenance can be determinative of how the urban forests and individual trees withstand hurricanes. Major hurricane events, such as Hurricane Katrina, have been shown to cause widespread tree mortality and the subsequent release of carbon on the order of the annual carbon sink for the entire US forest.[130] The way tree and landscaping debris is disposed of contributes to the amount of climate emissions a tree may capture or release in its life cycle. Conducting a life cycle analysis of urban trees in the region would provide a better understanding of the impact of current practices and potential adjustments to improve performance.

126 Miami-Dade County. (n.d.). Tree preparation for hurricanes. https://www.miamidade.gov/global/emergency/hurricane/hurricane-tree-preparation.page IFAS Extension University of Florida. (n.d.). Hurricane/disaster preparation. https://sfyl.ifas.ufl.edu/miami-dade/weather-issues/hurricane-and-disaster-preparation/#landscape.

127 Mayer, H. (2009, June 25). Trees & Hurricanes. Miami-Dade County. p. 12-13. https://sfyl.ifas.ufl.edu/media/sfylifasufledu/miami-dade/documents/disaster-preparation/hurricane-and-disaster/Trees-and-Hurricanes-2009-b.pdf

128 Miami-Dade County. (n.d.). Comprehensive development master plan 2030, CM-80.

129 US Forest Service Department of Agriculture, Florida Forest Service, Miami Beach Rising Above, Green Infrastructure Center, & Trees to Offset H20. (2018). Trees to offset stormwater. Case study 05: City of Miami beach, Florida at p. 24-25. http://www.gicinc.org/PDFs/1.13_MiamiBeach_webspread_lores.pdf (The report recommends that the City of Miami Beach "Require and enforce 600, 1,000, and 1,500 cubic feet soil volume planting requirements for small, medium, and large trees, respectively.")

130 Zeng et al., 2009 (no. 10).

7. Trees, stormwater, and water quality

Urban tree resources offer significant opportunities to be incorporated into existing and future green infrastructure. ("GI"). The urban canopy essentially increases the capacity of a municipality's grey infrastructure, for example canopy and root systems often alleviate pressure on stormwater discharge management systems through absorbing water before it becomes runoff.[131] Trees are integral to the stormwater protection in their role within functioning ecosystems. Urban tree benefits for hydrology and water quality are multifold.[132]



131 Trees to offset stormwater, 2018 (no. 129) at p. 24-25.

132 Swann, 2017 (no. 6). ("When it rains, trees capture rainfall in their canopies (rainfall interception). Intercepted rainwater is temporarily stored in the canopy before being released by evaporation directly into the atmosphere or transmitted to the ground via stems, branches, and the tree trunk (stemflow) for root absorption. The water delivered to the base of trees penetrates the soil rapidly (infiltration) by following interconnected pathways in the soil formed by large roots and macropores. Rainfall that is not intercepted by the canopy layer reaches the underlying ground as throughfall. This water can be lost to evaporation, transpiration by the underlying vegetation, or infiltration or it can become runoff. If the underlying ground cover is pervious, leaf litter and other organic matter, soil macropores, and small depressions all work to slow runoff, hold water and further promote infiltration. The infiltrated water can feed into local waterways through interflow or replenish groundwater supplies (recharge). In between storms, trees can also absorb water from the soil by root uptake and release the unused portion back into the atmosphere in the form of water vapor through transpiration. This increases soil water storage potential, effectively lengthening the amount of time before rainfall becomes runoff.")

The Miami-Dade County Biscayne Bay Taskforce's Report and Recommendations include multiple measures that could be adopted to enhance and preserve the urban tree canopy through implementation of green infrastructure and planning measures that would reduce water quality impacts. The recommendations include multiple calls for incorporating green infrastructure, which includes trees, into design and planning. This includes updating policies to "promote the installation of natural shorelines and green infrastructure consistent with protection and enhancement of Biscayne Bay."[133] The Taskforce Recommendations call for developing and implementing local ordinances and policies to reduce stormwater pollution through best management practices ("BMPs") and amending the Miami-Dade County comprehensive plan to require "more stormwater retention through installation of permeable surfaces [and] green infrastructure."[134]

A 2018 City of Miami Beach Study, Trees to Offset Stormwater, set out to identify reductions in water volume entering the City's Municipal Separate Storm Sewer System ("MS4") via tree-based mitigation of stormwater runoff.[135] The study creates a model and recommendations to improve stormwater management using trees and green infrastructure.

Stormwater control measures such as tree canopy retention and root protection serve to minimize runoff. For example, soil systems entailing structured soil, enhanced tree pits, and tree filters provide infiltration and improved water quality.[136] If trees are planted in a proper manner to account for their eventual size and root mass, the stormwater benefits continue to improve over time as trees become larger. Involved planning, ongoing monitoring and maintenance, and coordination with built elements of the blue-green infrastructure are crucial. Synergies with green infrastructure, which enables the collection of stormwater and delivery to areas or spaces adjacent to tree root structures makes this water available for use by the urban forest.[137]

The stormwater planning and permitting process provides significant opportunity for municipalities to further expand best practices that incorporate trees and green infrastructure. Green infrastructure, low impact development, and BMPs that incorporate the value of existing trees and planting new trees can be central components of municipal stormwater plans and permits.

133 Biscayne Bay Task Force Members, (2020). A unified approach to recovery for a healthy & resilient Biscayne Bay: Biscayne Bay task force report and recommendations at p. 10. https://environment.fiu.edu/where-we-work/biscayne-bay/_assets/bague-et-al.---biscayne-bay-task-force-report-and-recommendations.pdf

134 Biscayne Bay Task Force Members, 2020 (no. 133) at p. 11-12.

135 Trees to Offset Stormwater. 2018 (no. 129) at p. 3.

136 Bean, E., Jarrett, L., Searcy, J. K., & Szoka, M. (2019). Low-impact development & green infrastructure: Pollution reduction guidance for water quality in southeast Florida at p. 65. https://floridadep.gov/sites/default/files/LID-GI_Manual-Publish_Public_508Compliant.pdf

137 Gables, C. (n.d.). Mile streetscape and Giralda plaza. Local Office Landscape & Urban Design. http://www.localofficelandscape.com/projects/miracle-mile

a) Stormwater permits

There are more than 30 co-permittees under Miami-Dade County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System ("MS4") permit, including municipalities and transportation authorities. Each of the co-permittees must submit its own Stormwater Management Plan including BMPs. The City of Miami has its own stormwater permit. The Miami-Dade County permit, which expires in December of 2022 requires the co-permittees to:

Conduct an interdepartmental review of current local codes and land development regulations to identify potential changes to existing codes and regulations that will further reduce the stormwater impacts of new development and areas of significant redevelopment. In particular, focus on changes to the code that will promote low impact design, also termed green infrastructure: reductions in impervious surfaces, the use of swales or other retention BMPs, the incorporation of low impact development principles, reduction in flow and volume of stormwater, increase in natural hydrology, and adherence to the principles of the UF/IFAS Florida Yards and Neighborhoods ("FYN") program in new landscaping.[138]

Low Impact Design ("LID"), green infrastructure ("GI"), and reductions in impervious surface all present opportunities for landscape design that improves drainage while creating a hospitable environment for existing and new tree growth.

The co-permittees updates to "local code and regulations" to incorporate the LID/GI and "current and proposed techniques aimed at reducing the stormwater impacts of new development", as well as "innovative stormwater planning techniques" have the potential to sustainably transform land development regulations.[139] Local government comprehensive plans updates, land use code amendments, and the permitting of each provide entry points to incorporate and improve upon policies to preserve and enhance the tree canopy through integrating LID and GI into stormwater planning.

b) LIDs and BMPs that emphasize trees for nonpoint source management

LID and GI, along with BMPs for managing stormwater runoff are recognized strategies supported by regular funding and appropriations at the state and federal levels. The FDEP commissioned report on LID and GI recommends allowing "stormwater credit for natural areas if they remain undisturbed during construction and are protected by a permanent conservation easement that prescribes allowable land uses and prevents future development".[140]

The federal Clean Water Act includes several sections that govern stormwater management and nonpoint source pollution. While much of the authority to implement the Clean Water Act is delegated to the State of Florida, the interaction and funding provided between both FDEP, and the EPA are central to stormwater management programs at the local level.

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138 Miami-Dade County. (2017). Final MS4 Permit Number: FLS000003-004 at p. 32.

139 Final MS4 Permit, 2017 (no. 138).

140 Wanielista, M. P., & Livingston, E. H. (as cited in 2016, Pollution reduction guidance report (p. 50). Escambia County Lid Bmp Manual.

Through USEPA Clean Water Act Section 319 Nonpoint Source Management funding FDEP provides local governments with grants to improve stormwater management impacting impaired water bodies through standards that integrate natural resource preservation and best practices into stormwater management.[141] There are federally appropriated funds through EPA that support FDEP grants to local governments to "reduce nonpoint source pollution from land use activities."[142] Projects under this program emphasize natural resources and stormwater systems that integrate trees and green infrastructure to improve flood conditions. Between federal section 319 funds and state appropriations, including State Water-quality Assistance Grants ("SWAG"), approximately $11 million a year goes to programs in Florida to improve water quality through land use projects. These programs focus on integrating natural systems, including trees, into stormwater management.

Biscayne Bay and multiple waterbodies within Miami-Dade County are classified as impaired for nutrients and other parameters on the State of Florida's impaired water body list. As such, natural resource and tree canopy preservation and improvement projects impacting the County's impaired water bodies are potential sites for nonpoint source management initiatives and connected funding.

Several counties in Florida have developed a Low Impact Development BMP Manual through such funding sources that includes LID BMPs to supplement the County's stormwater management regulations. For example, Escambia County's LID BMP Manual ("Manual") includes design standards that support trees supporting green infrastructure as central elements, in addition to mechanisms for preservation of existing tree canopy.[143] The Manual also establishes standards for natural area preservation, requirements that the area remain undisturbed, restored, and maintained for exotics, have a vegetation management plan in place, and have a perpetual easement on file in the public records prior to the commencement of construction. LID and GI are effective conservation-oriented approaches to managing stormwater while preserving and enhancing natural systems, including trees. "LID can be thought of as the planning and design of communities to maintain pre-development hydrology and natural habitats where possible by mimicking natural processes. GI may indicate the physical stormwater control measures or infrastructure used to achieve the LID goals."[144] LID and GI can be incorporated into stormwater plans and permitting to support the urban forests and their role in stormwater management.

141 Florida Department of Environmental Protection. (n.d.). Nonpoint source funds (FDEP). https://floridadep.gov/wra/319-tmdl-fund

142 Florida Department of Environmental Protection. (n.d.). Nonpoint source funds (FDEP). https://floridadep.gov/wra/319-tmdl-fund

143 Wanielista, M. P. (2016). Escambia county low impact design BMP manual. Escambia County Florida. https://myescambia.com/docs/default-source/sharepoint-natural-resources-management/Water%20Quality%20Land%20Management/lid/escambia-county-lid-manual_final_9302016.pdf

144 Rouge River National Wel Weather Demonstration Project. (n.d.). Stormwater Management: Best Management Practices (BMPs). https://www.michigan.gov/documents/deq/ess-nps-savvy-bmp_209386_7.pdf

BMPs entail "structural, vegetative, or managerial practices" that are used in order to "treat, prevent or reduce water pollution."[145] BMPs may include design standards that facilitate canopy growth and infiltration by requiring sufficient soil, and green infrastructure for growing tree root systems and improved infiltration. For stormwater permitting purposes, applicants may be required to supply information "to document the BMP design criteria and the relationship to pollutant load reduction.[146] This can include trees and infrastructure like tree pits and structured soil that facilitate infiltration reducing pollution runoff. Stormwater utilities that find and take advantage of opportunities to integrate trees and green systems for stormwater management can contribute to local canopy expansion in pursuit of improving stormwater management performance.

c) Stormwater fees and credits

Municipalities pay for stormwater infrastructure by charging property owners stormwater fees. Stormwater fees in Miami-Dade County are assessed based on equivalent residential units.[147] Nonresidential developed property's fees are discounted through a calculation that accounts for the actual impervious area.[148] An ordinance that updates the fee system could be used to provide a credit reducing stormwater fees for pervious areas, preserving trees, planting trees, and incorporating green infrastructure like structured soil and silva cell soil (suspended pavement system) in designs.

145 Rouge River National Wel Weather Demonstration Project. (n.d.). Stormwater Management: Best Management Practices (BMPs). https://www.michigan.gov/documents/deq/ess-nps-savvy-bmp_209386_7.pdf

146 Wanielista, 2016. (no. 143) at p. 41 and p. 53. (Resources such as the University of Central Florida Stromwater Management Academy BMP Train Model software are available for free to help determine pollutant loads in a manner that is accepted by FDEP and the Water Management Districts.) http://www.stormwater.ucf.edu/

147 Miami-Dade County, Florida. (n.d.) Stormwater utility revenue bonds. https://www.miamidade.gov/finance/library/bond-book/2014/special/stormwater-utility-fees.pdf
(Referencing Ordinance No. 98-187 and Miami-Dade County Code)

148 Miami-Dade County Code §24-51.4.

There are multiple examples from other cities that provide stormwater credit for green infrastructure, tree preservation, and tree planting. In the City of Philadelphia the water department "offers up to a 100% fee credit against impervious surface-based fees for implementation of green infrastructure such as rain gardens, tree planting, rain barrels, wetlands and green roof."[149] The City of Pine Lakes, GA provides stormwater credits for saving existing trees based on the size of the tree to meet site runoff requirements with trees less than 12" DBH credited at 10 gallons per inch and trees larger than 12" DBH credited at 20 gallons per inch. Portland, Oregon provides impervious surface reductions for new and existing tree canopy with credits incorporated in design criteria. In Sacramento, San Jose, and Santa Clara Valley, California; Indianapolis, Indiana; and Seattle, Washington stormwater credits are given in the form of impervious surface reductions for new and existing tree canopy. Within these stormwater credit systems species, siting, planting methods, and design criteria are incorporated into the regulations for the credits to apply.

8. Carbon storage and carbon sequestration in trees

Climate mitigation through carbon storage and sequestration is a component of resilience in which trees play a significant role. The benefits related to carbon cycling in urban trees are widely recognized as an important ecosystem contribution of the urban forest.[150] Trees, especially within their woody tissues, can capture up to 55% of the carbon dioxide taken in daily from the atmosphere through storage of its tissues.[151] Different tissue types within a tree have varying carbon residence times in terms of carbon storage, with woody tissues having the longest residence times that are generally over the life of the tree. Accordingly, it is important to recognize two distinct contributions of trees to carbon cycling: carbon storage and carbon sequestration.

Carbon storage in carbon-based molecules within the tree's tissues represents a part of the historical legacy of carbon that the tree has captured from the atmosphere over its lifetime. The carbon storage of a tree can be estimated with simple measures of tree diameter and height, and the most precise estimates use an equation modeling tree bole volume (portion of the tree from the tree base at ground level to just below the first living branch of the tree's crown).

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149 Moore, J., Marcellis, A., & Bailey, K. (2014). Tree credit systems and incentives at the site scale. Stone Environmental Inc. at p. 13. https://vtcommunityforestry.org/sites/default/files/pictures/site_scale_tree_credits_2014_02_28_final.pdf Prepared for Urban and Community Forestry, Vermont Dept. of Forests, Parks & Rec. §4.1

150 Nowak, D. J. (1993). Atmospheric carbon reduction by urban trees. Journal of Environmental Management, 37(3), 207–217. https://doi.org/10.1006/jema.1993.1017, as cited in Pataki, D. E., Alig, R. J., Fung, A. S., Golubiewski, N. E., Kennedy, C. A., Mcpherson, E. G., Nowak, D. J., Pouyat, R. V., & Lanako, P. R. (2006). Urban ecosystems and the North American carbon cycle. Global Change Biology, 12(11), 2092-2102. https://doi.org/10.1111/j.1365-2486.2006.01242.x (p. 2095)

151 Teskey, R. O., Saveyn, A., Steppe, K., & McGuire, M. A. (2007). Origin, fate and significance of CO2 in tree stems. New Phytologist, 177(1), 17–32. https://doi.org/10.1111/j.1469-8137.2007.02286.x

Carbon sequestration represents an ecological benefit of trees complementary to that of their carbon storage. Rather than the historical accumulation of carbon stored in plant tissues, sequestration refers to the active current and future conversion of atmospheric carbon dioxide into plant tissues. Sequestration represents not only the current eco-benefits of trees but also their potential to reduce greenhouse gasses in the atmosphere into the future.

Carbon sequestration takes place within plant leaves via the process of photosynthesis. Consequently, the amount of carbon sequestered generally increases with increases in active leaf surface area. Generally, larger trees will sequester greater amounts of carbon because they have a greater amount of leaf surface area. However, just like many living organisms, the rate of active accumulation may slow with tree age (and accordingly, tree size). On the other hand, smaller trees that are growing rapidly may have a greater rate of accumulation as they grow. Therefore, when estimating carbon sequestration, both the current size of a tree and its future size and rates of sequestration—as it grows and ultimately senesces—must be considered. Furthermore, different tree species also have different rates of carbon sequestration due to differences in leaf size, shape, physiology, growth rate, and longevity.

9. Carbon accounting to include trees

Local governments are increasingly committed to reducing greenhouse gas ("GHG") emissions, which trees play an important role in sequestering. GHG inventories, or carbon accounting, are part and parcel of the process for meeting climate goals and assessing contributing sources and mitigating factors to reduce climate pollution.

The organization ICLEI – Local Governments for Sustainability ("ICLEI") released a Forest and Trees Carbon Accounting Cohort for cities to integrate the carbon sequestration value of trees into municipal carbon accounting/GHG inventories.[152] ICLEI has a technical assistance program to "guide communities in the application of the newly released appendix to the U.S. Community Protocol for GHG Emissions Inventories." Accounting for the carbon sequestration provided by the urban tree canopy in GHG inventories and in developing climate action plans will help local governments to better integrate the value of the urban tree canopy into its planning and priorities. Municipalities can utilize the technical assistance provided through ICLEI to ensure that trees are adequately accounted for in the carbon accounting processes.

152 Roberts, K. (2020, April 10). Forest & Trees Carbon Accounting 2020 Training Cohort. ICLEI. Local Governments for Sustainability. https://icleiusa.org/forest-trees-carbon-accounting-2020-training-cohort/

B. Case Studies

1. Case Study: City of Miami Beach Trees to Offset Stormwater and Integrated Water Management: Blue-Green Stormwater Infrastructure Concept Plan

In 2018 and 2020 The City of Miami Beach produced two important documents that establish trees and their supporting green infrastructure as vital elements of the City's stormwater management strategy. The 2018 report, "Trees to Offset Stormwater," includes a detailed land cover and tree cover analysis for the City of Miami Beach. The modeling looked at the impact of landscape conditions on stormwater uptake.

The recommendations from the report in priority order were to: (1) Use the green infrastructure coalition's "stormwater uptake calculator to determine the benefits of maintaining or increasing tree canopy goals by island group"; (2) "Use the urban forestry funding calculator to assist in setting tree planting goals"; (3) "Conduct a land cover assessment every four years to measure and compare tree canopy coverage change over time"; (4) "Develop a stormwater best management practices design manual for Miami Beach"; (5) "Develop an urban forest management plan for the city"; (6) "Determine urban forestry data needs and which software can best meet urban tree data collection and management needs"; (7) "Conduct proactive tree risk assessments yearly in highly trafficked areas of the city"; (8) "Continue the integration of planning for trees in all planning and development activities"; (9) "Prioritize forest activities. Develop a contingency budget for the urban forest to allow critical urban forestry maintenance items to continue through economic downturns"; (10) "Educate special magistrates and staff about the importance of tree canopy coverage, and the social and financial benefits"; (11) "Train code enforcement staff in basic tree health and care"; (12) Require and enforce 600, 1,000, and 1,500 cubic feet soil volume planting requirements for small, medium, and large trees respectively"; (13) "Identify key streets where green infrastructure and bike lanes are needed"; (14) Develop more information for citizens detailing how they can engage in supporting the city's urban canopy"; and (15) "Re-use urban waste wood."[153]



153 Trees to Offset Stormwater, 2018 (no. 129) at p. 24-25.

The report recommended the city create "a stormwater best practice design manual…, [that] include[s] trees and constructed green infrastructure."[154] Standards for tree pits/trenches and other tree-oriented designs allow for their incorporation into stormwater permitting and planning.[155] Notably the authors state that "without standards, innovative stormwater techniques such as green roofs, suspended pavement systems, vegetated swales and tree pits cannot be credited to stormwater requirements."[156]

The City of Miami Beach Integrated Water Management: Blue-Green Stormwater Infrastructure Concept Plan ("BGSI Concept Plan") produced by Jacobs in 2020 presents strategies to reduce flooding from storms; manage non-point source pollution and protect water quality; increase rainwater infiltration; leverage urban design to integrate Blue-Green Stormwater Infrastructure ("BGSI"); and provide social, environmental, and economic co-benefits to increase the value of BGSI.[157] The plan recommends "steps to formally incorporate BGSI policy into master planning, design standards, capital improvement plan (CIP) projects, [and] codes" and funding specific considerations, among other recommendations.[158] The plan includes applications for enhanced tree pits/trenches and tree canopy and design recommendation for aquifer recharge to protect tree roots by keeping salt water at bay.[159]

The BGSI Concept Plan identifies Florida friendly trees for urban canopy restoration, including Red Maple, Geiger Tree, Laurel Oak, South Florida Slash Pine, Gumbo Limbo Tree, Lancewood, Black Ironwood, American Mahogany.[160] The site-specific recommendations in the plan detail how enhanced tree pits can be incorporated into the streetscape and design standards for different typographies within the city. The plan also highlights strategies such as permeable pavers that provide benefits for trees, such as recharging the fresh-water lens.[161]

"Trees are a key component of BGSI, and the City's… Urban Forest Master Plan[, which] provide a strategic framework to guide the City in managing, maintaining, planting, and preserving its urban forest."[162] The City of Miami Beach has innovated a path in developing its BGSI (blue green stormwater infrastructure) Concept Plan and "Trees to Offset Stormwater" report, now complimented by their 2021 Urban Forestry Management Plan. These works can serve as a foundation for other Southeast Florida municipalities looking to integrate urban forestry and stormwater planning to optimize co-benefits.

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154 Trees to Offset Stormwater, 2018 (no. 129) at p. 25.

155 City of Miami Beach. (2020). Miami beach integrated water management: Blue-Green Stormwater Infrastructure Concept Plan. JACOBS Report. Appendix C, at p. 5. https://www.mbrisingabove.com/wp-content/uploads/Blue-Green-Stormwater-Infrastructure-Concept-Plan.pdf
("Enhanced tree pits/trenches combine the stormwater capture benefits of subsurface infiltration/storage systems with the water and air quality benefits of trees…. These structures typically capture stormwater runoff that is piped in from street or parking lot drains or runoff that flows through permeable pavement. The runoff then slowly enters the underlying soil (called infiltration) or drains into the [c]ity's drainage system within 2 to 3 days. Trees selected for these systems are hardy Florida-friendly species that can withstand both extended dry and wet conditions.")

156 Trees to Offset Stormwater. 2018 (no. 129) at p. 25.

157 Blue-green Stormwater Infrastructure Concept Plan. 2020 (no. 155) at ES-1.

158 Blue-Green Stormwater Infrastructure Concept Plan. 2020 (no. 155) at ES-1.

159 Blue-Green Stormwater Infrastructure Concept Plan, 2020 (no. 155) at 2-2 and Appendix: Resilience Conservation Series: Blue-Green Infrastructure, September 17, 2019, at p. 8.

160 Blue-Green Stormwater Infrastructure Concept Plan, 2020 (no. 155) at p. 160.

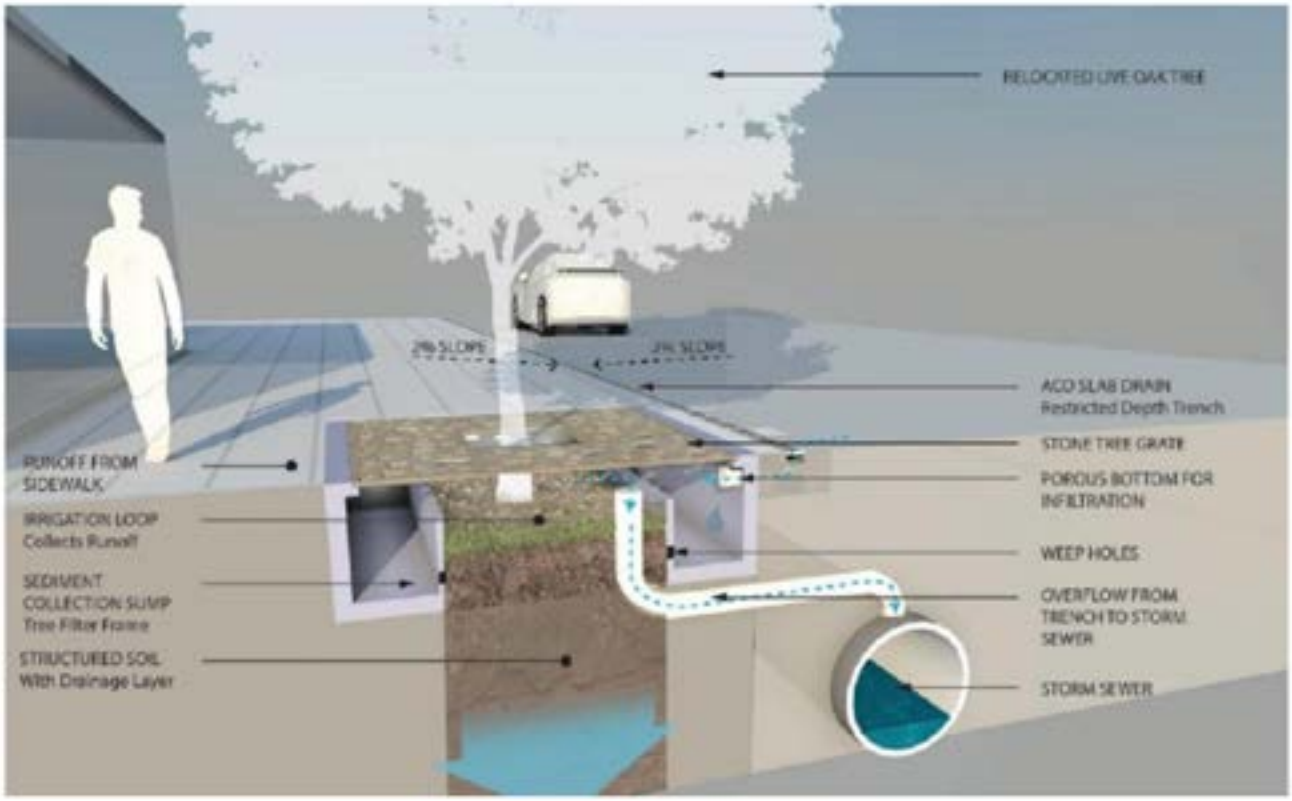
161 Blue-Green Stormwater Infrastructure Concept Plan, 2020 (no. 155) at p. 199.

162 Blue-Green Stormwater Infrastructure Concept Plan, 2020 (no. 155) at p. 2-2.

2. Case Study: Miracle Mile Streetscape and Giralda Plaza (City of Coral Gables, construction completed 2017)

A capital project completed in the City of Coral Gables in 2017 provides a proof of concept for the value of designing streetscapes with trees in mind to create resilient, climate ready urban environments. The Miracle Mile Streetscape and Giralda Plaza project was designed to handle increased flash flooding from storm events. With the arrival of hurricane Irma in Southeast Florida shortly after the project was completed, the effectiveness of the design was put to the test when it effectively withstood "7" of water per hour", allowing businesses in Giralda Plaza to re-open the day after the hurricane hit.[163] Through the use of trenches, structural soils, and porous pavement the networked green infrastructure provides ample space for tree roots below the surface with well-drained subgrade directing water towards tree roots and connecting to stormwater sewer pipes for overflow.[164] The design will provide for an expansive tree canopy into the future that will be less likely to damage surface pavers because of the space provided for the root system. The below image from Local Office Landscape and Urban Design illustrates the innovative design.

163 Gables, (n.d.) (no. 137).
164 Gables, (n.d.) (no. 137).



3. Case Study: ULI ASP report on Waterfront Resilience for Miami (2019)

The 2019 ULI ASP Report on Waterfront Resilience for Miami recommends multiple measures to improve Miami's resilience through green infrastructure, a principal component of which is often tree canopy. The report discusses the impact on resilience of increased impervious surfaces from urban development. "Replacing the natural landscape with these surfaces leaves fewer opportunities for water infiltration, which can prompt more frequent flooding. Private-sector developers and designers are playing a growing role in meeting cities' water management-related goals. Local regulators are seeking increased participation from the private sector, requiring, or incentivizing the real estate community to incorporate enhanced water management mechanisms in new development projects."[165] The report also points out the prospect that increasing extreme heat presents a risk for Miami's local economy and "even consumer preferences" and that "[h]eat in Miami is particularly challenging along the waterfronts and downtown because of the lack of an existing tree canopy to provide shade throughout the day."[166]

The ULI Report on Waterfront Resilience for Miami also points out that some resilience measures may "unintentionally contribute more greenhouse gas emissions or inadvertently cause more problems—such as installing water pumps to keep downtown dry that might also increase pollution in the bay and harm the natural environmental, inadvertently adding to the impact of storm surge."[167] Strategies that increase the tree canopy and utilize trees and green infrastructure to improve drainage and increase shade throughout the city effectively address many of the considerations raised by the report.

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165 Urban Land Institute. (2019). Waterfront resilience Miami, Florida at p. 6-7. https://2os2f877tnl1dvtmc3wy0aq1-wpengine.netdna-ssl.com/wp-content/uploads/ULI-Documents/ULI-ASP_Report_Miami_FINAL.pdf

166 Waterfront Resilience Miami, Florida, 2019 (no. 164) at p. 7.

167 Waterfront Resilience Miami, Florida, 2019 (no. 164) at p. 7.

4. Case Study: Growing Green Bus Stops

Growing Green Bus Stops started as a pilot project among several local partners targeting "unshaded bus stops along transit corridors throughout Miami-Dade County to mitigate the urban heat island effect and enhance the transit experience for riders."[168] The project resulted in 20 canopy trees planted adjacent to 10 unshaded bus stops across the County. An additional component of the project was a partnership that involved "stenciling a haiku poem about trees, written by a local resident, onto the surrounding sidewalk." [169] Through incorporating tree canopy into transit stops, riders benefited from shaded cooler bus stops, the roadway was beautified, and the public engaged in the process through poetry.

C. Recommendations

1. Prioritize trees and green infrastructure in resilience planning, capital projects, code updates, and investments.

Resilience planning, capital projects, and code updates should be verified to be consistent with canopy cover targets. Land use decisions can be set up to evaluate whether the project provides for sufficient current and future tree canopy cover for a project of its size in a given zoning district. Essentially, we recommend calculating the necessary tree canopy on a given project that is required to meet the project area's contribution to the local government's overall canopy coverage target. Utilize best scientific information available and a Tree Public Benefits Table, discussed further in Section VII, to calculate existing and potential ecosystem service contributions from urban forestry components of resilience plans and projects.

2. Develop a tree canopy vulnerability assessment and climate adaptation plan, including updated landscape design criteria to improve tree resilience to increased heat, storms, flooding, and sea level rise.

Better understanding of the climate vulnerabilities of Miami-Dade County's urban tree canopy, as well as evaluation of potential measures to improve the viability of it in the face of climate change impacts would help to future-proof the County's tree canopy resources. This would include a roadmap of interventions that may be necessary to improve the viability of existing urban forests in the face of current and projected climate change impacts.

Urban forestry decisions would be better informed with improved guidance for appropriate tree species and tree placement for present day resilience and future climate conditions.

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168 Resilient 305 Strategy (no. 98) at p. 63.
169 Resilient 305 Strategy. (no. 98) at p. 63.

Design and maintenance regulations and standards may require updating to be more responsive to current and future climate impacted conditions in South Florida. Tree transition recommendations should be responsive to projected climate change impacts corresponding with forestry transition planning. Creating tree planting guidelines for different regions of the County adaptive to current and future climate change impacts will help ensure that trees are planted in a manner that will be supported in future conditions.
Updating design criteria to ensure adequate soil conditions will ensure existing and new trees can develop into thriving canopy trees.[170] Soil requirements also define the future canopy. Local government design criteria for "soil volumes, based on species," along with identification of projects where tree pits, structured soil, and other green infrastructure should be incorporated would help to ensure development moves forward in a manner that will promote a healthy tree canopy into the future, while optimizing stormwater benefits and improving the urban forests resilience to storms.

Some adaptation measures will be reflected in updated stormwater design standards and landscaping code and can build on existing work product from across the County and State. Numerous streetscape plans have been conducted through Miami-Dade County, City of Miami, and other localities.[171] Urban forestry resilience or adaptation planning should build upon and not duplicate those efforts.

3. Adopt an Urban Heat Reduction Ordinance that emphasizes tree canopy.

An urban heat ordinance or flooding and heat ordinance could serve as a delivery mechanism for a combination of policy and code updates that will help to improve UTC while improving resilience to climate change. There are several potential amendments to code language discussed in other sections of this paper that could improve outcomes for trees in land development decisions. Code amendments to improve responses to the shocks and stresses of climate change can be written to emphasize the role of trees in combating heat, water quality, and flooding challenges.

4. Integrate nature-based climate preparedness into comprehensive planning, land use, and zoning.

See more detailed land use and zoning recommendations in Section VI.

5. Prioritize trees in land acquisitions for resilience benefits, as well as new and expanding parks.

Resilience planning should account for the urban heat island and stormwater benefits trees provide. Given the significant stormwater management and heat reduction benefits large canopy trees provide, those high value tree assets should be prioritized in resilience planning and projects for conservation.

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170 US Environmental Protection Agency. (2013). Stormwater to street trees: Engineering urban forests for stormwater management at p. 7.
https://www.epa.gov/sites/default/files/201511/documents/stormwater2streettrees.pdf
EPA recommends, "[f]or a mature tree with a canopy spread of approximately 30 feet, 1,000 cubic feet of soil is needed." The Miami Beach Trees to Offset Stormwater Case Study recommends requiring and enforcing "600, 1,000, and 1,500 cubic feet soil volume planting requirements for small, medium, and large trees respectively" Trees to offset stormwater. 2018 (no. 131) at p. 25.

171 See Appendix A for a summary of relevant treescape efforts as well as other tree related initiatives.

Parcels with Public Benefit Trees[172] that provide significant infiltration and shading benefits can be prioritized for land acquisition and green space components of resilience efforts. Land acquisition, and preservation strategies related to resilience planning should prioritize existing tree canopy and potential for new tree canopy.

Potential updates to park and open space impact fee provisions to encourage the dedication of land containing protected trees, including those delivering significant resilience and ecosystem services are discussed further in Section VI.

6. Incorporate urban forests and trees into greenhouse gas accounting.

7. Assess environmental and climate impacts of current tree debris management practices through life-cycle analysis. Evaluate opportunities to minimize environmental and climate emissions impacts from such activities and implement solutions.

8. Develop a local plan for the Miami-Dade County Back Bay Study that is consistent with canopy cover goals, including significant green infrastructure and land conservation components.

9. Develop and codify a "Tree Public Benefits Table" to accurately reflect the ecosystem and resilience benefits trees deliver in Southeast Florida using the best scientific information available.

This "Tree Public Benefits Table" could be used to identify trees that are providing important contributions to the level of service for certain municipal demands. Understanding these contributions in relations to this unique tropical environment will help to ensure these generally externalized costs are better captured by market decisions and government planning decisions. Once trees providing significant services can be identified based on developed criteria, incentives for their preservation can be adopted in the code and in planning decisions. In some ways, such a table could be adopted as an expanded application of what is traditionally a mitigation table. This follows the concept of tree benefits tables created by the City of Miami Beach in its Urban Forestry Master Plan. Mitigation tables are discussed in further detail in Section VII.

172 A proposed Public Benefit Tree designation is discussed in Section II.

10. Establish and implement stormwater design standards, best management practices ("BMPs"), low impact design ("LID"), and green infrastructure ("GI") that prioritize trees.

Develop a stormwater best practice design manual that emphasizes trees and green infrastructure. "Without standards, innovative stormwater techniques such as green roofs, suspended pavement systems, vegetated swales and tree pits cannot be credited to stormwater requirements."[173]

The BGSI Concept Plan for Miami Beach, FDEP Low-Impact Development and green infrastructure: Pollution Reduction Guidance for Water Quality in Southeast Florida, and numerous examples of stormwater manuals for LID BMPs provide strong starting points for developing Southeast Florida appropriate design manuals.

Additionally, we recommend exploring opportunities to support and obtain funding for nature-based stormwater solutions that focus on tree preservation and expansion of tree canopy through section 319 and SWAG.

11. Expand the role of trees and green infrastructure in forthcoming updates of the stormwater management MS4 permits for Miami-Dade County and its co-permittees and the City of Miami.

12. Update stormwater credit and fee reduction criteria to better value contributions from new and existing tree canopy cover.

Stormwater fee reductions and credits can be updated to accurately account for the contributions of existing trees, using a Tree Public Benefits Table referenced above.

D. Model Language

1. Model comprehensive plan language for trees and resilience

By authors

Conservation Element

Goal Con-xx

Optimize the benefits trees can provide for resilience and climate action efforts.

Objective XX

173 Trees to offset stormwater, 2018 (no. 131) at p. 25.

Ensure that resilience planning and project implementation aligns with urban tree canopy ("UTC") cover targets and climate action targets.

Policy XX.

Integrate tree preservation, new trees, along with supporting green infrastructure into resilience* planning, project design, and expenditures. Establish tree requirements in resilience projects consistent with UTC targets.

Policy XX. Establish land use criteria across zones that are consistent with UTC targets.

Policy XX.
Evaluate and as needed update landscaping guidelines to require and support soil requirements, design, and maintenance procedures that will minimize tree loss from storms while serving to advance goals for increased UTC.

Policy XX.
Establish and implement a system to identify trees providing ecosystem services and resilience benefits and incentivize preservation of such trees on private and public land through integration in forestry management, resilience, land use, and capital planning and projects. Trees providing such services shall be defined in the code as Public Benefit Trees. Threshold contributions to levels of service to qualify as a Public Benefit Tree service shall be established in a Public Benefits Tree Table utilizing the best scientific information available and applicable to conditions in South Florida.

Policy XX.
Conduct a life-cycle analysis study of current tree and landscaping debris management practices, including climate emissions impact. Evaluate feasibility of alternative landscape debris management approaches to reduce climate polluting emissions.

Authors' note: timelines and specific tasks should be considered and adopted based on the specific body adopting the language.

*Depending on how a specific municipality defines resilience projects, it may be appropriate to adopt the language to apply more broadly to certain types of capital improvement, roadways, pathways, or public land projects. Depending on the specific comprehensive plan, the policies may fit within existing goals or objectives or be best organized under a new goal. The Conservation Element or as it is called in Miami-Dade County's CDMP, the Conservation, Aquifer Recharge and Drainage Element is one potential location for the proposed policies.

IV. Trees and Environmental Justice

The goals of EJ are to ensure equal protection from environmental and health hazards and to ensure equal access to the decision-making about environmental issues, in both the natural and the built environments. While born in the context of environmental hazards, environmental justice also concerns the equitable distribution of environmental benefits within a society. Here, we include the recently expanded discussion of EJ as a concern for the equitable distribution of environmental benefits within a society—in addition to the prevention of environmental harms. Within this expanded discussion, tree preservation and canopy cover are central to ensuring equitable distribution of the valuable ecosystem services conferred from the urban forest.

A. Discussion

1. Environmental justice background and historical trends

The environmental justice (EJ) movement represents the intersection of two significant movements from the 20th Century: the civil rights movement of the 1960s and environmental movement of the 1970s. Beginning in the 1980s, the EJ movement rode on the coattails of the environmental movement to address the concerns of the environmental movement in the 1970s—industrial toxins seeping into the air and water—disproportionately affecting communities and workplaces of people of color.[174] The U.S. Environmental Protection Agency (EPA) now defines EJ as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."[175] In this context, EJ deals with the health concerns and other harms associated with exposure to pollutants with measurable deleterious health effects on adjacent populations.

Unfortunately, Florida law previously contained disparaging and segregationist "Jim Crow" provisions prohibiting racial intermarriage, prohibiting cohabitation, designating separate education, and separate housing for juvenile delinquents.[176] The pervasive and foundational nature of racism throughout the institutional landscape of America has led to widespread segregation that pervades market institutions that shape the property value and character of many of the communities and residential areas of people of color.[177] This unfortunate legacy of poor decision-making has solidified the challenging reality that many communities of color face.[178] The impacts continue today, as recent occurrences spawning

174 Bullard, R. D. (1993). Anatomy of environmental racism and the environmental justice movement. Confronting Environmental Racism: Voices from the Grassroots, 15, 15– 39. https://cpb-us-e2.wpmucdn.com/sites.uci.edu/dist/c/3308/files/2020/03/Bullard_Anatomy-of-Env-Racism-and-the-EJ-Mov.pdf

175 United States Environmental Protection Agency. (n.d.). Environmental justice. https://www.epa.gov/environmentaljustice

176 Ferris State University. (n.d.). Examples of Jim Crow laws – October 1960 – civil rights. https://www.ferris.edu/HTMLS/news/jimcrow/links/misclink/examples.htm

177 Imbroscio, D. (2021). Race matters (even more than you already think): Racism, housing, and the limits of The Color of Law. Journal of Race, Ethnicity & the City, 2(1), 29–53. https://doi.org/10.1080/26884674.2020.1825023

178 Grove, M., Ogden, L., Pickett, S., Boone, C., Buckley, G., Locke, D. H., Lord, C., & Hall, B. (2018). The legacy effect: Understanding how segregation and environmental injustice unfold over time in Baltimore. Annals of the American Association of Geographers, 108, 524–537. https://doi.org/10.1080/24694452.2017.1365585

activism within the Black community, as well as the COVID-19 pandemic have shown a spotlight on the inequalities faced in these communities. This includes the availability and use of park space in Black communities and tension and inherent racism that the Black community faces when using parks.[179]

The historical underpinnings of the inequities with respect to EJ are grounded in the unfortunate past of intentionally excluding individuals belonging to a particular race or ethnic background—particularly persons of color—from purchasing or renting properties in affluent and desirable neighborhoods. These practices of "redlining," established by the federal Home Owners' Loan Corporation (HOLC) in the 1930s, have caused multigenerational socioeconomic impacts, and on average communities of color have only approximately half of the tree cover as their counterpart U.S.-born White communities.[180] Notably, the A-D ranking system that the HOLC used in the 1930s to assess increasing loan risk in metropolitan areas concurrent with increasing minority populations parallels the modern-day decline in average tree canopy cover as the racial composition becomes less White.[181]

2. Miami-Dade immigration trends and neighborhood divisions, power & governance

The unique residential landscape in Miami-Dade is unlike any other region of the country. Since its very onset, the community in what is now Miami-Dade has been a vibrant assemblage of racial, national, ethnic, and religious diversity. Black immigrants from The Bahamas have shaped the character of Miami since the early days of the twentieth century.[182] Miami has experienced waves of immigrations throughout its history, including: Bahamian immigrants seeking employment and livelihood in Florida, freed slaves from British territories, freed slaves from other US states, 1960s Black Americans fleeing areas where Jim Crow laws were more prevalent and oppressive, the Cuban diaspora beginning with the Cuban Revolution in 1959, continued mass Cuban migrations fleeing the oppressive regime in the 1980s, and masses of Haitian immigrants in the 1980's and 1990's fleeing oppressive political regimes and poverty. Interestingly, the distinctly Black neighborhoods of Miami-Dade include both those that have existed since Miami's early development as well as satellite suburbs and developments that are largely a product of the gentrification of more desirable areas.

With each successive wave of immigration, there has been movement and consolidation of white non-Hispanic communities as well as the establishment of the wonderful nuances in diversity within Miami-Dade neighborhoods and communities. Even within single neighborhoods, there can be extreme socio economic divides. Miami-Dade has a remarkable retention of culture, given the international nature of residents, especially from Latin America and the Caribbean. In some cases, there is more of a national-focused differentiation of neighborhoods, e.g., Little Havana and Little Haiti.

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179 Hoover, F. A., & Lim, T. C. (2020). Examining privilege and power in US urban parks and open space during the double crises of antiblack racism and COVID-19. Socio-Ecological Practice Research, 1-16. https://doi.org/10.1007/s42532-020-00070-3

180 Locke, D. H., Hall, B., Grove, J. M., Pickett, S. T. A., Ogden, L. A., Aoki, C., Boone, C. G., O'Neil-Dunne, J. P. M. (2021). Residential housing segregation and urban tree canopy in 37 U.S. cities. npj Urban Sustain, 1, 15. https://doi.org/10.1038/s42949-021-00022-0.

181 Locke, et al., 2021 (no. 180).

182 Mohl, R. A. (1986). Black immigrants: Bahamians in early twentieth-century Miami. The Florida Historical Quarterly, 65(3), 271-279. https://stars.library.ucf.edu/fhq/vol65/iss3/3

Given Miami-Dade's unique assemblage of residents as well as its settlement history, the institutional dynamics and composition of individuals in positions of power is distinct, especially in the context of the conversation on institutional racism. Miami has seen a shift from white Caucasian to white/mixed race Hispanic majority in its population and power structure.[183] While there remain primarily Black and primarily Hispanic communities that are underprivileged, there are also affluent and extremely privileged communities that are primarily Hispanic. Low-income communities in Miami-Dade do correlate with racial and ethnic minorities as is the case with the rest of the country, but the Miami system is more nuanced and race or ethnic heritage alone is not an appropriate classification system. Now all communities, including Black and Hispanic communities, have their own respective environmental concerns. However, the distribution of canopy cover throughout the county is correlated with socio-economic status, with canopy cover or lack thereof serving as an indicator for affluence or disadvantage in communities.[184]

3. Environmental equity of ecological benefits from trees

The core of the Environmental Justice movement is that the environmental harms should not be concentrated in communities of color.[185] Here, we extend this notion by proposing that environmental benefits also must be equitably distributed in all communities. To achieve Environmental Justice in Miami-Dade County, it is important to view tree canopy as a public resource that must be equitably distributed regardless of race, color, national origin, income, or age. The equitable distribution of environmental benefits, especially those conferred by trees is an important goal to achieve moving forward in Miami-Dade County. Section I.B. supra details the benefits that trees provide to the community, including absorption of air pollutants[186] and water filtration, serving as a first line of defense against shoreline erosion and sea level rise, localized urban heat[187] and residential energy savings, as well as improved community aesthetics that correlate to improved mental health and elevated property values. While the true dollar value of those benefits has yet to be memorialized into policy, it is not beyond the reach, as is discussed in Sections II and VII.

Although the precise value of the ecological disparity between communities may be currently unassessed, there is a known disparity in tree cover in Miami-Dade that corresponds to communities of color. For example, a 2011 study analyzing tree cover differences between White, Hispanic, and Black communities within urban Miami-Dade County, analyzing tree cover with GIS remote sensing and U.S. Census data for demographic trends, found a stark contrast in the distribution of tree cover

183 Vogel, R., & Stowers, G. (1991). Miami: minority empowerment and regime change. In H. V. Savitch, & J. C. Thomas (Eds.), Big city politics in transition (pp. 115-131). SAGE Publications, Inc. https://dx.doi.org/10.4135/9781483325781.n8

184 Wolfe, 2007 at 3.

185 Lake, R. W. (1996). Volunteers, NIMBYs, and environmental justice: Dilemmas of democratic practice. Antipode, 28(2) 160–174. DOI:10.1111/j.1467-8330.1996.tb00520.x

186 Escobedo, F., Klein, J., Pace, M., Mayer, H., Varela, S., & Iannone, B. (2011). Miami-Dade County's urban forests and their ecosystem services. Institute of Food and Agricultural Sciences, University of Florida. FOR285. doi.org/10.32473/edis-fr347-2011

187 Dialesandro, J., Brazil, N., Wheeler, S., & Abunnasr, Y. (2021). Dimensions of thermal inequity: Neighborhood social demographics and urban heat in the Southwestern U.S. International Journal of Environmental Research and Public Health, 18(3), 941. https://doi.org/10.3390/ijerph18030941

between these communities.[188] The analysis also noted disparities in tree species diversity, since generally speaking "a greater number of tree species indicates more resilience against pests and diseases, resistance to hurricane impacts, and provides a wider suite of ecosystem services."[189] Areas with predominantly White residents had greater tree density, greater tree and shrub cover, more tree diversity, and the greatest amount of energy savings due to trees compared to Hispanic and Black residents.[190] The researchers proposed that rates of homeownership in Miami remain lower among Black and Hispanic residents compared to White residents. Because tenants do not own or control the property on which they reside and have higher levels of transience, they are less likely to take on the long-term maintenance that trees require. Also, within lower-income communities, homeowners may lack the necessary resources to properly maintain trees on their private property.

Black communities within Miami-Dade were found to benefit from only 5% residential energy savings due to trees, while Hispanic and White communities had 43% and 52%, respectively.[191] Thus, the tree coverage disparity shown in communities of color carries real and measurable economic consequences, which from an institutional perspective are not directly taken into account when making planning decisions. Lack of tree canopy in predominantly Black communities increases the energy and thus housing cost burden for those residents. Tree cover disparities effectively exacerbate the already existing socio-economic divides that are associated with and linked to race.

In the Miami housing market, tourist demand heavily influences property value as well as the affordability of neighborhoods to renting residents, especially with the expanded availability of short-term vacation rentals, causing further barriers to home ownership by elevating property values—and subsequent rental costs. South Florida currently has an affordability crisis in the residential housing market.[192] Rents are increasing at unprecedented rates as affluent individuals and families flock to South Florida, due in part to external factors inherent to the COVID-19 pandemic.

One measurable metric concerning the value of elements within a community, which includes trees, is the property sale value. The hedonic pricing method entails the willingness that consumers are willing to pay for a property and thus incorporates a pricing element for non-use or hard to quantify elements, such as tree cover or community aesthetics, within the property valuation.[193] In the residential market, large shade trees and healthy lawns are key indicators of "The Ecology of Prestige."[194] These indicators are thus likely important external factors in elevating property value. Moreover, in the Miami climate, lawns, ornamental flowers, and many trees require irrigation during the dry season, dedicated lawn and garden care, and fertilizer inputs, all of which represent increased costs.

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188 Flocks, J., Escobedo, F., & Wade, J. S. (2021). Environmental justice implications of urban tree cover in Miami-Dade County, Florida. Environmental Justice, 4(2), 125–134. DOI:10.1089/env.2010.0018

189 Min Zhao et al., 2010 (as cited in Flocks et al., 2021) (no. 188).

190 Min Zhao et al., 2010 (as cited in Flocks et al., 2021) (no. 188).

191 Flocks et al., 2021 (no. 188) at p. 132.

192 Iglesias, J. (2022, April 8). Daniella Levine cava declares a housing affordability crisis in Miami-Dade County. Miami Herald. https://www.miamiherald.com/news/local/community/miami-dade/article260244695.html

193 De Groot, R. S., Wilson, M. A., & Boumans, R. M. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological economics, 41(3), 393-408, as cited in Wolf, K. L. (2007). City trees and property values. Arborist News, 16(4), 34-36.

194 Zohu, et al., 2009, as cited in, Locke, D. H., & Grove, j. M. (2016). Doing the hard work where it's easiest? Examining the relationships between urban greening programs and social and ecological characteristics. Applied Spatial Analysis and Policy, 9, 77–96. https://doi.org/10.1007/s12061-014-9131-1

The largest increases in price willing to pay value increases occurred where tree cover coincided with an already affluent neighborhood.[195] This begs the question of whether the concerns of springing gentrification from expanding tree cover are unfounded; simply having more trees does not necessarily change the perceived characterization of a neighborhood. As the article alludes, tree presence and neighborhood desirability are already linked. Whether planting trees or planning green infrastructure projects alters the desirability of a neighborhood likely depends on a wide set of factors, as the next subsection discusses.

4. Preventing green gentrification

Gentrification is a potential dis-service to the implementation of green infrastructure projects in formerly redlined communities and thus careful consideration of Environmental Justice is necessary when implementing such projects in these communities.[196] Gentrification occurs when long-standing residents in a community are displaced with the influx of more affluent residents due to the increased cost of living so that their increased rent or living expenses causes their long-standing home to no longer be an economical place to live. In some cases, in Miami, 'revitalization' projects have inflated property and rental values that cause previous residents to be unable to afford to live in their former homes, making way for high-rise buildings for higher density housing.[197] Community consolidation and gentrification has been rampantly occurring in Miami-Dade for decades, with some of the most notable examples occurring in the areas of Brickell, Midtown, downtown Miami, Overtown, Little Haiti, and Coconut Grove, with new development projects, soaring condominium constructions, and other high density residential projects targeting luxury clients and young professionals.

Greater Miami is currently experiencing record increases in property value and analogous increases in rent, and this is apart from any localized gentrification. Tree cover, green space, and access to parks confer known benefits on property values, as discussed above, but the Locke study from Baltimore notes that these property value increases may not be as welcome in communities where there is a high percentage of rental occupants, as there would also be commensurate increases in property taxes for non-homesteaded properties and rental expenditure. Locke et al. indicates that these residents are instead best motivated by improved aesthetics, job opportunities, health outcomes, cleaner and safer surroundings.[198] Mid-sized shade trees and even individual planters could be appropriate landscaping elements that do not change the fundamental dynamics of a neighborhood, can occupy limited space, and also confer respective ecosystem benefits.[199] Further, specifically in Miami-Dade County, the favoring of resilience programs in affluent communities may increase the rent gap as climate-based risk influences extant disparities and gentrification.[200]

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195 Wolfe, 2007 (no. 193). at p. 3.
196 Hoover & Lim, 2020 (no. 179).
197 Samara, T. R., & Chang. G. (2008). Gentrifying downtown Miami. Race, Poverty & the Environment, 15(1), 14-16. https://www.reimaginerpe.org/files/15.Samara.Chang_.pdf
198 Locke, et al., 2021 (no. 180) at p. 17.
199 Locke, et al., 2021 (no. 180) at p. 17.
200 Taylor, Z. J., & Aalbers, M. B. (2021). Climate gentrification: Risk, rent, and restructuring in greater Miami. Annals of the American Association of Geographers, 1-17. https://doi.org/10.1080/24694452.2021.2000358

Indeed, some of Miami-Dade's highest profile Green Infrastructure projects discussed supra have been sited within the most affluent cities and neighborhoods. Idealization of white residential neighborhoods contributes to gentrification,[201] resulting in a number of marginalized communities into areas of existent, and potentially ongoing infrastructure deficiencies. Studies have shown concern for furthering socio-economic disparities by implementing Green Infrastructure projects in formerly redlined communities.[202] Even when employed in marginalized communities, there is concern that subsequent increases in property costs and value may lead to gentrification and displacement of the very residents for whom the programs were designed.[203] It is important to note that these studies voice concerns for large-scale Green Infrastructure projects, involving substantial investment and community changes. Alternatively, inexpensive restoration measures such as urban greening and vacant land restorations were found to not drive residents away but instead were found to reduce violence and fear.[204] Thus, the crux of the matter is how to designate elements that improve the living conditions and livelihoods of communities of color without changing the fundamental character and residential composition of the community, so as to encourage gentrification.

It is important to note that the power of a municipality to encourage or mandate low-income and rent-controlled housing options, especially though mandatory inclusionary zoning[205] is both a much larger and more powerful manner to mitigate changes in affordability connected with tree planting. Advocates for social as well as ecological sustainability are crucial within the institutional policy-making framework. In a study extensively surveying the code language of green infrastructure initiatives in municipalities across the US, social criteria were found to be the second-largest thematic group—after hydrological considerations of stormwater management—but environmental justice criteria were found at less than 2% prevalence.[206] Here, we emphasize that absent specific language relating to environmental justice in municipal green infrastructure planning, there are no guarantees that Environmental Justice measures will be implemented, as stormwater management is often of stronger political focus.[207] Alternatively, when Environmental Justice provisions are explicitly stated in the plans there is increased accountability to ensure these considerations are actually implemented.[208]

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201 Glotzer, P. (2015). Exclusion in Arcadia: How suburban developers circulated ideas about discrimination, 1890–1950. Journal of Urban History, 41(3), 479-494. https://doi.org/10.1177/0096144214566964

202 Locke et al., (2021) (no. 180).

203 Wolch, J. R.., Byrne, J., & Newell, J. P. (2015). Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. Landscape and Urban Planning, 125, 234–244. https://doi.org/10.1016/j.landurbplan.2014.01.017

204 Branas, C. C., South, E., Kondo, M. C., & MacDonald, J. M. (2018). Citywide cluster randomized trial to restore blighted vacant land and its effects on violence, crime, and fear. PNAS, 115(12), 2946–2951. https://doi.org/10.1073/pnas.1718503115

205 Lerman, B. R. (2006). Mandatory inclusionary zoning—The answer to affordable housing Problem. Environmental Affairs Law Review, 33(2), 383-346. https://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=1092&context=ealr (Mandatory inclusionary zoning is when governments require developers "to create affordable residential units as a part of any new development. Typically, inclusionary zoning ordinances mandate a percentage of affordable units, designate an income level defined by median income, and provide for an affordable period—a required length of time for the units to remain affordably priced. In return, inclusionary ordinances often provide developers with incentives, the most common of which is a density bonus." at p. 383

206 Hoover & Lim, 2020. (no. 179) at p. 676.

207 Hoover & Lim, 2020. (no. 179) at p. 666.

208 Hoover & Lim, 2020. (no. 179) at p. 666.

The risk of perpetuating larger disparities in urban infrastructure development and disadvantaged communities of color is readily apparent absent institutionally mandated protective measures.[209]

5. Community involvement

Environmental Justice initiatives need to be grounded in efforts that engage with and actually attempt to improve the living conditions of the overall community. What should be avoided is justice-washing aimed to accomplish political ends, e.g., developers selling a project to the surrounding community as equity for the under-served when the project will actually fundamentally damage community dynamics.

The implementation and ongoing efficacy of green infrastructure programs in Greater Miami are both shaped by the level of community involvement and engagement, before, during, and after a project. Community engagement allows for the ability to identify and respond to relative cultural issues, which are important to consider given the desirability of longevity of projects involving tree plantings. By working in concert with communities rather than imposing what policymakers or landscape architects think is best, programs can offer lasting impacts. Even the most comprehensive tree ordinances and protective regulations of trees are wholly ineffective when local leaders or community members are unwilling to enforce or follow same.

In Miami-Dade County, the Southwest Streetscape and Street Tree Master Plan embraces a community approach for tree planting and protections. The streetscape project strives to connect green infrastructure while also incorporating existing traffic and parking conditions within a 6.7 square mile portion of the City of Miami.[210] For example, the Southwest Street Master Plan contemplates parking spaces for multi-family homes when designing appropriate tree spacing in swale areas, so as to not conflict with the existing patterns of usage.

The stakeholder outreach approach works with communities, as opposed to pushing an outside agenda on communities, recognizing that community buy-ins are a critical component to the longevity of greening initiatives. Here, a “market-like analysis of neighborhoods” is encouraged in order to best assess community needs.[211]

B. Case Studies

The placement of certain infrastructure projects in Miami-Dade that have been associated with the permeation of environmental contaminants and subsequent EJ concerns. While the argument of systemic racism is not necessarily connected to the views or even decision-making power of a single policy maker, the totality of the circumstances, including lack of extension of public infrastructure and resources to underrepresented communities, is indicative of systemic racism in urban design and marginalization of communities of color.

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209 Hoover & Lim, 2020. (no. 179) at p. 676.

210 Southwest (SW) streetscape and street tree master plan. (n.d.) (no. 81)

211 Locke, D. H., Grove, J. M., Galvin, M., O’Neil-Dunne, J. P. M., & Murphy, C. (2013). Applications of urban tree canopy assessment and prioritization tools: Supporting collaborative decision making to achieve urban sustainability goals. Cities and the Environment, 6(1). http://digitalcommons.lmu.edu/cate/vol6/iss1/7

1. Old Smokey

"Old Smokey" was the colloquial name given to the trash incineration facility in Coconut Grove that was built in 1926 due to the large amount of ash that spewed into the air—approximately one ton of smoke per day—and blanketed the surrounding primarily Black community for decades. The historic Black community of the West Grove, historically settled by Bahamian laborers in the early twentieth century.[212] Old Smokey has now been criticized as an indication of systemic racism in local policy making.[213]

What is remarkable about the Old Smokey case study is the cascading effects and ongoing impacts that exacerbated the injustices on the surrounding community. The failure to test for environmental impacts and deposition of toxic substances continued until the mid-2010s, and there is continued lack of remediation efforts. For example, even after discovering dangerous levels of toxic contaminants in residential properties in 2014, there was institutional reluctance to pursue soil removal due to its cost.[214] In addition to the deleterious health impacts, the full extent of which are still unknown, there have been further cascading effects on the surrounding population, including leaching of heavy metals into the well water systems of the West Grove. The lack of water quality monitoring has led these impacts to be undocumented until only recently.

Ash disposal in lands that are now parks has raised safety concerns, such as the 2014 closure of Blanche Park in Coconut Grove.[215] Although the parks were created after the fact, an important consideration for the discussion of greening of vacant lands is potential of exposing past contamination, as the greening and revitalization of these areas may draw individuals toward or expose buried toxic waste or residue.

The use of trees and plants for phytoremediation can serve to support remediation efforts. Plant species that have proven useful as phytoremediation of heavy metal contaminated soils include Thalaspi and Alyssum species.[216] While trees may offer only a limited benefit in terms of remediating the heavy metals, tree cover once adapted to contaminated soils offer the benefit of capping the contamination through root cover and organic litter from fallen leaves,[217] as well as reducing the flow of water through the contamination because of the trees' transpiration of water.[218]

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212 Mohl, 1986 (no. 182).

213 Alfieri, A. V. (2014). Paternalistic interventions in civil rights and poverty law: A case study of environmental justice. Michigan Law Review, 112(6), 1157-1177. https://repository.law.umich.edu/mlr/vol112/iss6/15

214 Villano, D. (2014, September 30). City ignores reports of toxic soil in residences, sidewalks in coconut grove, reports show. Miami New Times. https://www.miaminewtimes.com/miami/Print?oid=6521340

215 CBS Miami. (2014, March 11). Grove's blanche park to close for toxic soil removal. https://miami.cbslocal.com/2014/03/11/groves-blanche-park-to-close-for-toxic-soil-removal/

216 Pulford, I. D., & Watson, C. (2003). Phytoremediation of heavy metal-contaminated land by trees-A review. Environment International, 29(4), 529-540. DOI:10.1016/S0160-4120(02)00152-6. at p. 530.

217 Tree benefits for contamination do not supplant applicable contaminated property laws and remediation guidelines.

218 Pulford & Watson, (2003) (no. 216) at p. 534.

2. I-95 construction and Historic Overtown

The construction of interstate highway I-95 in the late 1950s bisected the Overtown neighborhood and in so doing destroyed generations of Black Miami history and a thriving cultural gem.[219] Whether or not the placement of this construction ripping through the Black community of Overtown was the unfortunate reality given the need for a vital roadway or an embodiment of the systemic institutional racism to further separate the affluent coastal communities from the marginalized inland communities of color, there were generations of history unrecorded and lost due to the careless failure to document and preserve its heritage. The project caused the direct displacement of thousands of Black residents, including individuals and families that had lived in the area for generations. Displaced residents migrated areas including Liberty City, Brownsville, and Richmond Heights. Although much of the losses were largely undocumented, recent artistic work by acclaimed contemporary artist Derrick Adams visually exposed the pain and cultural destruction that the Overtown community felt in the building of I-95.[220]

Decision making such as this example is reminiscent of a legacy of Environmental Justice concerns, such as those found in a study in Baltimore where formal and informal segregation in the city's early history, combined with "redlining" in the 1930s left an indelible mark on present-day distribution of social and environmental inequalities.[221] Roadworks projects entail an alarming loss of trees and further incite micro heating, and the loss of tree canopy combined with creation of impervious surface that channels water runoff, in addition to providing greater surface area for heating. In the I-95 case, the lack of community input in the development process further demonstrates the unfortunate nature of these harms on the Black community.

C. Recommendations

The uneven distribution of benefits derived from tree and canopy cover, which is closely tied to the history of discriminatory zoning, land use, banking, and other policies must be addressed from an institutional perspective in Greater Miami. Below we detail specific recommendations to address the disparate ecosystem services conferred to disadvantaged communities.

1. Identify areas of concern.

First, the extent and distribution of environmental inequities must be assessed. Here, we call for a county-wide assessment of municipalities, and in some cases specific neighborhoods, to identify areas of EJ concern. At the national level, the White House Council on Environmental Quality ("CEQ") created a Climate and Economic Justice Screening Tool, Pursuant to Executive Order 14008. The map screening tool allows for identification of disadvantaged communities facing Environmental Justice challenges. The tool aims to "identify disadvantaged communities that are marginalized, underserved, and overburdened by pollution." Notably, most of inland Miami-Dade is included in the public beta form of this tool.

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219 King, L. J., & Shakealia, Y. F. (2015). Race is a highway. In P. T. Chandler (Ed.), Doing race in social studies: Critical perspectives (p. 195 - 228). Information Age Publishing.

220 Marvar, A. (2018, December 11). Artist Derrick Adams shows I-95's impact on black Miami. Bloomberg. https://www.bloomberg.com/news/articles/2018-12-11/artist-derrick-adams-shows-i-95-s-impact-on-black-miami

221 Grove, et al., 2018 (no. 178).

The data from beta-version of the Climate and Economic Justice Screening Tool[222] indicates that a sizable percentage of inland Miami-Dade municipalities are areas of concern. Local studies commissioned and conducted in Miami-Dade County would offer better resolution and ground truthing of these data and institutional expertise to effect positive change in the remediation of local EJ concerns.

The Justice40 Initiative aims to provide 40% of the benefits of indicated federal investments to disadvantaged communities in the areas of: "climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, the remediation and reduction of legacy pollution, and the development of critical clean water infrastructure."[223] Tree planting projects, green infrastructure, along with designation and conservation of valued tree resources each contribute to energy efficiency, reduction of legacy pollution, and water filtration. Ecosystem benefits are more robust when there is connective green infrastructure in place.[224]

2. Mitigate for past environmental injustices.

Second, within the areas of concern that may be identified in the proposed county-wide assessment, pursue opportunities to mitigate past harms and confer valuable benefits on marginalized communities. Although certainly not a complete satisfaction for the harms caused by the injuries of systemic racism and environmental injustice, tree planting initiatives are the low-hanging-fruit to begin and ensure these areas are more livable spaces. Knowledge of areas of concern above allows municipal planning decision makers to be cognizant of environmental justice implications and consciously incorporate the same in future policy decisions.

Urban forests represent approximately 35% of the urban land cover in the United States, extending valuable ecosystem services to nearly two thirds of the American population.[225] The ecosystem services that the urban forest of Greater Miami provide include reduction of airborne pollutants, stormwater management, energy savings, reduced crime, increased property values, and improved living conditions.[226] The canopy cover of Miami-Dade County is not equally distributed across race and income levels, and we recommend integrating EJ priorities into land use planning for meeting canopy coverage targets wherever possible.

3. Greening of vacant lands.

The conversion, or alternatively greening of vacant lands both provide an opportunity for improving conditions in under-privileged neighborhoods without substantially changing the character of the neighborhood or inflating the property values to a point where it is no longer an affordable place for its residents to live.

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222 Climate and Economic Justice Screening Tool. (n.d.). Explore the data. https://screeningtool.geoplatform.gov/en/

223 U.S. Department of Transportation. (2022, March 10). Justice40 initiative. https://www.transportation.gov/equity-Justice40

224 Madureira, H., & Andresen, T. (2014). Planning for multifunctional urban green infrastructures: Promises and challenges. Urban Design International, 19(1), 38-49. DOI:10.1057/udi.2013.11

225 Pike, et al., 2021 (no. 34).

226 Escobedo et al., 2011 (no. 186).

Small-scale greening is the potential answer to the concerns of exacerbating gentrification with green infrastructure projects but also increased tree and plant cover in a meaningful way that improves the quality of life for existing residents. For example, a 2018 study noted that 15% of the land in municipally incorporated areas across the country is vacant or abandoned, and "interventions" of greening vacant or abandoned land areas reduced the perception of crime, increased availability of spaces for socialization, and importantly also correlated with measured reductions of crimes such as burglary and nuisance.[227] Implementing small-scale greening projects would be an inexpensive alternative to larger scale green infrastructure and community transformation, which may inspire undesirable gentrification.

4. Pair green infrastructure and greening initiatives with affordable housing.

The availability of affordable housing is a separate but intricately related and increasingly important concern in Greater Miami. Local governments must be mindful of these disparities, especially when planning future tree plantings or green infrastructure projects. We recommend that municipalities prioritize public tree plantings in areas that have a disparity in tree canopy and create a viable maintenance plan for ensuring long-term survival of those trees. For example, to help incentivize tree preservation, local governments could consider creating a grant program to help low-income homeowners comply with the tree care requirements. Or using models like that represented in the model language for Venetian Tree maintenance in Venice, Florida in Section VII, create tree maintenance programs supported by public dollars because of the value certain trees confer on the community.

227 Branas, et al., 2018 (no. 204).

D. Model Language

1. Model environmental justice comprehensive plan language

By authors.

Goal xx. Avoid, minimize, and mitigate past and present environmental inequities with respect to access to green space, natural areas, and canopy cover.

Objective xx. Achieve [___%] increase in canopy cover and park space through greening efforts in collaboration with underserved communities.

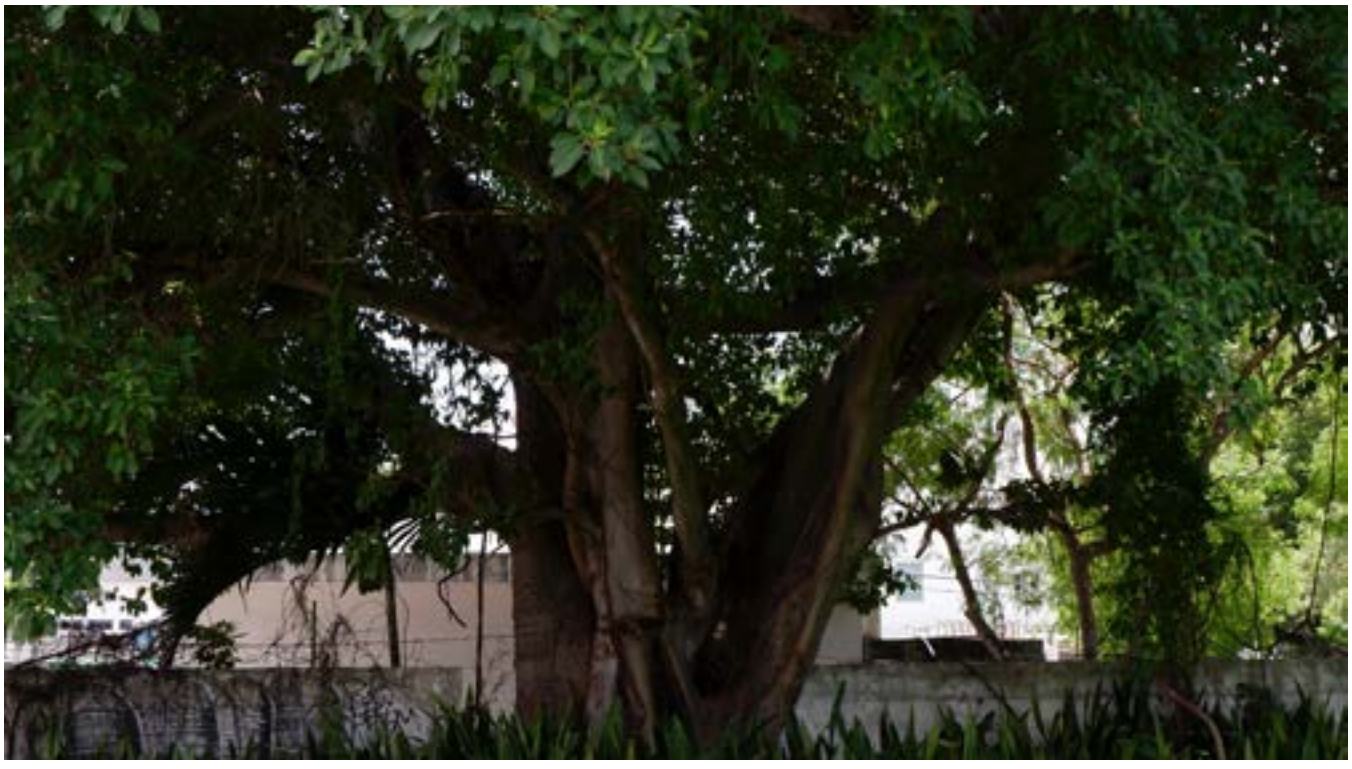
Policy xx. Conduct [city- or county-wide] study to assess the extent and distribution of environmental inequities with respect to access to canopy cover, urban forests, parks, and green space.

Policy xx. Develop strategy to optimize park and urban forestry benefits in disadvantaged communities through the federal Justice40 program, and other funding sources.

Policy xx. Create plan to work with disadvantaged communities to identify vacant land for greening. Implement strategy to green vacant land, including delivery of canopy expansion co-benefits.

Policy xx. Consider and address equity disparities in planning, infrastructure, capital project, and development decisions.

Policy xx. Assess public health risks and benefits in greening of vacant land and creation and development of new and existing parks.



V. Relevant Federal and State Statutes, Regulations, and Programs

This section includes a discussion of some of the relevant state laws that must be considered in developing local strategies and policies for managing natural resources and trees. It also touches on federal programs that provide resources and funding to support urban forests and natural area restoration.

State and federal involvement through the various regulatory regimes discussed in this section open access to the expertise of agency staff and state and federal appropriations. For example, the federal National Estuaries Program connects to EPA resources, a unique stakeholder process, and millions of dollars of annual federal appropriations to the State of Florida, largely supporting land uses improving natural resources.

Aspects of state laws and programming facilitate land acquisition and land trusts for conservation. The Land Acquisition Trust Fund established by the State in Florida in 1964 was amongst early efforts to set aside public land for conservation and outdoor recreation in the state. Because of the Environmental Land & Water Management Act of 1972,[228] along with the Land Conservation Act, Florida Forever and a host of related programs, "more than 10 million acres are managed for Conservation in Florida."[229] These programs have additionally translated into money for local government purchases of conservation and park land.

The Florida Forever Act, Florida Communities Trust program provides grant funds to local governments for acquisition of conservation lands, urban open spaces, parks, and greenways.[230] Additional grants are available for recreational development assistance. The 2014 Water and Land Legacy Amendment Act was designed to fund the Land Acquisition Trust Fund from a percentage of the existing excise tax.[231]

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228 The Environmental Land and Water Management Act of 1972, as codified in Fla. Stat. § 380.012 et seq., provides a legal mechanism to coordinate "lland and water management activities and specifically authorizes" Developments of Regional Impact ("DRI"). A DRI "means any development which, because of its character, magnitude, or location, would have a substantial effect upon the health, safety, or welfare of citizens of more than one county." § 380.06(1), Fla. Stat.

229 Florida Department of Environmental Protection. (2022, April 15). Florida Forever. https://floridadep.gov/lands/environmental-services/content/florida-forever

230 Florida Department of Environmental Protection. (2021). Land and recreation grant programs. https://floridadep.gov/sites/default/files/Land%20and%20Recreation%20Grants%20Program%20fact%20sheet%208-2021.pdf

231 The State of Florida has been accused in the past of misusing the funds from the Water and Land Legacy Amendment. See Schmitz, Ali (2018, June 13). Amendment 1 lawsuit alleging misuse of Florida conservation funds headed to trial. Treasure Coast Palm, https://www.tcpalm.com/story/news/politics/2018/06/13/lawsuit-claiming-state-misused-conservation-funds-headed-trial/673056002/

Natural resource conservation in Florida has a long history of checks and balances, intergovernmental collaboration, and discord between the state and local governments. Throughout the 1970s and 1980s Florida put in place environmental, land use, comprehensive planning, and growth management laws that included significant components aimed towards conservation of natural resources and sustainable growth. In 2011, the then governor of Florida signed HB7207 into law, effectively repealing large parts of the Local Government Comprehensive Planning and Land Development Regulation Act and changing the name to the Community Planning Act. The amendments emphasized sensitivity to private property rights, while removing some checks and balances, as well as other measures that provided for natural resource protection.

Through utilizing state regulatory levers to increase urban tree canopy, local governments may find opportunities to regain agency over some decisions that may have been stripped away through state preemption of local governance. Florida Statutes provide the land use mechanisms for conservation easements, covenant restrictions, and conveyance of development rights for conservation, parks, and environmentally endangered land.[232] Florida statutory designations such as Adaptation Action Areas ("AAA") under §163.3164 and Areas of Critical State Concern under Florida Statute §380.05, provide regulatory frameworks for designating and protecting natural resources, legislative flexibility, and potential access to financial resources.

Municipalities have what are called "Home Rule" powers to govern in accordance with the Florida Constitution. The Florida Constitution states in Article VIII, Section 2(b): "Municipalities shall have governmental, corporate and proprietary powers to enable them to conduct municipal government, perform municipal functions and render municipal services, and may exercise power for municipal purposes except as otherwise provided by law." The Home Rule provisions of the state constitution were adopted by the people of Florida in 1968 and adopted by the Legislature in 1973.

Notwithstanding Home Rule powers, local government policies and management of development and conservation, among other aspects of governing at the municipal level, continue to be guided and restricted by legislative and regulatory frameworks established by the Florida legislature and governor. Local government land use decisions are required to comply with the Community Planning Act, and the planning and land use rules it imposes, along with other rules in the Florida Statutes.

In more recent years, the Florida Legislature has eaten away at local Home Rule in a manner that has restricted local governments' abilities to implement their own rules to protect natural resources and facilitate sustainable development in their communities. Such legislation, essentially preempting local government authority, has covered a range of topics from development impact fees, tree removal, and plastic bag bans, to decisions regarding local ports.

232 Fla. Stat. §193.501.

Despite the repeal of multiple statutes related to growth management and home rule for local government to protect tree resources, there are regulatory levers for local governments to advance preservation efforts through working with state regulatory systems and programs. The incorporation of these regimes to protect and enhance the tree canopy can facilitate conservation-oriented decision-making at the local level. State involvement can also serve as a check and balance on local pressure for development. The complex state rules impacting urban forests, tree removal, land development, and conservation in Florida communities must be considered strategically to facilitate achieving local urban forestry goals.

A. Discussion

1. Removal of local authority over "dangerous trees" by the State of Florida

Legislation signed into law by the Governor of Florida in 2019 places restrictions on local government regulation of tree maintenance and removal activity. Section 163.045 of the Florida Statutes, entitled "Tree pruning, trimming, or removal on residential property" prohibits cities from requiring a permit to trim, prune, or remove a tree on private residential property that "presents a danger to persons or property." The law also prohibits cities from requiring owners to replace trees deemed dangerous. Property owners must obtain a report from an arborist (certified by the International Society of Arboriculture) or a Florida licensed landscape architect certifying that the tree is "dangerous," but no other application, permit, fee, or mitigation can be required.

According to the statute language, local governments will no longer be allowed to require a permit for removal of a tree that an arborist determines to be "dangerous." In practical terms, tree removal permits are typically approved for truly dangerous trees. However, the law's lack of mitigation requirements and government oversight in the process creates some vulnerabilities for the tree canopy. The statute's omission of mitigation requirements for trees removed under this provision has the potential to lead to a decline in the number of replacement trees planted after tree removals. Local governments in Florida committed to preserving and enhancing urban canopy coverage need to evaluate mechanisms outside of their tree ordinance's mitigation provisions for tree removals to preserve and enhance urban forests in alignment with canopy coverage targets.

a) Relevant case law

(1) Larry and Ellen Vickery v. City of Pensacola

Interpretation of the tree ordinance preemption statute came up in a case in Escambia County, where the City of Pensacola filed for injunctive relief to prevent property owners from removing a 200-year-old oak tree on their property. In that case, the court found that the arborist the homeowners had hired changed his opinion at the property owners' request regarding whether the tree presented a danger, and he did not follow industry standards. The court interpreted that the statute "implicitly adopted the professional standards applicable to ISA certified arborists and licensed landscape architects in interpreting whether a tree is dangerous.[233]

233 Vickery v. City of Pensacola, No. 1D19-4344 (Fla. Dist. Ct. App. Feb. 16, 2022). 1st Judicial Circuit Court, Escambia County 2019) Order Denying Motion to Dissolve Temporary Injunction at p. 8.

The County Court found that "the Legislature has not preempted local governments from challenging the documentation determining a tree is a danger if the documentation and opinion are not credible."[234]

The First District Court of Appeals reversed the County Court and found, "Section 163.045(1) is clear. It expressly prohibits the actions to which the City seeks to establish a right through declaratory judgment." The Court found the "City therefore failed to show a substantial likelihood of success on the merits, and the temporary injunction is improper."[235] The holding essentially limited the City's ability to question the merits of the tree removal documentation in issuing a temporary injunction on tree removal activity.

(2) Nicci v. City of Tampa

Another case from Tampa challenged the applicability of the dangerous tree provisions of the state law to a commercial zoning district. In this case, the owners of a mobile home park, relying upon the state tree removal preemption law, removed trees from their property and were fined $840,000 by the City of Tampa. Although the property had been used as a mobile home park for 50 years, the property has a commercial zoning designation. The City argued that the commercial zoning designation puts the property outside the scope of the new state law while the property owner argues that the property's primary use as a residential community means that the City is preempted from imposing fines for removal. At issue in the case is the interpretation of the term "residential property" in §§ 166.021 and 163.045 of the Florida Statutes. The property owner sought a declaratory judgment in the 13th Judicial Circuit. The case was voluntarily dismissed as of February 28, 2020.[236]

2. Florida Community Planning Act and comprehensive plans

The Florida Community Planning Act ("Community Planning Act" or "Act"), found in Chapter 163 of the Florida statutes, creates a framework for city planning and decision making around land development and conservation. The Act's purpose is to "utilize and strengthen the existing role, process and powers of local governments in the establishment and implementation of comprehensive planning programs to guide and manage future development…"[237] It establishes minimum requirements "to protect human, environmental, social, and economic resources; and to maintain, through orderly growth and development, the character and stability of present and future land use in the state."[238]

234 Vickery v. City of Pensacola (no. 233) at p. 13-14.
235 Vickery v. City of Pensacola (no. 233) at p. 4.
236 Nici, James R., et al. v. City of Tampa, Hillsborough County Circuit Court Case No. 2019-CA-10572.
237 Fla. Stat. §163.3161.
238 Fla. Stat. §163.3161 (no. 237).

"A comprehensive plan is essentially 'a constitution for all future development within the governmental boundary.'"[239] The Community Planning Act is largely implemented at the local level through the Comprehensive Development Master Plan ("CDMP" or "comprehensive plan") requirements found in the Act.[240] "The purpose of comprehensive planning is not to compel local governments to regulate their land in a particular way, but rather to 'establish meaningful and predictable standards for the use and development of land and provide meaningful guidelines for the content of more detailed land development and use regulations.'"[241]

The comprehensive plan, as well as amendments and updates to it are required to be consistent with regional plans, and subject to review by relevant state agencies through a state coordinated review process through the Department of Economic Opportunity ("DEO").[242] Once a comprehensive plan or amendment to it is adopted, all development orders, and land development regulations are required to be consistent with it.[243] As such, the comprehensive plan is the fundamental and guiding source for land development decisions and regulations within local government.

Goals, policies, and objectives within the comprehensive plan focused on natural resources, land development, tree preservation, and tree planting establish the foundation of conservation and development practices.[244] All elements are required to be "based upon relevant and appropriate data and … analysis…."[245] The treatment of trees within the comprehensive plan sets the tone for the effectiveness of tree canopy policies and strategies throughout the code and other governing documents.

3. Adaptation Action Areas

Adaptation Action Areas ("AAA") are a legislatively recognized land use designation that can be identified in the Comprehensive Plan and utilized as a tool to identify and designate flood vulnerable locations. AAAs can be used for the benefit of trees where tree resources are integrated into the adaptation strategy for such locations. Florida Statute defines AAAs as "a designation in the coastal management element of a local government's comprehensive plan that identifies one or more areas

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239 Machado v. Musgrove, 1987, as cited in, Imhof v. Walton County, 328 So. 3d 32, 37 (Fla. Dist. Ct. App. 2021).

240 Florida Department of Economic Opportunity. (n.d.). Evaluation and appraisal review of the comprehensive plan. https://floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/evaluation-and-appraisal-of-comprehensive-plans. Chapter 73C-49 of the Florida Administrative Code and The Evaluation and Appraisal Review ("EAR") process to regularly update Comprehensive Plans provides an opportunity for local governments to adopt resilience policies and land uses that prioritize tree canopy preservation and enhancement.

241 Imhof v. Walton County, 328 So. 3d 32, 36 (Fla. Dist. Ct. App. 2021); Fla. Stat. §163.3177(1).

242 Fla. Stat. §163.3184. (DEO reviews plans for completeness and compliance with the Florida Community Planning Act. Any affected person has the right to administratively challenge plans and plan amendments within 30 days of local government adoption.)

243 Fla. Stat. §163.3194.

244 The comprehensive plan must "provide the principles, guidelines, standards, and strategies for the orderly and balanced future economic, social, physical, environmental, and fiscal development of the area that reflects community commitments to implement the plan and its elements." The conservation element of comprehensive plans addresses "conservation, use, and protection of natural resources." Fla. Stat. §163.3177(1). Land Use, Transportation, and other elements of a comprehensive plan also significantly influence outcomes for urban trees, among other aspects of comprehensive plans.

245 Fla. Stat. §163.3177(1).

that experience coastal flooding due to extreme high tides and storm surge, and that are vulnerable to the related impacts of rising sea level for the purposes of prioritizing funding for infrastructure needs and adaptation planning."[246] Local governments can utilize AAA designations as a mechanism to preserve and enhance the tree canopy through development of adaptation plans that proliferate tree canopy resilience benefits. As such, climate adaptation planning must be consistent with urban tree canopy goals and targets.

There are currently existing AAAs in Miami-Dade County in Arch Creek and Little River. The County's Sea Level Rise Strategy identifies current and future AAAs across the county. The County engaged with the community throughout the AAA process to create detailed adaptation plans for [247] respective focus areas. The AAA designation applied with the tree canopy in mind can assist in prioritizing funding for resilient green infrastructure, as well as tree canopy preservation and enhancement in vulnerable areas.

4. Assessment of lands, conservation easements, environmentally endangered lands ("EEL"), and recreational and park land under Florida statute

Florida statute §704.06 establishes the creation, acquisition, and enforcement of conservation in the state. While Florida statute §193.501 provides for the assessment of conservation, park, and environmentally endangered lands. These land use mechanisms create potential openings for the protection of valued trees that might otherwise be vulnerable to removal as dangerous trees under state law.

One such land classification recognized by the State of Florida and Miami-Dade County are environmentally endangered lands ("EEL"). Environmentally endangered land "has unique ecological characteristics […] or features of a rare or limited nature constituting habitat suitable for fish, plants, or wildlife[.]"[248] EEL designated lands are eligible for Florida Forever and other state funds. Local funding mechanisms are used for purchasing EEL parcels from willing sellers. Miami-Dade County has adopted an EEL program pursuant to Fla. Sta. §193.501, which has "brought more than 20,700 acres of environmentally endangered lands into public ownership since 1990."[249] While the maintenance and operations of EEL properties is an ongoing concern for Miami-Dade County, the program is an excellent example of local land acquisition applying a state program. EEL land is often targeted and acquired for use in Everglades' restoration projects, truly making it a local, state, and federal collaboration.

246 Fla. Stat. §163.3164(1).

247 Miami-Dade County. (2021, April 8). Chapter 3: Our next steps. In Miami-Dade country sea level rise strategy. https://storymaps.arcgis.com/stories/49e753b0df474d6b94478399e8715fe8

248 Fla. Stat. §193.501.

249 Miami-Dade County. (2021, October 1). Environmentally endangered lands program. https://www.miamidade.gov/environment/endangered-lands.asp

5. Areas of Critical State Concern

The Florida Environmental Land and Water Management Act of 1972 created the Areas of Critical State Concern Program, which is designed to "protect the natural resources and environment of this state as provided in s. 7, Art. II of the State Constitution, ensure a water management system that will reverse the deterioration of water quality and provide optimum utilization of our limited water resources[.]"[250] Areas of Critical State Concern are designated by the State of Florida following the recommendation of the Florida Department of Economic Opportunity ("DEO").[251]

There are currently four designated Areas of Critical State Concern in the State of Florida: Big Cypress Area, Green Swamp Area, City of Key West and Florida Keys Areas, and Apalachicola Bay Area.[252] The Big Cypress Area of Critical State Concern includes a small portion of Miami-Dade County. However, as that part of the County is outside of the Urban Development Boundary ("UDB"), the Big Cypress designated area is less relevant and applicable to protection of natural resources and the environment within Miami-Dade County's Urban Development Boundary. The designated area for Key West and the Florida Keys, on the other hand, has more similarities to the challenges for protection of natural resources, public health, safety, housing, and the environment that Miami-Dade County faces. These designated areas receive additional state support in land use decisions, growth management and planning, along with frequent carve-outs from state regulations. The designation is broader than trees, as it is more inclusive of public facilities and resources. However, the benefits for natural resource conservation from the designation are prolific.

DEO's website states, "The program is intended to protect resources and public facilities of major statewide significance, within designated geographic areas, from uncontrolled development that would cause substantial deterioration of such resources."[253] This designation provides state support and flexibility for planning, land use, water quality, affordable housing, and environmental preservation schemes. To the extent a local government aligns its development and natural resource preservation goals with the designation, the designation has the potential to provide local governments with access to natural resource protections that might otherwise be preempted by state law.

The State of Florida Area of Critical State Concern designation provides the regulatory framework and state statutory backing to support comprehensive natural resource management that prioritizes conservation.

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250 Fla. Stat. §380.021.

251 Fla. Stat. §380.05 (1)(a).

252 Florida Department of Economic Opportunity. (n.d.). Areas of critical state concern program. https://floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/areas-of-critical-state-concern

253 Areas of critical state concern program (n.d.) (no. 252).

6. Federal resources for urban forests

Certain land or environmental designations can establish access to significant federal appropriations to pay for green infrastructure projects and code development to support an expanding urban tree canopy. The National Estuary Program ("NEP"), which is authorized under section 320 of the Clean Water Act ("CWA"), is a voluntary program focused on study areas that include estuaries and their surrounding watersheds of national significance. It pays for programs to restore water quality in impaired waterbodies usually involving natural area protection and restoration, including support for an expanding urban tree canopy.

Some of these US Environmental Protection Agency programs, administered through FDEP connected to surface water quality, contribute millions of dollars to projects that include trees and green infrastructure to help improve water quality in surrounding qualifying water bodies. The federal government contributed $29.8 million to Florida from 2012-2016 through the Nonpoint Source Pollution Management Program (discussed in Section III above) and $11.7 million from 2012-2016 through the NEP (these moneys currently go to the Tampa Bay, Sarasota Bay, Charlotte Harbor, and Indian River Lagoon National Estuaries).[254] A NEP designation for Biscayne Bay could provide access to federal appropriations and support for urban forests and trees in connection with program NEP goals. Additional federal resources to support urban forestry sit in the US Department of Agriculture ("USDA") and other agencies. The USDA Urban and Community Forestry Program "is a technical, financial, and educational assistance program, delivering nature-based solutions to ensure a resilient and equitable tree canopy where more than 84% of Americans live."[255] Other federal programs aimed at more rural and agricultural areas will be relevant to agricultural land in areas of South Dade and outside of the UDB.[256]

B. Case Study

1. Case Study: Monroe County Area of Critical State Concern designation and Carrying Capacity Study

In the Florida Keys where, the Area of Critical State Concern designation has been an integral part of Monroe County's success in transitioning away from septic to central sewage, maintaining its ability to evacuate in 24 hours in the face of a hurricane, directing development away from native habitat and towards scarified property, and maintaining affordable housing. The impact of the Area of Critical State Concern designation on conservation of natural resources and the archipelago's tree canopy is tied to the growth management aspects of that program and the rules promulgated through it.

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254 Environmental Defense Fund. (2017). State of risk: Florida at p. 4. https://www.edf.org/sites/default/files/content/florida_report_r7.pdf

255 Forest Services: U.S. Department of Agriculture. (n.d.). Urban and community forestry program. https://www.fs.usda.gov/managing-land/urban-forests/ucf

256 Everglades restoration is also a controlling factor in some parts of Miami-Dade County and involves a mix a federal and state partnerships that is beyond the scope of this paper.

The process of developing a comprehensive plan approach that would implement the goals of the area of state concern designation in the Florida Keys involved multiple administrative and legal challenges from Florida Department of Community Affairs and other organizations. Ultimately the Florida Administrative Commission ("FAC") issued an Executive Order in 1996 calling for the preparation of a "carrying capacity analysis" for the Florida Keys.[257] The Florida Keys Carrying Capacity Study ("FKCCS" or "carrying capacity study") was "designed to determine the ability of the Florida Keys ecosystem, and the various segments thereof, to withstand all impacts of additional land development activities."

As a result of the carrying capacity study, the land development and growth management system developed in Monroe County under the Area of Critical State Concern designation classified every parcel of land in the county with a tier designation. The tier overlay system prioritizes scarified land for development, restricts clearing on land with native habitat, and makes it more difficult to develop land with significant hardwood hammock and other critical natural resources.

The concept of submitting to further state oversight over the comprehensive planning process from DEO might seem counterintuitive to many local governments confronted with state preemption concerns.[258] However, the negotiations for participation in certain state regulatory programs may present opportunities to implement community- and conservation-oriented regulations that might otherwise be preempted by state law. The Area of Critical State Concern designation has been successfully used by Monroe County to obtain carve-outs from certain state laws that would otherwise infringe upon that county's Home Rule.

C. Recommendations

1. Establish federal lobbying priorities to fund land conservation, restoration, and maintenance activities supporting urban forests, including through the National Estuary Program and the Nonpoint Source Pollution Management Program.

2. Establish state lobbying priorities for funding Florida Forever and the Florida Land Acquisition Trust Fund, including local land conservation projects.

3. Establish a State of Florida lobbying priority to reestablish home rule over permitting of tree removal and development impact fees.

4. Optimize the use of state statutory and regulatory conservation land use mechanisms through adoption in local rules and plans to advance urban forestry priorities.

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257 URS Corporation. (2002). Florida Keys carrying capacity study: Draft final report at p. 9. https://www.monroecounty-fl.gov/DocumentCenter/View/84/2-Florida-Keys?bidId=
The State of Florida through Department of Community Affairs (now DEO), and the USACE jointly sponsored the study. The 1996 Water Resources Development Act ("WRDA") authorized USACE to cooperate with a non-federal sponsor to complete the Florida Keys Carrying Capacity Study."

258 A specific local government's strategy and approach to handling state preemption will need to be part of any evaluation and analysis considering seeking an Area of Critical State Concern designation through DEO.

5. Identify, designate, and develop AAAs that prioritize trees and green infrastructure.

6. Update Comprehensive Development Master Plan ("CDMP") to develop and strengthen land conservation programs to improve outcomes for canopy cover expansion and support urban forests.

7. Evaluate costs and benefits of seeking Area of Critical State Concern status for all or parts of the region.

Guidance and involvement from DEO towards protecting the natural resources and environment in Miami-Dade County, or parts of it, could help ensure that development in the region is conducted in a manner that is protective of its unique natural resources and tree canopy. Theoretically, the Area of Critical State Concern designation would be an appropriate framework to create a robust planning and regulatory framework for managing a broad range of challenges facing the Greater Miami area and specific measures for preservation and enhancement of invaluable natural resources, including cherished urban forests.

Upon evaluation of the potential costs and benefits locally, Miami-Dade County and or individual municipalities might consider opening a dialogue with DEO to explore seeking a recommendation from the agency to designate the County or specific areas within it as a designated Area of Critical State Concern. For particularly environmentally sensitive locations, or areas with stressed public infrastructure, the designation could support addressing those concerns, in addition to serving as a tool to better manage and protect tree canopy and natural resources.

D. Model Language

1. Sample comprehensive plan language: Monroe County

The Monroe County 2030 Comprehensive Plan includes numerous policies prescribing preservation and minimization of natural resource impacts in land development practices. The policies below demonstrate how Monroe County's Comprehensive Plan addresses conservation of trees within the growth management framework established through its Area of Critical State Concern designation.

Monroe County 2030 Comprehensive Plan[259]

Objective 205.2
To implement Goal 105 of this Plan and the recommendations in the Florida Keys Carrying Capacity Study (FKCCS), Monroe County shall maintain land development regulations which further protect and provide for restoration of the habitat values of upland native vegetated communities, including hardwood hammocks and pinelands. [F.S. § 163.3177(6)d.2.d., h.]

259 Comprehensive Plan of Monroe County, Florida Codified through Ordinance No. 022-2021, enacted August 18, 2021. (Supp. No. 8) https://library.municode.com/fl/monroe_county/codes/comprehensive_plan

Policy 205.2.2
Monroe County shall discourage developments in Tier I and within tropical hardwood hammock or pinelands of one acre or more in area to protect areas of native upland vegetation (See Policy 101.6.4). [F.S. § 163.3177(6)d.2.d., h.]

Policy 205.2.6
The allowable amount of permitted clearing of native upland vegetation communities shall be defined by habitat and the location of the property in the tier overlay district maps. Clearing of upland native vegetation communities in the Tiers I, II, III and III-A (SPA) shall be limited for the portion of the property containing upland native vegetation in accordance with Policy 101.5.27.* [F.S. § 163.3177(6) d.2.d.]

*Clearing on Big Pine Key and No Name Key is limited to the provisions in the USFWS issued Incidental Take Permit (ITP) TE083411-0.

Policy 205.2.8

Development shall not disturb the following vegetation:
1. champion trees;
2. specimen trees (diameter at breast height that is greater than seventy-five (75) percent of the record tree of the same species for the State of Florida); and
3. plant species listed by the USFWS as threatened and endangered. [F.S. § 163.3177(6)d.2.d., h.]

VI. Integrating Trees into Land Use, Building, Zoning, and Planning

The policies and rules in a local government's code of ordinances, along with some state laws, determine much of the outcome for the urban tree canopy in Southeast Florida. "[L]and use itself is a primary factor in determining the tree canopy cover in urban environments because different land uses experience different degrees of development; not surprisingly, variation in canopy cover exists across land-use types."[260] As such, municipal code and zoning regulations that ensure land development activities are implemented in a manner that is consistent with urban forestry goals are essential for tree preservation.

Municipal ordinances are the rules, regulations, and code enacted into law by the local government. Following Miami-Dade County's Climate Strategy, "considerations of heat exposure need to be integrated into land use and transportation policies and plans and streetscape designs."[261] While many of the rules related to trees are often packaged in a specific tree ordinance or tree chapter of a given local government's code, decisions that determine outcomes for trees are determined throughout the municipal code and policies. A combination of land use, zoning, and code amendments can be used to ensure that the benefits urban trees provide to communities are not lost to uninformed land use and development decisions.

Code language and policies related to land development and zoning that emphasize trees can improve the outcomes for the urban forests. Some specific zoning overlays correspond with state statutes and are discussed in Section V. This section includes land use, development, and zoning strategies that are most closely under the purview and discretion of local governments to adopt and implement at their discretion. "Historically, states have delegated their authority to regulate and mitigate the effects of land use to local governments."[262] Local governments can use the mechanisms discussed in this section as tools to facilitate tree preservation and proliferation of the tree canopy.

A. Discussion

1. Zoning for Tree Canopy

The Florida Attorney General has recognized that "municipalities may exercise home rule powers to enact zoning ordinances which are consistent with the provisions of [Florida Statutes].[263]

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260 Mincey, S. K., Schmitt-Harsha, M., & Thurau, R. (2013). Zoning, land use, and urban tree canopy cover: The importance of scale. Urban Forestry & Urban Greening, 12, 191-199. at p. 1.

261 Miami-Dade County climate action strategy, 2021 (no. 101) at p. 39.

262 Nolon, J. R., L., & Land Use Law Center (2019). State and local jurisdiction: Local land use solutions. PACE University. at p. 1. https://law.pace.edu/sites/default/files/LULC/State%20and%20Local%20Jurisdiction.pdf

263 Attorney General State of Florida (1991). Advisory legal opinion number: AGO 91-24. http://www.myfloridalegal.com/ago.nsf/Opinions/8428A577360F8E92852562A800520BA8

The local comprehensive plan "control[s] and direct[s] the use and development of property within a municipality or county."[264] "A comprehensive plan legislatively sets a zoning norm for each zone."[265] "Zoning is the means by which the comprehensive plan is implemented".[266] While comprehensive plans "operate as limitations on a local government's otherwise broad zoning powers."[267]

Municipal zoning ordinances may have both direct or indirect influences on the urban canopy cover.[268] These zoning laws can be used as tools for tree preservation or for rapid development.[269] Due to the fact that municipalities establish their land use policies using zoning law, the municipalities influence city-wide urban tree cover notwithstanding any ordinances that have specific provisions relating to tree canopy.[270] "Some municipalities utilize zoning regulations to go beyond typical land-use requirements to directly influence tree canopy cover."[271] This may entail a requirement to include a certain percentage of canopy cover by zone. Under such an approach, the criteria for development in each zone should be consistent with municipal timelines for meeting canopy cover targets. Applying the concept of Science Based Targets[272] to tree canopy cover in land use and zoning, municipal zones could set canopy cover requirements for each zoning district, applying calculations to identify the amount of canopy cover required in a zoning district and determine potential cover (up to the parcel level or tree level) for calculating contribution towards meeting overall canopy cover goals. Zoning descriptions and zoning overlays can set standards that require a certain amount of canopy cover, permeable surface, preservation of certain trees, and other measures to increase overall canopy cover throughout zoning districts.

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264 Machado v. Musgrove, 519 So.2d 629, 631 (3 D.C.A. Fla., 1987), as cited in, Advisory legal opinion number: AGO 91-24 (1991) (no. 263).

265 Machado v. Musgrove (no. 264).

266 Advisory Legal Opinion Number: AGO 91-24 (1991) (no.263).

267 Advisory Legal Opinion Number: AGO 91-24 (1991) (no.263).

268 Hartel, (2003). as cited in, Mincey et al, (2013). (no. 260) (Hartel (2003) reports that the municipality of Chesapeake, Virginia required through its zoning ordinance the maintenance of 10% tree canopy cover in multi-family residential zones, and 20% canopy cover in single-family residential zones. In Athens- Clarke County, Georgia, similar zoning ordinances have been developed (for example, there the target tree canopy for residential zones is 45%).

269 Center for Urban Pedagogy. (n.d.). What is zoning. http://welcometocup.org/Projects/EnvisioningDevelopment/WhatIsZoning

270 Mincey, et al., (2013). (n. 260) at p. 1-2.

271 Hartal, 2003 as cited in, Mincey et al., 2013 (no. 260), reporting that the municipality of Chesapeake, Virginia required through its zoning ordinance the maintenance of 10% tree canopy cover in multi-family residential zones, and 20% canopy cover in single-family residential zones. In Athens- Clarke County, Georgia, similar zoning ordinances have been developed (for example, there the target tree canopy for residential zones is 45%).

272 Anderson, C., Bicalho, T., Wallace, E., Letts, T., & Stevenson, M. (2022). Forest, land and agriculture science based target setting guidance: Draft for public consultation. Flag Science Based Target Setting Guidance. https://sciencebasedtargets.org/resources/files/FLAG-Guidance-Public-Consultation.pdf ("GHG emissions reduction targets are considered "science-based" if they are in line with what the latest climate science says is necessary to meet the goals of the Paris Agreement - to limit global warming to well-below 2°C above pre-industrial levels and pursue efforts to limit warming to 1.5°C.")

Zoning laws specifically regulate land use, density, setbacks, the size and shape of structures, and other characteristics of land development. Each of these factors influence outcomes for the tree canopy. The way zoning affects the tree canopy will correspond with setbacks, landscaping, and other criteria specific to a zoning district. "Some communities regulate the maximum proportion of impervious land cover through zoning ordinances, policies often meant for the management of stormwater, but with impacts on the amount of land area with the potential for urban tree growth."[273]
A study evaluating the impact of zoning on canopy cover looked at 16 zoning districts in Bloomington, Indiana. The results of the study "suggest the importance of zone-specific impervious cover regulations for attaining canopy cover goals."[274] The study suggests applying "canopy cover goals at finer scales of land use – the parallel of zoning districts as opposed to zone types."[275]

Certain zoning designations or districts correlate with higher canopy cover. In a recent study of Miami-Dade County's trees, "[t]he highest tree density per land use, or number of trees per acre, occurred on park/institutional lands. The term 'park/institutional lands' is commonly used to describe public lands such as parks, schools, government facilities, and conservation areas. In Miami-Dade County, the designation includes mangroves."[276]

Zoning overlays can provide for greater natural resource protection on specific parcels. For example, as with the tier overlay system in Monroe County, each parcel of land has a specific tier designation based on specific criteria including ecosystem benefits. This tier layer is a zoning overlay that creates criteria over and above the criteria in the zoning district where a given parcel is located. Those properties with the higher ecological value in the tier overlay system are designated as Tier I parcels and are more difficult to develop. If Tier I parcels do receive development rights, only a small percentage of hardwood hammock can be cleared.

The tier overlay concept could be applied in other municipalities in Southeast Florida for preservation of urban tree canopy. This might include a zoning overlay that identifies and prohibits clearing of protected trees,[277] Natural Forest Communities, and other natural resources prioritized for conservation. This would require creation of such a zoning overlay in the local government's comprehensive plan and municipal code of ordinances.

The public process that involves the development of comprehensive plan and zoning regulations include entry points for advocates to support policies and regulations consistent with urban forestry goals and targets. The criteria that define the characteristics and land use regulations in various zoning districts can be determinative of whether a local government is on track to meet canopy cover goals.

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273 Mincey, et al., 2013 (no. 260) at p. 8.
274 Mincey, et al., 2013 (no. 260) at p. 8.
275 Mincey, et al., 2013 (no. 260) at p. 9.
276 Escobedo et al., 2011 (no. 186).
277 Protected Tree designations are discussed in Section II.

2. Land use flexibility as an incentive for tree preservation and planting

For many property owners, benefits and flexibility under the municipal code have real monetary value. "Not all potential uses are routinely acceptable anywhere within the land use category," … "a potential use must be evaluated for compliance with the goals, objectives and policies of the plan."[278] For example, in some locations it may be appropriate within a zoning overlay to provide a given property the flexibility to rent out a residence for short term rentals in consideration for the preservation of a large canopy tree on the property, while a different type of land use flexibility might be appropriate in another location.

These bargaining chips may include other economic incentives in exchange for tree preservation or planting, including allowing commercial use in what may otherwise be a residential area or other flexibility in use. Municipal governments can offer something of value through flexibility in land development and land use in the municipal code. Zoning criteria can be written to provide flexibility and benefits under the land development code and in land uses in exchange for preservation and increased canopy cover on properties within a given zoning district.

3. Transfer of Development Rights, Transfer of Development Density, and Public Benefits

Transfer of development rights ("TDRs") are government programs that allow property owners to transfer development rights on one property for use on a different property. This serves to allow the owner of the receiving site to build more than they otherwise would have been able to. The owner of the sending site then retires some or all the rights to develop the sending site property. Local governments can use TDRs as mechanisms to encourage preservation through making historic properties or land desirable for conservation potential sending sites, while allowing for greater development rights than what would have otherwise been allowed on the receiving site. Designated sending sites tend to be protected areas with more restrictions on development and receiving sites tend to be designated in areas where development is encouraged. "Under a TDR program, the owner of a Sending Zone parcel may elect to grant an easement—generally a conservation easement—to the government in exchange for Transfer of Development Rights Credits ("TDR Credits"). Such easements typically result in a permanent adjustment to height limits or density thresholds. TDR Credits may then be purchased by property owners in Receiving Zones who can use the TDR Credits to augment the development potential of their own land."[279]

278 Dixon v. City of Jacksonville, 774 So. 2d 763, 767 (Fla. Dist. Ct. App. 2000).

279 Joye, B. N., & Tribbey, C. S. (2020). Unbundling rights: An overview of TDR. Orange County Bar Association. https://www.orangecountybar.org/news/unbundling-rights-an-overview-of-tdr/

The concept of TDRs is sometimes referred to as a public benefits program. For example, in the City of Miami, the public benefits program allows "bonus building capacity in T6 zones in exchange for the developer's contribution to specific programs that provide benefits to the public."[280] Sender site criteria could bfe revised to include mechanisms for preservation of protected trees. Allowing properties to qualify for participation as sender sites by way of measures to preserve protected trees and increase tree canopy would help to incorporate the tree priorities into development decisions. Language for tree preservation could also allow bonus building capacity on parts of a property not covered by Protected Trees or other properties in consideration for establishing a permanent conservation easement covering the protected tree. Public benefits programs also provide an opportunity to incentivize historic preservation, in addition to natural resource conservation.

TDR Credits are used by municipalities to insulate themselves from legal actions for downzoning. The Supreme Court in Penn Cent. Transp. Co. v. City of New York found that TDRs were "just compensation for a downzoning action."[281] For example, property owners could be compensated with TDRs for downzoning restricting the clearing rights on part of a parcel to protect urban forest resources.[282]

4. Construction, Development Permitting, Development Orders, and Trees

a) Construction

Development itself need not be detrimental to individual trees and overall canopy coverage. Studies have shown the outcomes for trees on construction sites vary widely. "Until recently, scholarly literature that examined the effect of construction on the urban forest was scarce; however, evidence is mounting that development can lead to tree loss and therefore a decline in canopy cover."[283] Integration of urban forestry priorities into decisions impacting development, along with following best practices for caring for trees during construction improves outcomes for the tree canopy. "[L]and regulations for property development and municipal infrastructure projects" that "establish standards for the protection of trees before, during, and after construction and development occurs [...] have been shown to increase urban canopy cover."[284]

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280 The City of Miami, Florida. (n.d.). Public benefits program. http://www.miami21.org/PublicBenefits_jump.asp

281 Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 151 (1978).

282 Monroe County has land acquisition mechanisms in place for instances where downzoning may completely prevent development of a parcel addressed further in subsection 6 below, entitled Land acquisition and surplus land for trees.

283 Pike et al., 2021 (no. 34) at p. 2.

284 Pike et al., 2021 (no. 34) at 2.

One study found statistical differences in the condition of trees between redeveloped and non-redeveloped properties, but these differences were only slight."[285] On the other hand, increasing "impervious cover through urban development" was indicated as a "major factor" in reducing canopy cover and may result in "ecosystem homogenization."[286] The prediction of overall decline in urban canopy cover is evident when building permits for single-family homes are in effect.[287]

Finally, one study looked at the perceptions and practices of homebuilders in Midwest locales where code requirements for tree preservation were lacking. The "responding developers listed consulting a tree preservation expert as the least important activity when preserving trees on wooded residential properties, and only 37% reported that house footprints were moved in order to avoid tree damage."[288]

b) Development permitting and development orders

Criteria and landscape requirements for new development can lead to widespread adoption of innovations in green infrastructure, project design creativity to preserve tree canopy, and future-proofed landscape design. Providing greater credit for preservation of existing trees than for new trees in the construction permitting process is one mechanism that is used to incentivize preservation of existing trees.

The City of Miami Beach Trees to Offset Stormwater study recommends "holding pre-development conferences, calculating stormwater impact from tree removal or planting, and sketching site designs to allow for exploration of ideas for tree conservation before extensive funds are spent on site planning."[289] Incentives to encourage tree preservation in the permitting of development plans, along with policies and regulations to limit clearing and encourage preservation in the land development process are critical to maintaining and increasing canopy cover.

The Florida Community Development Act defines "development order" as any order granting, denying, or granting with conditions an application for a development permit.[290] It defines development permit as "any building permit, zoning permit, subdivision approval, rezoning, certification, special exception, variance, or any other official action of local government having the effect of permitting the development of land."[291] The permitting process for new development and redevelopment through county and municipal governments is an important decision point for valuing and prioritizing the preservation of existing trees and planting of new trees.

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285 Pike et al., 2021 (no. 34) at p. 7.

286 Pike et al., 2021 (no. 34) ("A study looking at tree removal and retention on redeveloped residential properties – that is, properties where pre-existing homes were demolished and replaced with new homes – found that over a 5-year period, 44 % of trees were removed on redeveloped properties compared to only 13.5 % of trees removed on non-redeveloped properties (Guo et al., 2019)."

287 Steenberg, et al., 2017, as cited in Pike et al., 2021 (no. 34).

288 O'Herrin, et al., 2016, as cited in Pike et al., 2021 (no. 34) at p. 2

289 Trees to offset stormwater, 2018 (no. 131) at p. 24 (emphasis added).

290 Fla. Stat. §163.3164 (7) (no. 243).

291 Fla. Stat. §163.3164(8) (no. 243).

It is well established that development orders shall be consistent with the governmental body's objectives, policies, land uses, etc., as provided in its comprehensive plan.[292] "Under [Florida's Community Planning Act], complete conformity is the floor, not the ceiling."[293] As such, regulations in the comprehensive plan and the Municipal Code of Ordinances must facilitate reaching ambitious tree canopy targets across zones in order to ensure that development occurs in a manner that supports healthy urban forests. Development orders can be more accommodating to canopy cover through updating the criteria in the code for evaluating development permit applications to prioritize urban forestry goals. Proposed draft language to better prioritize trees in the development permitting process is included in the model language in this section below.

5. Concurrency & Impact Fees

The concept of concurrency or impact fees is that these fees compensate for the pressure on public resources and infrastructure attributed to new development. Concurrency and impact fees are mechanisms to ensure public facilities are in place and available to serve new development. It takes the form of a contribution from the developer towards the additional public infrastructure and green space needed to meet the added demand on those resources.

Florida statutes on growth management under Chapter 163 establish a framework for concurrency in Florida under the premise that "public facilities will be provided in order to achieve and maintain the adopted level of service standard."[294] Public facilities include parks under the applicable definition in Florida Statute.[295] A local government in Florida "may extend the concurrency requirement so that it applies to additional public facilities within its jurisdiction."[296] As such, community's benefit from more parks and green space when municipalities adopt a high level of service standard for parks, in addition to extending concurrency to include land acquisition and development of parks and green space, including proliferation of healthy urban forests and canopy cover.[297] These are important steps for optimizing the expansion of park systems, including parks that provide, or with potential to provide, valuable contributions to the proliferation of the urban tree canopy.

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292 Fla. Stat. §163.3194(3) (a) Fla. Stat. (1999); §§163.3161(5); 163.3194(1)(a); 163.3215(1), & Dixon v. City of Jacksonville, 774 So. 2d 763, 764 (Fla. Dist. Ct. App. 2000).

293 Imhof v. Walton County, (no. 241) ("applying strict scrutiny to zoning action examining a development order for exact compliance with, or adherence to, the comprehensive plan." (citation omitted).); Fla. Sta. §163.3194(1)(a) (no. 243).

294 Fla. Stat. §163.3180 (2)(d).

295 Fla. Stat. §163.3164 (no. 243).

296 Fla. Stat. §163.3180(1) (no. 294).

297 The State of Florida imposes certain requirements on the execution and reporting of concurrency and impact fee programs in Fla. Stat. §§ 163.3180 (no. 243); 163.31801.

Miami-Dade County updated the impact fee provisions of its code in March of 2022. It "amended criteria and procedures for land dedications in lieu of payment of park impact fees."[298] The update also maintained minimum required recreation open space at 2.75 acres for each 1,000 residents in the County.[299]

Section 33H-10 of the Miami-Dade County code provides that impact fee credit may be given towards up to 50% of the land dedication requirements for Natural Forest Community designated land, land targeted by the EEL program for acquisition and other conservation and historic values. Further accounting for tree canopy value, in addition to increasing the level of service for parks in the impact fee process could help to facilitate dedication of significantly more land including existing and future urban forests.

6. Land acquisition and surplus land for trees

Surplus government lands may include potential space to facilitate progress towards canopy cover goals. Combinations of appropriate tree planting and green infrastructure could be implemented on government surplus land in efforts to improve stormwater infiltration and improve water quality from runoff. With code amendments to provide a Heritage Tree and other protected tree designations, those trees that meet the criteria could then be targeted for public acquisition for conservation, along

with additional benefits under the code. Surveys and urban tree canopy cover maps can be used to identify land prioritized for public acquisition to address gaps in canopy cover, temperature hot spots, and inadequate permeable surfaces. Resilience funds and stormwater planning, and implementation should integrate land acquisition that supports canopy cover targets and urban forestry priorities. Monroe County code provides for public acquisition of ecologically valuable land as a growth management measure.[300] There, when a property owner wants to develop their land but does not have a Rate of Growth Ordinance allocation, they may be able to purchase and dedicate other parcels for conservation in exchange for development rights. Their land acquisition program also provides a mechanism to mitigate the risks from "takings" or Bert J.Harris claims, if a land development permit cannot be issued because it would endanger important natural resources to do so.

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298 Miami-Dade County. (2022, March 1). Memorandum: Agenda item no. 7(E). https://www.miamidade.gov/govaction/legistarfiles/Matters/Y2022/220344.pdf

299 Memorandum, 2022 (no. 298). https://www.miamidade.gov/govaction/legistarfiles/Matters/Y2022/220344.pdf (Mayor Levine Cava expressed to the Chairman and County Commission that while the update will comply with a new state law and make some organizational and technical changes, "No other specific social equity or benefit can be determined at this time.")

300 Board of County Commissioners (2013). Monroe County: The Florida Keys area of critical state concerns build-out challenges facing the Florida Keys. https://www.monroecounty-fl.gov/DocumentCenter/View/8433/Policy-and-Funding-strategies-for-potential-future-build-out-challenges?bidId=

B. Case Studies

1. Case Study: Buoyant City: Historic District Resiliency & Adaption Guidelines, City of Miami Beach (2020)

The City of Miami Beach's Historic District Resiliency and Adaptation Guidelines: Buoyant City, referred to herein as Buoyant City Report[301] presents strategies for adapting historic districts in Miami Beach to the impacts of climate change. The report includes multiple strategies for incorporating green infrastructure, including trees, into adaptation planning, as tools to improve flood conditions. The authors suggest that "increased development can go hand-in-hand with the maintenance of significant open (and floodable) green space, retrofitted as green infrastructure."[302]

The guidelines introduce the concept of an Experimental Action Area ("EAA") zoning overlay, which can be used as a tool to provide greater flexibility in the land development code in exchange for private investment in measures that will help to manage flooding. Recommendations include strategies to incentivize private investment in green infrastructure in exchange for flexibility in use, density, and height in the code. Properties in the EAA zoning overlays are given benefits and flexibility under the land development and land use regulations in exchange for measures that could include tree canopy preservation and proliferation.

An EAA is a zoning overlay where property owners are incentivized to adapt in place to the impacts of climate change. This is accomplished through incentivizing property owners to adapt in place and reduce flood risks with resiliency bonuses, such as expanded opportunities for rooftop additions or additional Flood Area Ratio ("FAR").

The types of benefits the Buoyant City Report recommends include expanded uses, tax incentives, resiliency bonuses, Transfer of Development Rights, and accretive urbanization for rear and rooftop development in consideration for implementation of measures that improve flood water retention like Blue-Green Stormwater Infrastructure, trees, and landscaping. The Buoyant City Report is an excellent example of what guidelines could look like to incentivize natural systems for stormwater benefits. Similarly, local governments could provide favor under their code in exchange for property owners placing protected tree(s) under a permanent conservation easement or installing new plantings along with supporting green infrastructure on private property.

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301 Shulman, A (2020). Buoyant city: Historic district resiliency & adaptation guidelines. City of Miami Beach, Florida. https://www.miamibeachfl.gov/wp-content/uploads/2020/03/2020-0309-BUOYANT-CITY-FINAL-DRAFT.pdf

302 Shulman, 2020 (no. 301) at p. 43.

2. Case Study: City of Miami, Development Review Processes, Neighborhood Conservation Districts and Environmental Preservation Overlay Districts

a) City of Miami Development Review Process

In the City of Miami, the permitting process for development and construction occurs in a siloed fashion in which various City disciplines review plans for proposed construction. Applicants have been allowed to choose the order in which various City departments review permit applications for new construction. Often the Environmental Resources Division review can occur at the very end of the process when plans have already received approvals from other City departments and financing packages have been confirmed. As a result, plans are likely less prone to involve consultation with tree experts or efforts to design and conduct construction activities in a manner that preserves the tree canopy.

In December 2018, the City of Miami launched ePlan, a long-awaited digital platform for Electronic Plan Review to assist the Building Department and other disciplines in processing building permit applications. As part of its ongoing permitting process improvements, the city could modify its process to ensure more fair, predictable, and consistent administration of Chapter 17. The ePlan system provides a terrific opportunity for city departments to be far more collaborative and less siloed in reviewing plans for proposed construction, so that building plans that do not comply with the City Code do not get approved. To that end, requiring applicants to submit plans to the Environmental Resources Division earlier in the process would prevent delays and the need for multiple resubmissions to address tree protection at the final stages of the application process.

b) City of Miami Neighborhood Preservation Districts and Environmental Preservation Districts

The City of Miami's Tree Ordinance found in Chapter 17 provides for additional protections for certain trees in areas designated as Environmental Preservation Districts ("EPDs") in a zoning overlay. Areas designated as EPDs are those with "significant natural or manmade attributes in need of preservation and control because of their educational, economic, ecological, and environmental importance to the welfare of the general public and the city as a whole."[303]

To qualify for designation as an EPD, a property or geographical area must contain one or more environmental features, including "clusters of trees with extensive tree canopy, natural hammock areas and mangrove areas" and exposed geological formations, …." The designation is also available for Scenic Transportation which are roadways that have "unique landscape character and an extensive tree canopy."[304]

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303 City of Miami Code of Ordinances Section 17-31. Environmental preservation districts. (Code 1967, § 64-6; Ord. No. 8798, §§ 1, 2, 5-19-78; Ord. No. 9427, § 1(C), 5-27-82; Ord. No. 9769, § 1, 12-15-83; Code 1980, § 17-6; Ord. No. 13174, § 2, 5-13-10; Ord. No. 13971, § 2, 2-25-21) https://library.municode.com/fl/miami/codes/code_of_ordinances

304 City of Miami Code of Ordinances §17-31(b) (no. 303).

Private individuals and organizations, city departments, the City Commission, or members of the Historic and Environmental Preservation Board ("HEPB") may submit areas or sites for consideration as new EPDs. Designation of a new EPD requires notice to all property owners within boundaries of the EPD and a hearing before the HEPB, which votes whether or not to recommend the designation.

Additionally, the city has a Neighborhood Conservation District ("NCD") zoning overlay, which is aimed at preserving natural landscaping features, as well as historic architectural character. Protected features within either zoning overlays can be subject to additional review by the HEPB.[305]

The creation of this additional layer of review has at least on one occasion led to the reversal of a decision to approve the removal of a significant tree. In 2021, the HEPB asked a property owner to go back to the drawing board and redesign its development around a tree, reversing the previous decision at the staff level in the case of a tree removal permit on Shipping Ave. In the case of a live Oak tree at 2800 Shipping Ave., staff had recommended a waiver to the City of Miami law prohibiting its removal. Because the site is part of the Coconut Grove Neighborhood Conservation Overlay District, concerned neighboring property owners were able to appeal staff's decision to the HEPB. This additional layer of review and opportunity for public engagement led to a pivot in the decision, ultimately requiring the property owner to develop new plans for the property that will preserve the tree.[306]

C. Recommendations

1. Include canopy cover targets across zones, including land development criteria that support such targets.

Zoning districts will vary in their contribution to canopy cover. Establishing targets to maximize the potential for canopy cover across zoning districts can better ensure canopy cover targets can be met. Existing tree canopy assessments may aid in determining current and potential zoning district contributions to overall canopy cover.

Including criteria across zones to facilitate meeting canopy cover targets can be in the form of various land development guidelines that may facilitate the expansion of healthy urban forests. This could be in the form of setbacks, criteria incentivizing designing around existing trees, landscaping criteria that supports healthy canopy growth, and other measures to ensure that zoning code is consistent with urban forestry goals.

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305 City of Miami Code. Article 8– NCD Neighborhood conservation districts and section 17-31.

306 City of Miami. (2021). Meeting minutes: Historic and environmental preservation board. http://miamifl.iqm2.com/Citizens/FileOpen.aspx?Type=12&ID=2373&Inline=True

2. **Update and adopt zoning overlays and zoning district requirements to ensure tree planting, green Infrastructure, and tree preservation including sufficient setbacks and land development flexibility to provide space to meet ambitious canopy cover targets.**

Permanent conservation easement or other agreements, including robust replacement requirements, may be necessary to ensure the ongoing preservation and maintenance of protected trees and parcels.

3. **Evaluate potential for zoning overlays like The Buoyant City Report's Experimental Action Areas ("EAA") zoning overlay to provide land use and zoning flexibility in exchange for tree preservation and planting, while maintaining the historic character of communities.**

Zoning overlays like the EAA described in the City of Miami Beach Buoyant City Report could be established in a municipal comprehensive plan and code. Zoning overlays to incentivize property owners and developers to preserve protected trees, as discussed in Section II, and create new tree landscaping in exchange for flexibility and benefits under the land development code and in land uses.

4. **Establish transfer of development rights, transfer of development density and public benefit programs that qualify sites with protected trees as sender sites and prevent portions of parcels with protected trees from being receiver sites.**

5. **Allow subdivision of parcels to facilitate tree conservation.**

Under such a scheme, parcels could be subdivided to allow for transfer of development rights within a parcel, i.e., allowing greater height in one location to allow for preserving a canopy tree in another location on the same parcel.

6. **Prioritize tree preservation and green infrastructure in evaluation factors for permitting new development.**

7. **Identify land to prioritize for public acquisition to address gaps in canopy cover, temperature hot spots, and inadequate permeable surfaces.**

8. **Increase the level of service established for parks to the greatest extent possible to facilitate increased investments in green space through impact fees and other land use tools.**

Evaluation of increasing the number of acres of parks per 1,000 residents could provide for additional impact fees and related land dedication towards parks and overall canopy cover. Compared to Pinellas County's level of service for parks of 14 acres per 1,000 residents, Miami-Dade County maintains a relatively low level of service for this important community resource at 2.75 acres per 1,000 residents.

9. Evaluate potential to increase credit towards park impact fees for dedication of land with significant tree canopy.

Miami-Dade County currently provides park impact fee credit towards up to 50% of the requirement for park concurrency for Natural Forest Community, EEL, or conservation land. We recommend evaluation of the potential to provide up to 100% of park impact fees for dedicated park land that includes extensive canopy cover and Protected Tree resources.

10. Require that development take an approach to avoid, minimize, move, replace, and mitigate any lost public benefits from tree removal, in that order of priority. Apply the best scientific information available to calculate actual tree benefits for preservation, mitigation, and landscaping requirement purposes.

11. Develop landscape requirements, design standards, and construction and development guidelines to minimize risk of conflict between trees and the built environment on private and public land during and after construction, including best practices and standards like ANSI300.

12. Integrate canopy cover targets and best practices for tree planting and maintenance in code language determining the treatment of trees in the public right of way ("ROW").

13. Establish covenants and other agreements for the preservation, continued maintenance, and if necessary, replacement of protected and required trees.

14. City of Miami Specific Process Improvements

It must be clear from the beginning of an application process what tree preservation protections will be imposed on a property subject to new development. Providing notice to the entity or individual buying real estate that compliance with tree regulations must be a requirement, as developers and purchasers alike will benefit from improved notice when buying real estate that is in compliance with tree regulations. The financing and design packages should incorporate tree related activities from the beginning of the development process.

D. Model Language

1. New Development and Redevelopment Permit Applications – language to augment the development review sections of a municipal code.

Model Land Development Criteria Drafted by Authors

Sec. XX. Evaluation Factors for New Development and Re-Development Permit Applications.

The evaluation factors for permit applications for new development and re-development shall include:

[the below criteria are meant to supplement existing provisions establishing criteria for the review and approval of land development plans]

The overall impact of the project of urban tree canopy, including preservation of existing tree canopy cover;
projected contribution to increase or decrease in tree canopy cover, including alignment with canopy cover targets;
impact of the project on protected trees*;
incorporation of networked green infrastructure, tree filtration infrastructure, structured soil, silva cell and impervious surface, along with tree planting into the design;
utilization of green infrastructure to increase water retention capacity, maintain water on the property, and augment stormwater capacity on the property itself; and
the overall performance of the project site, preserved and planned trees, under the calculations of the Tree Public Benefits Table referenced in [Section XX]**.

*[Local governments define protected trees in a particular manner and the appropriate language and designated trees in a given jurisdiction should be applied. Model language defining types of protected trees is found in Section II of this document].
** The concept of a Public Benefit Tree is discussed further in Section II and the concept of an Urban Tree Ecosystem Services Table is explored further in Section VII.

2. Model TDR, TDD, Public Benefits Code Language:

Model Transfer of Development Rights and Transfer of Development Density Code by authors:

Sec. XX, Transfer of Development Rights and Transfer of Development Density

Parcels containing Public Benefit Trees, Champion Trees, Heritage Trees, native habitat, wetlands, or significant tree canopy*, are eligible sending sites for Transfer of Development Rights ("TDR"), Transfer of Development Density ("TDD"), and Public Benefits Programs.

Parcels containing Public Benefit Trees, Champion Tres, Heritage Trees, native habitat, wetlands, or significant tree canopy may serve as sending sites in all zones.

Parcels or sub parcels containing Public Benefit Trees, Champion Trees, Heritage Trees, native habitat, wetlands, or significant tree canopy shall not serve as receiving sites, unless the specified tree or trees are protected under a conservation easement.

A conservation easement covering a Public Benefit Trees, Champion Trees, Heritage Trees, native habitat, wetlands, or significant tree canopy on a parcel or subdivided parcel is required prior to achieving sender site credit under the TDR, TDD or public benefits program.

*[Local governments define protected trees in a particular manner and the appropriate language and designated trees in each jurisdiction should be applied. Model language defining types of protected trees is found in Section II of this document].

VII. Tree Ordinances

Tree ordinances are an important tool for the management of urban forest resources. A 'tree ordinance' refers to a specific section of the municipal code regulating tree planting, maintenance, and removal within a defined municipality or area. These regulations may also concern land development, permitting, design of roadways and pathways, tree maintenance, and other aspects of the municipal code that determine outcomes for urban trees. While the management of urban forests primarily via tree ordinances may indicate an under-developed urban forestry management program,[307] a strong tree ordinance is inherent to improving the status and the overall protection of the tree canopy.

In Florida, local governments administering tree ordinances face complicating factors because of the interplay between local and state law. Prior to amending a local tree ordinance, local governments may wish to analyze the legal implications of making any such amendments in relation to potential litigation connected to state preemption laws, including the removal of "dangerous trees" pursuant to Florida Statute §163.045. Despite the state preemption issue over permitting for the removal of "dangerous" trees, tree ordinances nonetheless continue to play an important role in the management of urban trees and forests.

A. Discussion

1. Guidelines for developing and evaluating tree ordinances

The California environmental consulting firm Phytosphere Plant Research developed extensive guidelines detailing the development, implementation, and evaluation of tree ordinances, called "Guidelines for Developing and Evaluating Tree Ordinances"[308] (hereinafter "Tree Ordinance Guidelines" or "Guidelines"). The Guidelines recommend that "ordinances should facilitate rather than prescribe management." Tree ordinances are one part of a "larger community forest management strategy."[309] For example, many municipal ordinances are designed to protect old 'heritage' trees, while allowing for the routine destruction of younger trees. The end result may be an unsustainable community forest, short on young trees and long on old, declining trees.[310] By focusing too narrowly on individual trees, such ordinances may contribute to the degradation of the community forest over the long-term."[311]

Phytosphere's Tree Ordinance Guidelines were created based upon review of city and county tree ordinances, as well as several proposed ordinances, representing approximately 50% of the city and 80% of county tree ordinances in existence in California in the early 1990s at the time of the study.[312] While California law is distinct from Florida and does not include the same limitations on local governments as Florida, the research and guidelines nonetheless provide comprehensive guidance for developing and evaluating tree ordinances with broad applicability.

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307 Remien, S. (2016). A comparative study of urban forest management programs for three major cities in Santa Clara County: A benchmarking study. Master's Project. San Jose State University. at p. 1. https://scholarworks.sjsu.edu/cgi/viewcontent.cgi?article=1469&context=etd_projects

308 Phytosphere Research (2001). Guidelines for developing and evaluating tree ordinances. (hereinafter "Tree Ordinance Guidelines" or "Guidelines"). http://phytosphere.com/treeord/treeord.pdf

309 Tree Ordinance Guidelines, 2001 (no. 308) at p. 12.

310 Tree Ordinance Guidelines, 2001 (no. 308) at p. 12.

311 Tree Ordinance Guidelines, 2001 (no. 308) at p. 12.

312 Bernhardt & Swiecki, 2001, as cited in Tree Ordinance Guidelines, 2001 (no. 308) at p. 6.

Following Miller's (1988) model of management planning process, the Guidelines suggest the following steps beyond the four corners of a tree ordinance in developing a community forest management strategy, including implementation of the following actions: assess the resource; review tree management practices; identify needs; establish goals; select tools and formulate the management strategy; implement the management strategy; and evaluate and review.[313] The Guidelines suggest that the effectiveness of a tree ordinance depends upon whether residents are aware of its provisions and support them; whether the ordinance is adequately enforced; whether it accounts for "environmental limitations that affect tree health, growth, and survival"; and whether financial resources are in place to support the ordinance.[314] Well-stated goals, clear designation of responsibility, basic performance standards, flexibility, specified enforcement methods, along with integration with a comprehensive urban forestry management strategy, and community support are all important criteria in evaluating the effectiveness of a tree ordinance.[315] The Guidelines identify several basic provisions that are found across tree ordinances[316] and other specific provisions are then necessary to facilitate meeting specific goals.[317]

2. Preventing and reducing conflict between trees and the built environment

Particularly, considering state preemption over municipal tree removal permitting for dangerous trees in Florida, efforts to minimize future damage to infrastructure that might lead an arborist to deem a tree dangerous, in addition to following appropriate maintenance routines, may help to reduce the number of trees that will be removed under the dangerous tree provisions of Florida law. Landscape standards that effectively minimize conflict with trees and the built environment will support this objective. Conflicts between trees and the built environment will be minimized into the future by adoption of design guidelines providing for sufficient soil, tree pits, structured soil, and other measures to provide space for root structures to grow in an urban environment.

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313 Miller, Hauer, & Werner, 2015, as cited in Tree Ordinance Guidelines, 2001 (no. 308) at p. 12. (emphasis added)

314 Tree Ordinance Guidelines, 2001 (no. 308) at p. 7.

315 Tree Ordinance Guidelines. 2001 (no. 308) at p. 7-8.

316 Tree Ordinance Guidelines. 2001 (no. 308) at p. 29. (Basic tree ordinance provisions include Title; Findings; Purpose and intent; Definitions; Determination of definitions; Jurisdiction; Policies regarding trees; Local government disclaims liability; Interference with planting, maintenance, and removal unlawful; Appeals; Penalty for violation; Enforcement; Performance evaluation of ordinance; Severability; Designate administrative responsibilities.)

317 Tree Ordinance Guidelines, 2001 (no. 308), p. 44-45. (Ordinance provisions for specific goals include: Establish a tree board or commission; Specify cooperation between departments and agencies; Develop a comprehensive management plan; Resolution of conflicts between trees and structures; […] Responsibilities of property owners; Help for citizens performing tree maintenance; Topping prohibited; Permit required for planting trees in the public right-of-way; Planting requirements; Situations which are declared to be public nuisances; Abatement of hazards and public nuisances; Abatement of hazards and public nuisances; Licensing of private tree care firms; Harming public trees forbidden; Permit required for activities that may damage city owned trees; Conservation of forest and woodland resources during development; Procedures to be followed in resolving tree disputes; Standards for resolution of tree disputes; Apportionment of tree dispute resolution costs; Recording for notification of future owners; Enforcement of tree dispute resolutions.)

3. Tree planting and mitigation

The cornerstone of a tree ordinance—enforcement for non-compliance—may be addressed by payment of fines or mitigating ecosystem losses incurred from tree removal. Here, it is important to consider both the immediate value of tree mitigation as well as the long-term value, which also considers risks and/or expected lifetime of the mitigation. It is impractical to replace large trees with those of equivalent size, given cost and logistical difficulty. Also, without proper care and maintenance, many large tree plantings may fail. In contrast, it is nearly impossible to plant enough small trees to completely replace the ecological benefits lost by removing a large tree.

In response to this conundrum, many municipalities employ a 'mitigation table' that categorizes trees by size and then prescribes planting a number of smaller trees for mitigation that will eventually replace the eco-benefits lost by larger trees. Indeed, such policies are often based on complicated projections of not only current eco-benefits but also future eco-benefits, which depend on how long trees that are removed would have survived and how much they would have continued to grow, as well as the survival and growth rates of any trees planted as compensation. If survivability and survival monitoring are incorporated with the mitigation table, then it is more scientifically sound to include future anticipated growth in the mitigation calculus.

There remains a great deal of debate around the appropriate economic discount rates to apply to tree eco-benefit values;[318] and uncertainty remains around the survival, growth estimates, and precise monetary value of urban trees. These uncertainties are even more relevant in Greater Miami area because of its unique tropical climate and seasonal rainfall differences.

Provisions ensuring proper maintenance and monitoring of mitigation plantings stipulated within the permit are key factors to ensure the ecological benefits of tree plantings continue under the appropriate scale and time period commensurate with the trees that were replaced. Ideally, tree planting would be followed to ensure proper maintenance and the survival and healthy growth of a tree so that it would provide the ecological benefits that were projected for mitigation. This may require increased personnel and funding for enforcement.

Mitigation may be categorized into two types of approaches. The most common approach to mitigation is for the permittee to plant other trees, in compensation for the eco-benefits lost from a tree's removal. In practice, however, instead of calculating the value of any tree(s) lost, a simplified practice based on measurements of tree size is used. However, the ecological value does not always have a direct relationship with tree size, as factors such as tree diversity, associated wildlife, and species-specific differences, complicate these calculations. However, calculations based on relationship with either bole or crown volume[319] offer satisfactory proxy measurements for ecological benefits.[320]

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318 Gollier, C., & Hammitt, J. K. (2014). The long-run discount rate controversy. Annual Review of Resource Economics., 6(1), 273-295. DOI:10.1146/annurev-resource-100913-012516

319 Using appropriate measurements for three dimensions and not extrapolating from a single trunk measurement.

320 Taugourdeau, S., Le Maire, G., Avelino, J., Jones, J. R., Ramirez, L. G., Quesada, M. J., Charbonnier, F., Gomez-Delgado, F., Harmand, J. M., Rapidel, B., & Roupsard, O. (2014). Leaf area index as an indicator of ecosystem services and management practices: An application for coffee agroforestry. Agriculture, Ecosystems & Environment, 192, 19-37. http://dx.doi.org/10.1016/j.agee.2014.03.042

4. The impact of tree mitigation and required trees in species diversity and native species

Another issue regarding tree planting replacements as a mitigation strategy is the choice of species. There are few requirements for species choice in mitigation, and often tree plantings represent the least expensive and most widely available landscape species, even if they are from an approved native tree list. As a result, the overall tree diversity of some neighborhoods can be impacted. Moreover, the composition of species in these neighborhoods may also be altered, favoring species that may not be native or best suited to the location. The consequences of reduced floral biodiversity may entail losses in associated faunal diversity that includes birds, mammals, butterflies, and other insects, as well as other important organisms in the soil.[321] High concentrations of single tree species also increase the vulnerability of those stands to pests and disease; therefore, diversity of plantings relative to each other on a local scale should be encouraged from a permitting and policy making perspective.[322]

Even the genetic makeup of trees within the same species is important to consider, as the introduction of genetic material from other regions may have consequences not only for the survival and growth of the trees that are planted, but also for other populations of the species that interbreed with the newly planted varieties. Here, a prominent example is the Live Oak (Quercus virginiana), which is native to the southeastern US, but has varying genotypes that are adapted to different climates. Similar arguments can be made for other common native landscape trees, such as Paradise Tree (Simarouba glauca), Gumbo Limbo (Bursera simaruba) and Caribbean Mahogany (Swietenia mahoganii).[323]

B. Case Studies

1. Case Study: City of Miami

a) City of Miami Tree Ordinance Legislative History

The City of Miami's Tree Protection Ordinance was first adopted by the City Commission in December 2004 as an amendment to the City's Zoning Ordinance 11000. Although the City's existing Environmental Protection Ordinance required tree removal permits, Commissioner Johnny Winton and Mayor Manny Diaz proposed additional protections to the tree canopy in response to public outcry about tree canopy loss, particularly in Coconut Grove.

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321 Shwartz, A., Turbé, A., Simon, L., & Julliard, R. (2014). Enhancing urban biodiversity and its influence on city-dwellers: An experiment. Biological Conservation, 171, 82-90. DOI:10.1016/j.biocon.2014.01.009

322 Plant, L., & Kendal, D. (2019). Toward urban forest diversity: Resident tolerance for mixtures of tree species within streets. Arboriculture & Urban Forestry, 45(2), 41-53. DOI:10.48044/jauf.2019.004

323 Another related example is the Florida native lantana (Lantana depressa) that has suffered from gene dilution due to the closely related shrub verbena (Lantana camara), which also poses an invasive threat to Florida farming by decreasing the productivity of citrus groves due to its toxicity. L. camara is a good candidate for creating cultivars that are either sterile or pose less risk of cross-pollination with the native species (Czarnecki, et al., 2014).
Czarnecki, D. M., Hershberger, A. J., Robacker, C. D., Clark, D. G., & Deng, Z. (2014). Ploidy levels and pollen stainability of Lantana camara cultivars and breeding lines. HortScience, 49(10), 1271-1276. DOI: https://doi.org/10.21273/HORTSCI.49.10.1271

During a Discussion Item regarding the proposed ordinance in October 2004, Commissioner Winton minced no words when explaining the impetus for the legislation:

> *Commissioner Winton: No, no -- and it's the canopy in the Grove that creates the value that helps drive our City, and you would be shocked and ticked beyond belief at the number of developers that are sweeping through the Grove and cutting down 75-year-old, 100-year-old oaks and spitting in our face… And so, this ordinance has been passed very strongly by -- pushed very strongly by Manny Diaz -- Mayor Diaz and myself because we just have to get a handle on these developers, and there are punitive measures in here that are very strong, and it's specifically to get after the developers that are spitting in our face. The good developers out there, they go get a permit. There's not an issue here. They don't get penalized. It's the ones that are -- and you know how Code Enforcement works. If somebody makes a mistake in any particular neighborhood and isn't spitting in our face, you can get -- you get warnings. This is designed to get after the ones that are literally spitting in our face and don't care about our community; don't care about anything…*

The ordinance remained largely unchanged until 2010, when the City of Miami transitioned from its previous Zoning Code, Ordinance 11000, to its current zoning code, Miami 21 (presently undergoing revisions). As part of the elimination of Ordinance 11000 and adoption of Miami 21, the Commission voted to move the language of the Environmental Protection Ordinance, including the Tree Protection Ordinance from its place in the zoning code to Chapter 17 of the City Code. Miami 21 incorporates the City's tree regulations by reference.

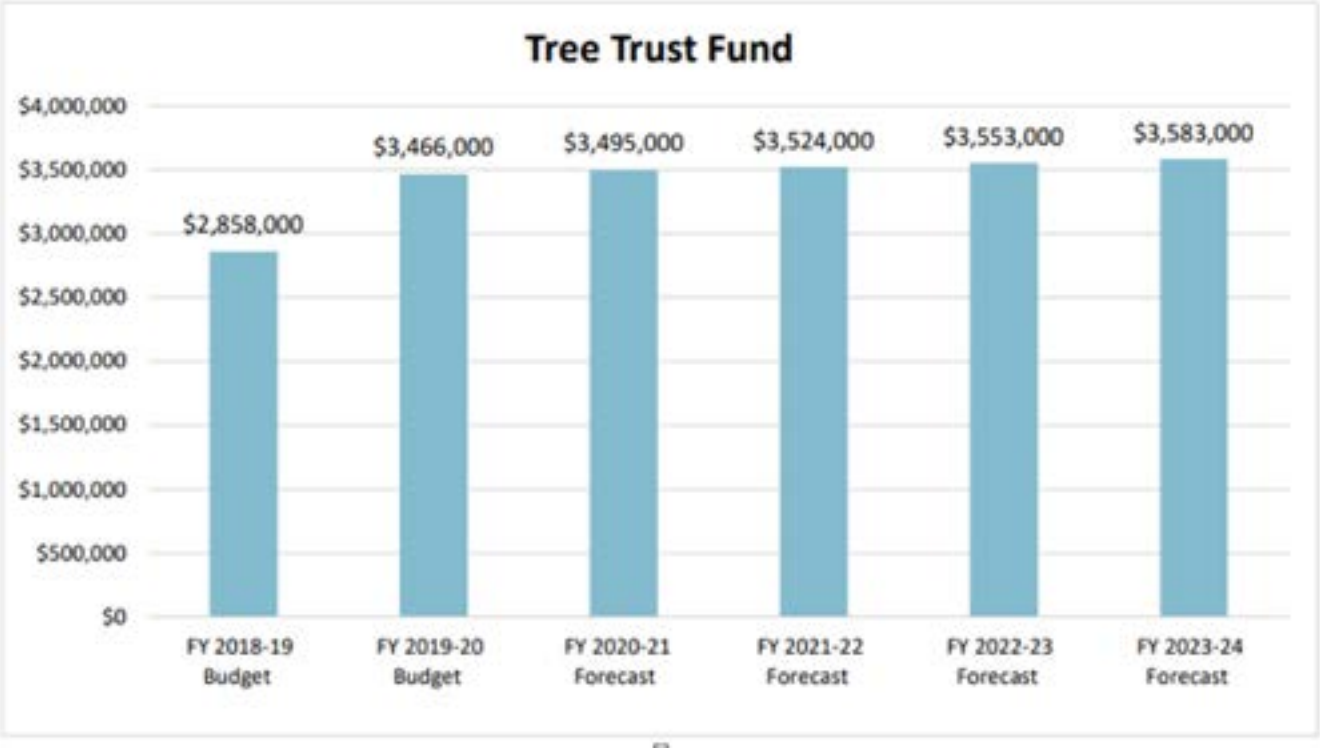
More than a decade after the city first enacted the Tree Protection Ordinance, amidst a strong real estate market recovered from the fallout of the 2008 housing bubble, residents began to observe a systematic degradation of the tree canopy. The outcry yet again reached a fever pitch, and in 2017, the City Commission passed its first significant update to Chapter 17 since its inception, stiffening the penalty and mitigation required for those who illegally cut or prune trees.

b) City of Miami Tree Trust Fund

In addition to requiring protective measures for trees during construction and permits for tree removal, the City's Tree Protection Ordinance also created a Tree Trust Fund to promote tree canopy expansion efforts. The Tree Trust Fund holds monies collected as part of required tree mitigation efforts whenever the City grants permission to remove, prune, or relocate trees.

The City of Miami Tree Trust Fund was established "to enhance tree canopy coverage throughout the city and to restore the loss of tree canopy covering the city." Chapter 62 of the city code governs collection and administration of Tree Trust Fund monies. At least 80 percent of funds collected from tree mitigation fees must be spent directly on tree replacement and restoration and enhancement of the tree canopy, including public tree giveaways, with expenditure in this category increasing over time. Up to 10 percent may be spent on costs like survey work, landscape architectural design services, and inspections for new plantings. Another 10 percent may be spent on training for code inspectors and administrative costs. Any expenditure of Tree Trust Fund money more than $50,000 must be approved by the City Commission. The city manager must also prepare an annual report on trust fund receipts and expenditures at the close of each fiscal year.

The Tree Trust Fund has amassed over $3 million since its creation in 2004 and was projected to top $3.5 million by 2021 according to the City of Miami's budget projections.[324]



As revenues have come into the Tree Trust Fund from developments granted permission to pay fees in lieu of on-site plantings, the City has conservatively expended funds for tree canopy expansion efforts but also contributed significant amounts for habitat restoration.
The City of Miami has not yet met its 2020 target date for 30% tree canopy coverage. As of this writing, the City of Miami is setting out to update its Tree Ordinance. Despite increasing commitments to address flooding, heat, and improve access to green space, the initial draft of the administration's proposed Tree Ordinance update contains many aspects that would only serve to weaken existing protections.[325]

c) City of Miami Tree Mitigation Table

In Chapter 17 of the City of Miami Code of Ordinances, tree mitigation—either via payments for services lost or planting new trees—is calculated based on categories of tree diameter for a given plot. Mitigation requirements are stated in the table, with entries corresponding to a monetary value

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324 The City of Miami, Florida. (2019). Proposed Operating Budget FY 2019-2020. http://archive.miamigov.com/Budget/docs/FY20/OperatingBudget.pdf

325 City of Miami. (2020). City commission meeting. (Item FL.1 10621) http://miamifl.iqm2.com/Citizens/FileOpen.aspx?Type=14&ID=2767&Inline=True

commensurate to the size of the tree lost or a number of smaller trees of certain size. For example, removal of a tree with a 30" diameter trunk requires planting of ten 2" trees or five 4" trees under Chapter 17. If bole and canopy volumes are extrapolated from the Grove ReLeaf databases, these mitigations would result in at least a 98% deficit in related eco-benefits.[326]

Considering again the example of the removal of a live oak tree with 30" diameter, the City of Miami Chapter 17 would call for a mitigation payment of $10,000. Comparing this value with both the dollar translation of eco-benefits and the actual cost of replacement results in an ecological value of at least $15,000 by conservative estimates.[327]

Here, updating the table to the basis of size of the removed tree with bole and canopy volume measurements would provide for a more accurate substitution of ecological benefits. Since many replacement trees have trimmed leaves or limbs for purposes of planting, a more sophisticated measuring scheme can be put into place to estimate replacement canopy volume over time. For example, trees can be categorized by common type, e.g., palms, pines, hardwoods, or by size, e.g., shrubs, understory trees, canopy trees, emergent trees.

2. Case Study: Miami-Dade County Department of Environmental Resource Management (DERM) Tree Mitigation

An alternative mitigation strategy to the City of Miami is provided by the Miami-Dade County Department of Environmental Resource Management (DERM). Mitigation under this program, rather than basing calculations on tree diameter, requires calculation of tree canopy surface area. Although a calculation of tree canopy volume is preferred, tree canopy surface area offers a superior calculation for estimating ecological services when compared to simple diameter measurement. Moreover, the DERM requirements address the additional third point above, by calculating the sum of all canopy surface area to be lost across a given property covered in a tree permit.

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326 For example, using the Grove ReLeaf databases for reference, a 30" DBH tree has an average height of 59 feet; an average bole volume of 221 ft3 ; and an average crown volume of 81,288 ft3. A tree with 2" DBH has an average height of 7 feet; an average bole volume of 0.1 ft3 ; and an average crown volume of 151 ft3. And a tree with 4" DBH has an average height of 10 feet; an average bole volume of 0.7 ft3; and an average crown volume of 452 ft3. Therefore, replacing a 30" DBH tree with ten 2" trees would result in a reduction in bole volume of more than 99% and a reduction in crown volume of more than 98%. Replacing a 30" DBH tree with five 4" trees would result in a reduction in bole volume of more than 98% and a reduction in crown volume of more than 97 %. Here, in order to successfully compensate for the actual value of the 30" tree removal, more than 500 2" diameter trees or more than 200 4" diameter trees would be required.

327 For the dollar translation, we rely on estimates provided by iTree, which include a sum of eco-benefits values as calculated by the USDA Forest Service and American Forests. These estimates are the best we have at this time, although our Grove ReLeaf team is working to provide more precise metrics for trees in South Florida. In our example of the 30" diameter live oak, the sum of estimated eco-benefits for this tree would be about $275 each year. If we assume a very conservative period of life of 30 years over which these benefits would accrue, and a very conservative interest rate of 4%, then the net present-day value of the tree would be at least $15,000.

C. Recommendations

1. Update tree mitigation tables to reflect DERM tables and best scientific information available.

The current mitigation table should be phased into a “Tree Public Benefits Table” or “Urban Tree Ecosystem Services Table” system that accounts and values existing tree and natural system resources on a development parcel, including stormwater, shading and temperature moderation value. Moving towards the creation of this Table would allow the use of dynamic reference points of ecological services to value trees in land use decisions. The table could then be incorporated into policies, thereby potentially streamlining procedural stalls, or politically influenced changes.

Applying the Tree Public Benefits Table more broadly than a standard mitigation table may provide mechanisms to better value the benefits that trees provide throughout land development, re-development, and greening processes, as well as in decisions directly pertinent to a municipal tree ordinance.

2. Update contribution values to the Tree Trust Fund.

Tree mitigation efforts should reflect the commensurate ecological benefits of the trees removed. Given the desire to compromise between the immediate and long-term compensation of benefits, we suggest a minimum 50% increase of the contribution amounts to the Tree Trust Fund in the Tree Replacement Chart, as shown in the model mitigation table in the subsection below.

As a method of addressing the issue within the immediate timescale, we recommend a minimum 50% increase in monetary contribution and replacement trees within the mitigation table as shown below.

3. Mitigation for tree planting must achieve 100% of volume removed within ten years.

A mitigation for tree planting must immediately achieve a minimum percentage of the volumes removed with full replacement of ecological services within ten years. We suggest 25% of bole volume and 33% of canopy volume would be reasonable parameters for initial discussion. These values should be based on growth projections provided by research scientists, to update the categories currently projected by Miami-Dade County DERM. The mitigation value should be measured by each tree (dependent on that tree’s bole and canopy volumes) and not by summing tree diameters at a plot level.

Given the limitations of mitigation tables in influencing the replacement of trees removed under the dangerous tree provisions of Florida Statute, broader application of mitigation table concepts to the creation of a Tree Public Benefits Table could be used both to reflect mitigation requirements more accurately and to create an alternative means for preserving the public benefits from certain trees and tree stands.

4. Incorporate ecosystem benefit language.

Local policies should represent and monetize the expanding scientific understanding of tree ecological benefits. Tree mitigation efforts must reflect the commensurate ecological benefits of the trees removed. Calculating tree value utilizing metrics beyond trunk diameter to include measures that better reflect the ecosystem services that trees provide, such as bole and canopy volume, is important for achieving this goal. When permitting or compensating for replacement trees, there must be accounting for the immediate as well as long-term compensation of eco-benefits.

5. Evaluate effectiveness of tree ordinances prior to updates.

Evaluating the effectiveness of an existing tree ordinance is a crucial step in ensuring its ongoing success. By way of example, in the City of Miami, a tree ordinance has been in place since 2004. While the city looks to update the ordinance, little information or metrics are available regarding the efficacy of the ordinance, permitting and enforcement outcomes. Certain information would be helpful to inform updates to a local tree ordinance, including the update of the City of Miami Tree Ordinance, including a better understanding whether residents are aware of the tree ordinance and support it; the adequacy of existing enforcement efforts; how well the ordinance performs in accounting for "environmental limitations that affect tree health, growth, and survival;" and gaps in needed financial resources to support implementation of the ordinance.[328]

In drafting tree ordinances, we recommend evaluation of goals, responsibility, basic performance standards, flexibility, enforcement, and the comprehensive management strategy, as well as engaging with the community to develop goals for urban forestry that the community can support.

6. Provide guidance on impact of State of Florida dangerous tree statute on local tree removal.

With home rule limitations in Florida, we recommend greater focus on implementation of measures to reduce development of hazardous or dangerous trees and implementation of broad-based incentives, land use, and zoning measures for tree preservation and planting. Establishing guidance for administration of a municipal tree ordinance in consideration of the state law can be important to ensuring effective administration of the local tree ordinance.

7. Identify funding sources and regulatory guidance to provide for city maintenance of street trees.

8. Develop landscape standards that minimize conflicts between trees and the built environment through spacing, design, soil, and green infrastructure requirements.

9. Include protected tree designations, restrictions on removal of protected trees, and incentives for their preservation in the tree ordinance.

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328 Tree Ordinance Guidelines (no. 308) at p. 7.

D. Model Language

1. Model mitigation table by authors

The following draft mitigation table considers an increase in monetary contribution and replacement trees within the City of Miami's mitigation table in place at the time of this writing. Under this table, the DBH measure should sunset over time and canopy surface area or volume should be the reference metric for replacing ecological benefits. Trees to be removed must be inventoried to calculate bole volume (not simply diameter) and canopy volume (not simply surface area). Future updates of this table should be based on bole and canopy volume instead of tree diameter.

Total Tree Diameter (DBH)	Total number replacement trees (sm)*	OR	Total number replacement trees (lg)**	OR	Contribution to Tree Trust Fund
2—3"	1	or	0	or	$1,500.00
4—6"	3	or	2	or	$3,000.00
7—12"	6	or	3	or	$6,000.00
13—18"	9	or	5	or	$9,000.00
19—24"	12	or	6	or	$12,000.00
25—30"	15	or	8	or	$15,000.00
31—36"	18	or	9	or	$18,000.00
37—42"	21	or	10	or	$21,000.00
43—48"	24	or	12	or	$24,000.00
49—60"	30	or	15	or	$30,000.00

*Small replacement trees: (old: minimum 2" DBH x 6' canopy spread x 12' height)
**Large replacement trees (old: minimum 4" DBH x 8' canopy spread x 16' height)

2. Venice, Florida Tree Ordinance Treatment of Heritage trees and Venetian trees.*

*Venice, Florida's definitions for Heritage trees and Venetian trees are included in the model language in Section II. The following code language for the treatment of Heritage and Venetian trees under the local code in Venice, Florida demonstrate how incentives for the care and preservation of valued trees can be integrated into a tree ordinance, including through the establishment of a grant program to cover the maintenance of valued trees on private property. It remains to be seen how state dangerous tree removal statutory provisions may impact tree removal provisions related to Heritage trees and Venetian trees in places like Venice, Florida.

Given present day state preemption concerns in Florida, additional language is recommended to establish the development of a conservation easement, restrictive covenants, or other legally enforceable agreement to protect the specially designated tree from removal.

Sec. 118-10. – Heritage trees and Venetian trees.[329]

(a) *Designation of a Venetian tree:* Venetian trees on private property shall be nominated by the owner of the property where the tree is located. Citizens and city staff may nominate trees on city owned property. Nominations for trees with overhanging canopy (branches) onto adjoining properties must also include written consent to the nomination from all property owners where the overhanging canopy occurs. Tree nominations will be directed to the city arborist for review. The city arborist will prepare a brief report detailing attribute(s) and a description of the proposed tree(s). The report will provide technical guidance to city council on the health, condition, location and structure of the proposed tree(s) and the tree(s) suitability for preservation. Should Venetian tree designation be granted by city council, the tree or group of trees shall be placed on the registry of Venetian trees maintained by the city arborist and afforded the protections as stated in this chapter.
(b) *Venetian tree incentives and conditions:*
(1) *Annual consultation:* The city arborist will provide an annual consultation to the property owner where the designated Venetian tree is located to offer guidance with the management and maintenance of the tree.
(2) *Grant program:* To the extent funds are available, the owner of private property where a designated Venetian tree is located or adjoining owner(s) of private property where the overhanging tree canopy occurs, may be awarded a grant of up to $250.00 by the city to offset the cost of trimming the designated Venetian tree. One grant per property owner per calendar year will be considered and a maximum of five grants per year may be awarded. Implementation of the grant program shall be as follows:
a. Requests shall be submitted to the city arborist within ten days of completion of the trimming.
b. Trimming must be conducted under the supervision of a certified arborist in accordance with "ANSI A (300) Standards" for tree care.
c. The applicant shall provide a paid invoice stating the amount paid; the ISA certification number of the supervising arborist; and a brief narrative of the nature of the trimming work performed. The city arborist shall inspect the trimmed Venetian tree for compliance with "ANSI A (300) Standards" and confirmation of the nature of the work performed.

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329 City Clerk, Florida. Section 118-10. Heritage trees and Venetian trees. In Ordinance no. 2019-29. https://stevestreeandhauling.com/wp-content/uploads/2019/12/Ordinance-Passed-12-10-2019.pdf

(3) Pruning fee waiver: If a pruning permit application is required (removal of branches ten inches in diameter or larger), the pruning permit fee shall be waived.
(4) Venetian tree plaque: A plaque will be located near the designated Venetian tree(s) on public property stating the botanical and common name, size, and a brief description of the tree. Private property owners of a Venetian tree(s) may request a similar plaque to be placed on the property. Venetian tree plaques shall not be subject to the city's sign standards of chapter 86 Land Development Code, article VI Design and Development Standards, division 3 Signs.
(c) Changes in property ownership shall not affect the Venetian tree designation.
(d) Pruning Heritage and Venetian trees:
(1) Unless exempt, a tree permit is required for the pruning of a designated Heritage or Venetian tree branch ten inches in diameter or larger measured 12 inches from the branch union. Any tree pruning not performed in accordance with the "ANSI A (300)" will be subject to fines and penalties established in subsection 118-5(c).
(2) Applications for pruning shall provide:
a. A current photograph of the tree.
b. A sketch plan of the tree and branches to be removed with dimensions, or a current aerial photograph of the property where the tree is located. The sketch or photo must provide sufficient information to identify and describe the tree branches to be removed, species of tree, a description of the branch to be removed, and reason for removing the branch.
(3) The city arborist shall inspect the tree and property for approval or denial and may request an on-site meeting with the contractor or owner prior to the issuance of a permit. Violations of this permit requirement will be subject to fines and penalties established by the city in accordance with section 118-5.
(e) Removal of any Heritage and Venetian tree:
(1) Unless exempt, a tree permit to remove a Heritage or Venetian tree is required. Documentation by a professional landscape architect or certified arborist is required to justify the tree removal subject to section 118-15.
(2) Heritage or Venetian trees may be removed if the tree is located in an area where a structure or improvement will be placed and the applicant provides a report bearing the signature of an architect, professional landscape architect, or licensed engineer providing a determination that the proposed structure or improvement cannot be reasonably redesigned to preserve the Heritage or Venetian tree. The criteria in section 118-15 shall be utilized in determining whether to approve an application for tree removal.
(f) Replacement tree calculations for Heritage and Venetian trees: Unless otherwise stated in this chapter, Heritage and Venetian trees shall be replaced at a ratio of one tree inch to one tree inch (1:1). If there is insufficient land area on a site to accommodate the proposed trees, the applicant shall alternatively pay into the tree mitigation fund equivalent to the tree inches not able to be accommodated on the site.
(g) Removal of Venetian tree designation: Property owners where the Venetian tree exists or where the canopy overhangs shall have the right to petition city council to remove the Venetian tree designation. Petitions shall be submitted to the city arborist. The city arborist shall inspect the tree(s) and provide a brief report to city council of the health and condition of the tree prior to council's final determination.

VIII. Staffing Urban Forestry Programs, Outreach, Education, and Training

The effectiveness of urban forestry policies and programs depends on the existence of sufficient empowered, informed, and educated government staff to carry them out. Stakeholders, including professionals and workers in government and the private sector, along with property owners and residents all interact with trees in the community. Community buy-in, along with the licensing and education of professionals interfacing with urban trees are central to ensuring that local policies are implemented in practice.

A. Discussion

1. Staffing

Studies have identified insufficient funding, staffing limitations, and the need for professional staff as common barriers to urban forestry management programs.[330] The government entities responsible for urban forests need the human resources capacity to ensure the best practices and policies are followed in construction and development projects, as well as in tree planting, care, and maintenance activities. This involves hiring sufficient staff, including tree care labor, as well as urban forestry experts and arborists who are informed regarding the challenges facing the region's urban forests. Outreach, education, and marketing components of urban forestry programs require dedicated time and human resources as well.

2. Professional Education and Training

Those responsible for making land use, development, and code enforcement decisions in local government need to understand the local rules and best practices around tree care to effectively do their jobs. A City of Miami Beach report recommends "training code enforcement staff in basic tree health and care," in addition to training "special magistrates and staff about the importance of tree canopy coverage, and the social and financial benefits."[331]

We recommend the development of an education program for both government staff and private sector individuals. Education is needed to ensure that those working with trees are informed regarding urban forestry priorities, rules, and best practices, as well as incentives for tree preservation and care.

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330 Driscoll, A. N., Ries, P. D., Tilt, J. H., & Ganio, L. M. (2015). Needs and barriers to expanding urban forestry programs: An assessment of community officials and program managers in the Portland–Vancouver metropolitan region. Urban Forestry & Urban Greening, 14(1), 48-55. doi:10.1016/j.ufug.2014.11.004
At p. 3. Citing (Grado et al. (2006) and (Elmendorf et al., 2003; Stevenson et al., 2008)

331 Trees to Offset Stormwater, 2018 (no. 129) at p. 25.

3. Licensing and Business Tax Receipts

Licensing could improve accountability for those involved in tree maintenance, removal, and planting activities. The Business Tax Receipt ("BTR") is required for businesses operating in Miami-Dade County. While many construction professionals are required to obtain a professional license through Miami-Dade County, landscape professionals and arborists interfacing with trees are not subject to such requirements.[332]

Education requirements for licensed professionals and individuals interfacing with trees through their work is key to ensuring that the best practices and policies for trees are followed in the field. The Miami-Dade County BTR process could be adjusted to put in place a requirement for landscape professionals and others engaged in tree removal activities. Those subject to BTR requirements who interface with trees could then be required to meet an educational requirement to receive a license and BTR. This would help to ensure such professionals are well educated in the rules and best practices for maintaining a healthy tree canopy in the County.

4. Responsibility and Penalties for Tree Care Professionals

Extending the liability for violating rules related to tree care and removal beyond property owners, to include the professionals and workers engaged in such activity could create an incentive for compliance closer to the tree activity. Code provisions to make violations of tree rules applicable to arborists, landscaping, tree removal, and construction companies could improve accountability for tree activities. This may also help equitably distribute the burden for violations to include all of those engaging in rule-breaking activity.

In addition to monetary penalties, failure to comply with landscaping and tree removal provisions could be tied to an entity's ability to maintain its license with the county. In such a scenario, licensed professionals engaged in illegal tree maintenance or removal activity might risk suspension and eventual removal of their county license.

Licensed professionals could additionally be required to inform their clients of the risk of financial penalties for illegal tree removal and maintenance activities. While homeowners may face liability for removing a tree without a permit, the landscapers hired to remove trees are best positioned to educate their clients about permitting requirements.

332 Cam, P. (n.d.). Local business tax categories. Miami-Dade County. Local Business Tax Categories (miamidade.gov)

5. Public Outreach and Engagement

"A sustainable urban forest relies heavily on the shared vision and objectives held by community members."[333] Studies identified "strong evidence that new models that increase advertising and support for urban forestry are needed on a community wide basis."[334] There is a feedback loop whereby, educating residents of the benefits of funding urban forests builds tax-base support for healthy urban tree canopy.[335] Despite studies indicating that urban populations, on average, feel "very positively towards street trees—most highly valuing their shade, aesthetics, air quality, and noise amelioration, [...] canopy cover across U.S. cities is in decline."[336]

Community participation in activities to support urban forests improves along with the public's knowledge and understanding of trees "as a significant community resource".[337] One Miami Beach report recommends "developing information for citizens detailing how they can engage in supporting the city's urban canopy."[338] Accordingly, a primary component of Miami Beach's urban forestry plan is community and stakeholder engagement "about the benefits of trees to support implementation of the UFMP and urban forestry initiatives."[339]

The various policies, market-based mechanisms, and levers discussed throughout this report provide opportunities to inform the public of the monetary, ecosystem, and other benefits of healthy urban forests. Informing and educating the public about the value of specific trees, as well as programs, and financial incentives for their preservation is central to implementation of the policies discussed herein. Many of the recurring challenges for urban tree health, including "1) insufficient nutrients, 2) lack of water and 3) vandalism; […] can [each] be ameliorated by community and homeowner involvement."[340]

Citizen engagement in supporting tree canopy on private property is integral to meeting canopy cover targets. On average, 40 percent of land in U.S. cities is privately held residential land. Therefore, it is imperative to "engage private landowners and plant trees on residential properties [...] to meet goals to increase urban tree canopy."[341]

Aside from tax-base and general political support, along with private preservation and enhancement of healthy urban forests, community volunteers often contribute labor in support of public urban forests. Community stewards of the urban forests "may have multiple and diverse motivations for becoming involved in urban forestry," such reasons may be social and environmental.[342]

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333 Goldman, 2017 (no. 57) at p. 7.
334 Driscoll et al., 2015 (no. 334) at p. 8.
335 Driscoll et al., 2015 (no. 334) at p. 8.
336 Jack-Scott, E., Piana, M., Troxel, B., Murphy-Dunning, C., & Ashton, M. (2013). Stewardship success: How community group dynamics affect urban street tree survival and growth. Journal of Arboriculture, 39(4) 189-196. 10.48044/jauf.2013.025
337 Goldman, 2017 (no. 57).
338 Trees to Offset Stormwater, 2018 (no. 129) at p. 24-25.
339 Miami Beach urban forestry master plan, 2020. (no. 39) at p. 10.
340 Jack-Scott, et al., 2013 (no. 336).
341 Goldman, 2017 (no. 57) at p. 8.
342 Moskell, C., Allred, S. B., & Ferenz, G. (2010). Examining volunteer motivations and recruitment strategies for engagement in urban forestry. Cities and the Environment (CATE), 3(1), 9. DOI:10.15365/cate.3192010 at p. 2.

While we recommend municipal management and maintenance of street trees along with evaluation of resources to support residents who wish to better maintain trees on private property, volunteer engagement in activities to support the urban tree canopy is an important complement to government driven efforts. "As such, in addition to the actions of municipal agencies and private landowners in managing the urban forest, community-based groups and non-governmental organizations have a key role to play in civic stewardship of these resources[343] The capacity, size, and strengths of different associations and groups impacts their effectiveness.[344]

B. Case Studies

1. Local Ordinances Establishing Training and Licensing Requirements for Fertilizer Applications
The Tampa Bay area Sierra Club Chapter spearheaded efforts urging the adoption of fertilizer ordinances in that part of Florida for many years. Miami Waterkeeper has more recently led efforts advocating for local municipalities across Greater Miami to adopt fertilizer ordinances. As a result of the coordinated efforts to pursue better policies and practices for the use of fertilizers, Miami-Dade County, Coral Gables, Key Biscayne, Miami, Miami Beach, and West Miami have all adopted fertilizer ordinances with strong summer application bans.[345] The ordinance Miami-Dade County adopted requires training and licensing for commercial and institutional fertilizer applicators. The model of adopting new education requirements for those engaged in fertilizer activities, could be replicated to develop training and licensing requirements for professionals and workers engaged in activities influencing outcomes for trees, including maintenance, removal, planting, design, and construction. Miami-Dade County requires fertilizer applicators to submit an affidavit affirming that the "business applies fertilizer as part of its business activities in Miami-Dade County" and attaching a copy of their "training certification from the Florida Department of Environmental Protection, or equivalent."[346]

2. Urban Paradise Guild

Urban Paradise Guild is a nonprofit organization in Miami-Dade County that engages volunteers to plant native habitat, trees, and urban farms in locations across the region. The organization has volunteer days 5 days a week providing a gateway to volunteer labor, community engagement, and education to support urban greening. These types of non-profit partnerships support multiple co-benefits and tend to save local governments money. They work in partnership at project locations in multiple parks across the area, including Oleta River State Park, Arch Creek East Preserve, Amelia Earhart County Park, Vizcaya Museum & Gardens, and Matheson Hammock County Park.

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343 Roman, et al., 2018. (no. 99) at p. 42.

344 Jack-Scott, et al., 2013 (no. 336) at p. 6. ("Certain group types were also recurring factors affecting tree survival and growth. Street trees planted by neighborhood resident groups had significantly improved growth, although the opposite was true among vacant lot trees. Conversely, social service/non-profit groups demonstrated improved growth among trees in vacant lots and yards, and significantly lower growth on streets. Park groups were effective in park plantings, with higher survival rates, but had low growth rates among vacant lot plantings…. In support of Nowak's (1990) findings, public housing groups had lower survival of their yard trees than did other groups. However, yard trees planted by apartment groups actually had significantly higher survival rates, disputing findings by Nowak (1990) in that same paper.")

345 Google. (n.d.). Florida fertilizer ordinances. https://www.google.com/maps/d/u/0/viewer?mid=1tKWdTALmJxR0CE3rbZ4nQR3Ct6hHBWNO&hl=en_US&ll=26.46505868678586%2C-80.15486365809538&z=9

346 Miami-Dade Country, Florida. (n.d.). Affidavit for fertilizer application business activities. https://www.miamidade.gov/finance/library/fertilizer-affidavit.pdf.

C. Recommendations

1. Mandate professional licensing for arborists, landscapers, tree professionals, and construction workers involved in removal, maintenance, and planting of trees.

2. Require education on tree care best practices and policies for professionals, businesses, and government staff engaged in activities impacting trees.

3. Penalize tree professionals (and not just homeowners) for tree removal and maintenance violations.

4. Prioritize ongoing public and stakeholder outreach, engagement, and education. Establish marketing and public outreach campaigns to educate the public on the benefits of the urban forests, along with community goals for their health or expansion.

5. Evaluate private, public, and nonprofit partnerships to support urban forests.

6. Ensure adequate staffing, including arborists and other tree professionals to successfully implement urban forestry plans and policies to meet goals.

7. Ensure sufficient code enforcement, magistrate, and other staff to follow up on development permitting and construction maintenance to ensure compliance with tree policies and requirements.

D. Model Code

The following can be added to tree penalties provision of the municipal code to ensure that penalties for conducting tree removal or maintenance activities without the proper documentation or permitting are applied to tree removal companies who are conducting the work.

Sample amendment to municipal code[347]

Tree Ordinance Sec. _____. – Penalties, remedies cumulative.
(a) Tree Removal Companies; Construction Companies. All provisions of this Chapter shall apply to any person removing or pruning trees on behalf of any other person, including all tree removal construction companies or persons in the business of removing trees or conducting construction activities around trees. The fine and tree replacement requirements of Section [xx] shall apply to property owners and agents acting on behalf of property owners as described herein.

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347 Adopted from Matthews Municipal Ordinances (2022). Restrictions on tree removal, 1 (p. 2). In Matthews Municipal Ordinances § 34:75 (3d ed.). The Publisher's Editorial Staff.

IX. Conclusion

This report explores a broad range of levers to preserve and proliferate urban tree canopy cover, as well as barriers making expanding the canopy cover more challenging. No one policy, planning, land use, zoning, or other mechanism is going to solve all the region's challenges in achieving an abundant and thriving urban forest now and into the future. A combination of strategies will be required to achieve the desired increases in canopy cover. Distinct solutions will be appropriate in different parts of the region and among the various local government bodies. This document is written in a manner that it targeted to Miami-Dade County and its municipalities. However, it is also applicable to other communities across Florida. The circumstances for every local government are distinct from the next. The policies, practices, legal, and regulatory mechanisms discussed herein may be applicable to some governing bodies or geographies and not to others, even within Miami-Dade County.

The character, history, and heritage of Miami is closely tied to the urban tree canopy.
A flourishing tree canopy is a critical component for a resilient Greater Miami area. In the face of increasing temperatures and development pressures, increased precipitation, stormwater flooding, pressure on water management systems, likelihood of hurricane force wind events, and sea level rise, tree cover plays a small but important part of the overall resilience strategy. Continued efforts to create a walkable, livable, and healthy future for Greater Miami depends on vibrant urban forests.

We hope readers will use this work as a roadmap for urban tree conservation in Miami-Dade County and to gain inspiration for tree and canopy cover protections in other jurisdictions.

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Acronyms, Defined Terms, and Terms of Art

Adaptation Action Area (“AAA”)
American Forests (organization formally known as American Forestry Association)
ANSI 300: American National Standards (ANSI) A300 Standard Practices for Tree Care Operations
Benefit Investment Ration (“BIR”)
Best Management Practices (“BMPs”)
Blue Green Stormwater Infrastructure (“BGSI”)
Clean Water Act (“Clean Water Act”)
Comprehensive Development Master Plan (“CDMP” or “Comprehensive Plan”)
Connect & Engage (“C&E”)
Connect To Protect Network (“CTPN”)
Designated Area of Critical State Concern
Developments of Regional Impact (“DRI”)
Diameter at Breast Height (“DBH”)
Environmentally Environmental Lands (“EEL”)
“Natural Forest Community”
Environmental Justice (“EJ”)
Existing Urban Tree Canopy (“EUTC”)
Experimental Action Area (“EAA”)
Flood Area Ratio (“FAR”)
Florida Administrative Commission (“FAC”)
Florida Community Planning Act (formerly known as the Local Government Comprehensive Planning and Land Development Regulation Act)
Florida Department of Agriculture and Consumer Affairs (“FDACS”)
Florida Department of Economic Opportunity (“DEO”)
Florida Department of Environment Protection (“FDEP”)
Florida Keys Carrying Capacity Study (“FKCCS”)
Florida Fish and Wildlife Conservation Commission (“FWC”)
Florida Yards and Neighborhoods Program (“FYN”)
Green Infrastructure (“GI”)
Geographic Information System (“GIS”)
Greenhouse Gas (“GHG”)
Heritage Tree
ICLEI – Local Governments for Sustainability (“ICLEI”)
Low Impact Development (“LID”)
Miami-Dade County (“County”)
Miami-Dade County and its 34 municipalities (“Greater Miami”)
Municipal Separate Storm Sewer System (“MS4”)
National Estuary Program (“NEP”)
National Pollutant Discharge Elimination System (“NPDES”)
Neighborhood Conservation District (“NCD”)
Nonpoint Source Management
Plan & Manage (“P&M”)
Potential Urban Tree Canopy (“PUTC”)
Protected Tree(s)
Public Benefit Tree
Planned Unit Development (“PUD”)
Required Tree
Right of Way (“ROW”)
Specimen Tree
Florida Department of Community Affairs (“DCA”) (The department formerly known as DCA no longer exists. The roles and responsibilities of DCA are largely under the jurisdiction of DEO
Transfer of Development Density (“TDD”)
Transfer of Development Rights (“TDR”)
Transfer Development Rights Credits (“TDR Credits”)
Tree Inventory
University of Florida Institute of Food and Agricultural Sciences (“UF/IFAS”)
The City of Miami Beach’s Urban Forestry Master Plan (“UFMP”)
Urban Development Boundary (“UDB”)
Urban Tree Canopy (“UTC”)
Urban Tree Eco-system Services Table
United States Army Corps of Engineers (“USACE”)
US Department of Agriculture (“USDA”)
The USDA Urban and Community Forestry Program
United States Environmental Protection Agency (“USEPA”)
Water Resources Development Act (“WRDA”)
1996 Mangrove Trimming & Preservation Act (“MTPA”)

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