

MIAMI BEACH RISING ABOVE

MIAMI BEACH URBAN FORESTRY MASTER PLAN

10/16/2020

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY



PLAN VISION

Miami Beach's trees are a defining and valued feature of the city, recognized for the important contribution they provide in mitigating the effects of climate change. They are an integral part of the city's infrastructure that is planned, managed and planted considering future climatic conditions, adaptation efforts and changes in Miami Beach's landscape.

The City of Miami Beach, as a barrier island off the coast of Florida, is witnessing first-hand the effects of climate change, sea level rise, saltwater intrusion, flooding, king tides, and extreme storm events. In addressing these challenges, the City has become a pioneer in developing, evaluating and implementing innovative climate mitigation and adaptation strategies. While some of these are engineered and constructed (i.e. raising streets), others are focused on using natural systems, like the city's urban tree canopy to mitigate these effects. Trees have been proven to be one of the most effective tools for mitigating the effects of climate change.¹

Trees mitigate the effects of climate change by providing essential services and benefits to the city. Miami Beach's urban forest:

- removes ozone from the air helping to reduce atmospheric warming and improving air quality and the public health effects of air pollution.
- stores carbon and reduces the amount returning to the atmosphere as a greenhouse gas.
- shades and cools streets/buildings mitigating the urban heat island effect and reducing the use of air conditioning.
- intercepts and absorbs stormwater reducing flooding and the amount entering the city's stormwater system.
- improves water quality by filtering and removing pollutants.
- provides homes, food and shelter for wildlife.
- beautifies the community.
- increases real estate values by 7-10%.²
- positively impacts the overall health of urban residents³ and lessens the impacts of urbanization.⁴

PLANNING PROCESS

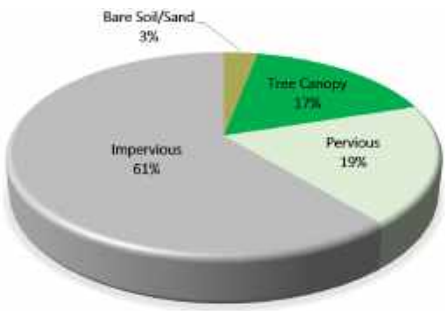
The development, organization and structure of Miami Beach’s UFMP was based on an understanding of what we have, what we want, how we get there, and how are we doing. This structure, termed “adaptive management,” is commonly used for resource planning and management⁵ and provides a useful conceptual framework for managing a community’s urban forest resource.



Benefits*	Shade Tree	Palm
	Live Oak, <i>Quercus virginiana</i>	Sabal Palm, <i>Sabal palmetto</i>
Diameter (DBH)	16"	16"
Carbon Dioxide (CO2) Sequestered (Absorbed)	510 pounds/year	2.71 pounds/year
Rainfall Intercepted	725 gallons/year	81 gallons/year
Ozone removed from air	20 ounces/year	1.70 ounces/year
Carbon dioxide stored	3,214 pounds over lifetime	26 pounds over lifetime
Energy Savings (A/C)	60 kWh	26 kWh
Energy Savings Value	\$10.00	\$4.60
Annual Value of Benefits	\$31.00	\$6.48
*Based on an analysis utilizing the USDA Forest Service’s i-Tree MyTree benefits tool (www.itreetools.org) - v. 2.4.16		

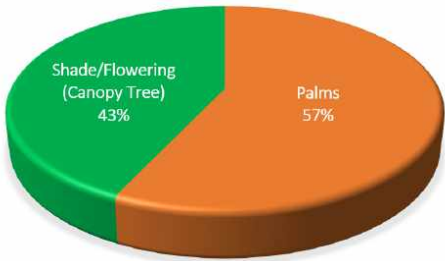
WHAT DO WE HAVE?

Miami Beach’s urban forest is made up of all of the trees, palms, and woody vegetation growing along streets, swales, in public parks and on private property. When viewed from above, Miami Beach’s tree canopy covers 17% of the city’s land⁶.



The City maintains a tree inventory of over 48,900 public trees and palms, which includes those growing along streets, in swales and public parks and other public lands. The inventory identified 302 unique species, including 212 species of shade/flowering trees and 90 species of palms. While there is a large number of different species growing on public lands, trees and palms are not evenly distributed among the 302 species. In fact, the top 5 species represent 44% of the total tree population.

Palms, while an iconic part of Miami Beach’s landscape, have moved from being an accent plant to a major component of the city’s urban forest. A general guideline for species diversity, states that no family should make up more than 30% of a city’s tree population. Arecaceae, the family of landscape palms, makes up over 55% of the public tree population; and 3 of the 5 top species within the City’s inventory are palms. This significant proportion of palms has an impact on the quantity and type of benefits the urban forest can provide. As Table 1 demonstrates, an average sized live oak tree provides nearly 7 times the annual benefits that an average sized cabbage/sabal palm provides.



The City of Miami Beach is responsible for maintaining trees and palms growing in city parks and along a limited number of street rights-of-way/swales, however, the primary maintenance responsibility or right-of-way/swale trees is the adjacent private property owner.

Miami Beach Land Cover



CHALLENGES AND OPPORTUNITIES

The following key urban forestry challenges and opportunities were identified during the planning process and are further addressed in detail elsewhere in the report and in the toolbox section:

- On most Miami Beach streets the right-of-way is not large enough to accommodate trees, utilities, bike lanes, travel lanes, and parking. Trees are not always a priority for these spaces.
- Tree species selection must take into consideration the unique challenges facing Miami Beach’s urban forest, including lack of diversity, rising groundwater (saltwater inundation), sea level rise, flooding, limited growing space and pests/diseases.
 - Due to these factors less than 50% of the species growing on public property are suitable for the site and changing climatic conditions.
 - An overpopulation of palms is impacting the species diversity and benefits that Miami Beach’s urban forest can provide.
- Opportunities exist for tree planting and removing impervious surfaces/retrofitting sites to accommodate trees on City-led projects.
- Private property owners are responsible for maintaining trees in the public rights-of-way, as well as those on private property, leading to improper maintenance, unnecessary tree removals and cases of tree abuse.
- There is limited knowledge on the current condition and risk rating of public trees.
- There is a lack of public education/outreach on the benefits of shade/ornamental trees and best practices for tree planting and care.
- Tree canopy cover and the benefits it provides, is not evenly distributed across the city.



Black olive street tree that has outgrown the space between the sidewalk and the curb.



Example of a poorly pruned (“hat-racked”) tree in Miami Beach

WHAT DO WE WANT?

City of Miami Beach staff and residents were engaged during the planning process to understand the needs, challenges and opportunities they see related to trees and the urban forest. Outreach and engagement occurred through public meetings, stakeholder interviews, and one-on-one conversations.

In general residents and City staff shared the following desired outcomes of the UFMP:

- Increase shade/ornamental trees in the urban forest, while reducing the palm population
- Focus efforts on the preservation and maintenance of existing shade/ornamental trees
- Collaborate and identify opportunities to preserve trees and add shade tree canopy on City and Florida Department of Transportation projects.
- Provide tools and strategies to assist in increasing shade tree canopy cover throughout the city.
- Increase outreach and education

GUIDING DOCUMENTS

Two overarching City of Miami Beach documents provided the strategic guidance for the development of the UFMP: 2010 Sustainability Plan and the 2019 Miami Beach Strategic Plan – Through the Lens of Resilience.

Sustainability Plan:

Developed in 2010, the Sustainability Plan serves as a guiding document to the City to help it develop and plan in a sustainable manner that “improve[s] resources, prevent[s] harm to the natural environment, protect[s] human health, and benefit[s] the social economic and environmental well-being of the community for present and future generations.”

City of Miami Beach Strategic Plan - Through the Lens of Resilience:

Developed in 2019, this plan combines the City’s strategic and resilience plans into one document to provide a comprehensive outlook of the city to develop goals, objectives and actions to become a resilient community.

HOW DO WE GET THERE?

The information, data and input gathered during the “What Do We Have?” and “What Do We Want?” phases were used to define the UFMP’s vision, goals, targets, recommendations and actions.

They support and align with the guiding principles and Natural Resource and Ecosystem Management program area goals, indicators and targets of the Sustainability Plan; and objectives in the Neighborhood, Environmental Infrastructure and Mobility vision areas of the 2019 Strategic Plan.

The Plan is organized around three strategic goals which were developed through the lens of climate adaptation and resilience and are based on the components of a sustainable urban forest.

Tree Canopy (TC): Protect and increase shade tree canopy to maximize the environmental, economic, health and climate mitigation services trees provide to Miami Beach.

Plan & Manage (P&M): Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.

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.

HOW ARE WE DOING?

The UFMP provides an overarching framework to guide the City of Miami Beach in the sustainable and strategic preservation, management, maintenance and growth of a resilient urban forest. It presents a high-level review of Miami Beach’s urban forest, its benefits, the City’s management program, historical context and the unique challenges it faces. Utilizing this information, the Plan connects the city’s vision of the urban forest with goals and recommendations to achieve it.

An assessment of the Indicators of a Sustainable Urban Forest to begin the plan development process, established the baseline of where Miami Beach’s urban forest is today. The goals, targets, recommendations and action steps are tied to these indicators and are designed to move Miami Beach towards a high-performance level and a sustainable urban forest. As the baseline metrics, the indicators can be assessed periodically to measure progress in Plan implementation and to develop an annual State of the Urban Forest report to share program successes, challenges and opportunities with the community.

PLAN ORGANIZATION

The UFMP is organized into two sections:

Section I: State of the Urban Forest.

Outlines the current state of Miami Beach’s urban forest through analysis of the city’s tree inventory and urban tree canopy assessment, stakeholder engagement and review of current policies, plans and operations. It details the Plan goals, targets, recommendations, and action steps.

Section II: Urban Canopy Toolbox.

Provides the tools to assist the City of Miami Beach, contractors, and developers with implementation of the goals, targets, recommendations and action steps in Section I. It includes specific streetscape typologies, and strategies to increase tree canopy cover, along with recommended tree species based on site conditions.



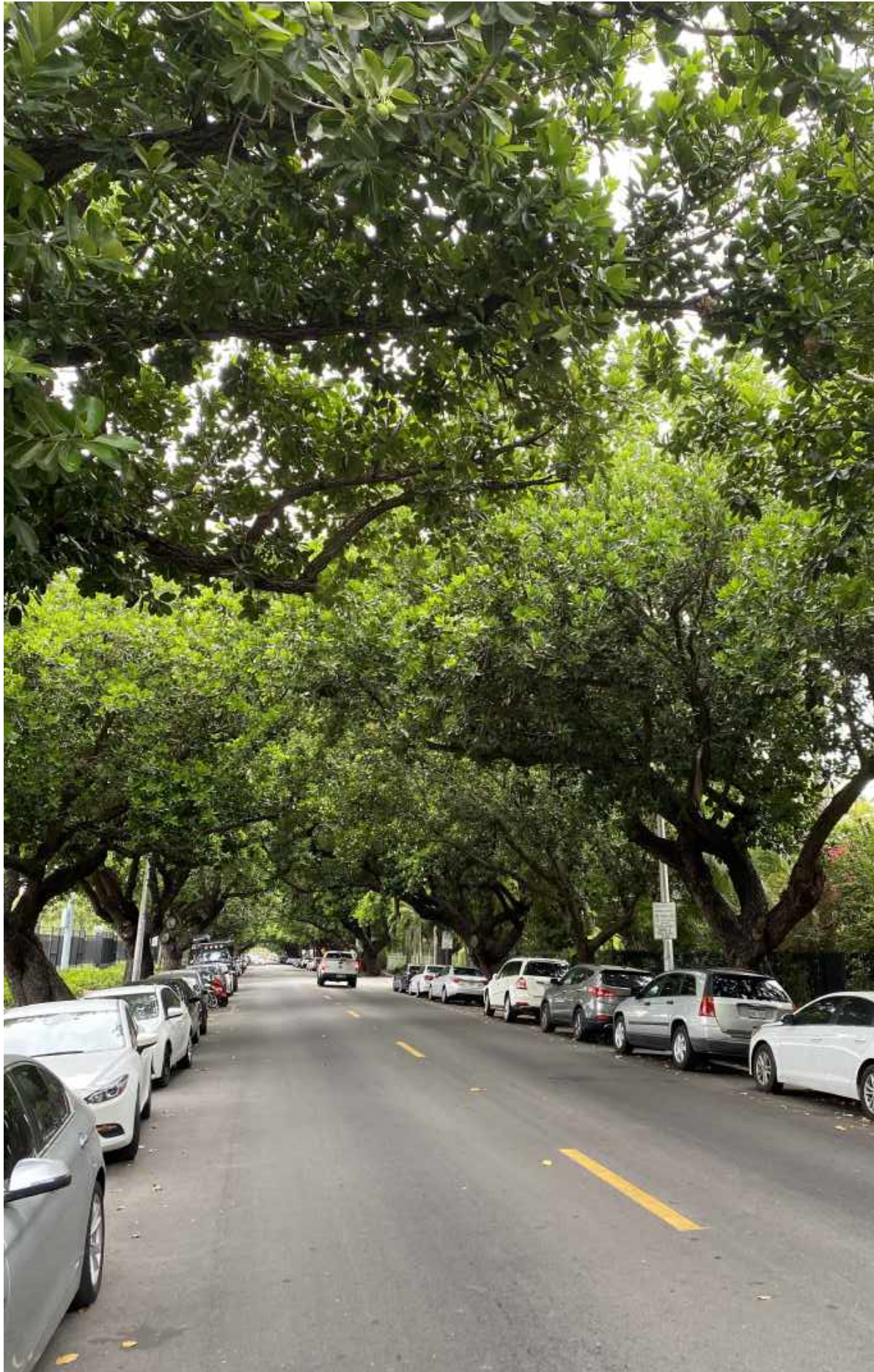
Example of detail from the Urban Canopy Toolbox

GOALS		
TREE CANOPY (TC)	PLAN & MANAGE (P&M)	CONNECT & ENGAGE (C&E)
Protect and increase shade tree canopy to maximize the environmental, economic, health and climate mitigation services trees provide to Miami Beach.	Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.	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.
TARGETS		
TREE CANOPY	PLAN & MANAGE	CONNECT & ENGAGE
Achieve 22% tree canopy cover city-wide by 2040.	Implement a 5-year urban forest maintenance plan by 2021. By 2050, palms should make up no more than 25% of the public tree population.	Release an annual State of Miami Beach Urban Forest Report beginning in 2021.
RECOMMENDATIONS		
TREE CANOPY	PLAN & MANAGE	CONNECT & ENGAGE
<p>TC #1: Track, quantify, evaluate and report on tree canopy cover trends, including amount and annual benefits.</p> <p>TC #2: Develop canopy cover targets and tree planting/preservation plans for neighborhoods that are below the city-wide neighborhood canopy cover average of 15%.</p> <p>TC #3: Conduct a tree canopy equity analysis to prioritize outreach and planting efforts in areas of the city where tree canopy is not equitably distributed</p> <p>TC #4: Develop a routine maintenance and preservation program focusing on public canopy (shade) trees greater than 18” DBH</p> <p>TC #5: Utilize the Urban Forest Master Plan Design Toolkit to identify opportunities for tree planting on city projects (e.g. infrastructure, utility, transportation, non-motorized transportation); improve diversity; and ensure that species are suited to the changing site conditions of Miami Beach, including, salt water inundation, flooding, sea level rise, climate change, and invasive pests.</p> <p>TC #6: Establish and adopt preferred minimum soil volume standards to achieve optimum size of mature trees.</p>	<p>P&M #1: Systematically and routinely update the street and park tree inventory assessing and updating diameter, condition, maintenance need, and risk rating of each tree.</p> <p>P&M #2: Explore opportunities to develop a proactive tree maintenance program and transfer all right-of-way/swale tree maintenance responsibility to the City of Miami Beach.</p> <p>P&M #3: Track and report on tree care, planting, and maintenance activities completed each year.</p> <p>P&M #4: Focus tree planting program on locations that advance city canopy cover goals, planting priorities, and climate adaptation efforts.</p> <p>P&M #5: Establish a tree inspector position responsible for enforcing city tree ordinances and serving as an in-field liaison between private, public and utility contractors and City departments.</p> <p>P&M #6: Establish a 3-person City Parks crew dedicated to tree care and emergency tree maintenance.</p> <p>P&M #7: Continue to contract out tree maintenance, care, and removal activities separately from litter removal and other landscape maintenance services.</p> <p>P&M #8: Adopt and implement an urban forest best management practices manual.</p> <p>P&M #9: Review Urban Forest Division Hurricane plan annually and revise, as needed.</p>	<p>C&E #1: Create and implement a public communication, outreach, and marketing plan for the urban forest.</p> <p>C&E #2: Engage and strengthen partnerships with stakeholder groups and City leadership to increase awareness of the importance of the urban forest and the role they play in its health, growth, and sustainability.</p> <p>C&E #3: Establish and implement City policy/standard operating procedures (SOP) to document the process for engaging Urban Forestry, Greenspace Management and Park Maintenance on all City projects, programs, plans and initiatives.</p> <p>C&E #4: Develop and implement a funding program to support additional forestry services, special urban forestry initiatives, and programs to address needs of the urban forest</p> <p>C&E #5: Continue to foster relationships and identify regional leaders to advocate for trees and the important role they play in the sustainability and climate resilience of the region.</p>

An aerial photograph of Miami, Florida, showing the city skyline and Biscayne Bay. The image is taken from a high angle, looking down on the city. The sky is filled with dramatic, colorful clouds in shades of blue, orange, and yellow, suggesting a sunset or sunrise. The water in the bay is a deep blue-green color. The city buildings are densely packed along the coast, with many tall skyscrapers. A large, prominent building with a distinctive white, spire-like roof is visible on the left side of the image. The overall scene is a vibrant and dynamic representation of an urban landscape.

SECTION 1: STATE OF THE URBAN FOREST

INTRODUCTION



INTRODUCTION

COMMUNITY HISTORY⁷

The first known settlers of the Miami Beach area were the Tequesta Indians who inhabited the area until the mid-1800's. In 1870, Henry and Charles Lum bought the island from the federal government for \$0.25 an acre. Originally only 165 acres, the land was planned to be used to grow and harvest coconuts but when the venture failed, the Lum's sold the property. It was eventually sold to John S. Collins, who in 1913, with funding from his business partner Carl Fisher, constructed a wooden bridge to connect Miami Beach to the mainland. The construction of the bridge led to the incorporation of Miami Beach in 1915, and a boom in development that lasted through the 1920's. Smaller developments were constructed during the Depression and today those developments make up the famous Art Deco District of South Beach.

Following World War II, the city saw a significant increase in population as veterans settled in the city. Today, at just over 7 square miles, the city is a thriving, international travel destination that is home to over 91,000 residents. Hospitality, arts and entertainment, retail, professional/scientific/technical services and health care are the lead contributors to the city's economy.

MIAMI BEACH TODAY

Today, Miami Beach is a unique and vibrant coastal community well known for its beautiful beaches, tree-lined parks and boardwalks, and its world-famous Art Deco Historic District. It is home to over 91,718 residents and is a popular tourist destination for millions of people each year. The uniqueness of the city lies not only in its community and culture, but also in its location. Miami Beach is a barrier island comprised of a mixture of natural and man-made islands that separate the Atlantic Ocean from the Florida mainland. As a barrier island it faces unique challenges and is witnessing firsthand the effects of climate change, sea level rise, saltwater intrusion, flooding, king tides, and extreme storm events.

In addressing these challenges and ensuring that Miami Beach is a dynamic and resilient coastal community, the City has become a pioneer in planning, developing, evaluating and implementing innovative climate mitigation and adaptation strategies and solutions. One of the solutions the City is pursuing is the preservation and growth of Miami Beach's urban forest because research has proven that trees are one of the most effective tools for mitigating the effects of climate change.

BENEFITS AND SERVICES OF THE URBAN FOREST

In 2019, the City of Miami Beach commissioned the development of the city's first Urban Forest Master Plan (UFMP/Plan) to effectively use the city's tree canopy as a climate mitigation and adaptation strategy and maximize the services the urban forest provides to the community.

Trees and the urban forest are constantly working to mitigate the effects of climate change and urbanization while protecting and enhancing the quality of life in Miami Beach. To provide an introduction to the benefits and services trees provide and their value to Miami Beach, an i-Tree MyTree analysis was performed on four species commonly found in the area, silver buttonwood (*Conocarpus erectus* var. *sericeu*), crapemyrtle (*Lagerstroemia indica*), royal poinciana (*Delonix regia*), and live oak (*Quercus virginiana*). i-Tree is a suite of peer-reviewed software applications developed by the USDA Forest Service to quantify the ecosystem services and benefits that a community's trees provide.

These benefits and services include:

- removing ozone from the air helping to reduce atmospheric warming.
- improving air quality and the public health effects of air pollution.
- storing carbon and reducing the amount returning to the atmosphere as a greenhouse gas.
- shading and cooling streets/buildings mitigating the urban heat island effect.
- intercepting and absorbing stormwater reducing flooding and the amount of water entering the city's stormwater system.
- improving water quality by filtering and removing pollutants.
- providing homes, food and shelter for wildlife.
- beautifying the community.
- increasing real estate values.
- positively impacting the overall health of urban residents and lessening the impacts of urbanization.

The overall value of benefits the four tree species provide to Miami Beach ranges from \$17.80 to \$87.46 per year according to i-Tree MyTree. A description of each of these benefits is outlined in the following sections.

Benefits*	Silver Buttonwood	Crapemyrtle	Royal Poinciana	Live Oak
	<i>(Conocarpus erectus var. sericeus)</i>	<i>(Lagerstroemia indica)</i>	<i>(Delonix regiai)</i>	<i>(Quercus virginiana)</i>
Diameter (DBH)	4"	8"	16"	20"
Carbon Dioxide (CO2) Sequestered (Absorbed)	72 pounds/year	179 pounds/year	124 pounds/year	983 pounds/year
Rainfall Intercepted	125 gallons/year	547 gallons/year	2,211 gallons/year	3,394 gallons/year
Ozone removed from air	0.9 ounces/year	3.5 ounces/year	14 ounces/year	25 ounces/year
Carbon dioxide stored	111 pounds over lifetime	589 pounds over lifetime	3,493 pounds over lifetime	5,877 pounds over lifetime
Energy Savings (A/C)	30 kWh	26 kWh	92 kWh	113 kWh
Energy Savings Value	\$5.23	\$3.89	\$16.25	\$18.96
Annual Value of Benefits	\$8.43	\$10.43	\$29.01	\$55.54
*Based on an analysis utilizing the USDA Forest Service’s i-Tree MyTree benefits tool (www.itreetools.org)				

STORMWATER AND WATER QUALITY

During storm events trees intercept rainfall in their canopy acting as a mini reservoir⁸. Intercepted rainfall evaporates from leaf surfaces or slowly soaks into the ground, reducing and slowing stormwater runoff, and lessening the impacts of rainfall on barren soils. While underground, tree root growth and decomposition increases water holding capacity and infiltration rates of soils allowing for greater absorption of rain⁹. Each of these processes greatly reduces the flow and volume of stormwater runoff, reducing flooding and erosion and preventing sediments and pollutants from entering waterways. Infiltrating and treating stormwater runoff on site can reduce runoff and pollutant loads by 20 to 60 percent¹⁰.

Planting trees in and adjacent to rights-of-way provides a unique opportunity to increase the effectiveness of gray and green stormwater systems. Existing stormwater management systems are not always adequate to accommodate runoff; when a system is overtaxed, peak flows can blow manhole covers off the ground, back up stormwater and cause flooding. Where existing systems are challenged by common stormwater events, planting additional trees is a cost-effective solution to improve functional capacity. To reduce pressure on existing systems and increase capacity, Miami Beach should consider using trees, to help manage stormwater. A royal poinciana (16” diameter at breast height (DBH)) growing along a residential street in Miami Beach can intercept an estimated 2,211 gallons of rainfall each year, reducing the amount entering the stormwater system and ultimately the Biscayne Bay.

Benefits*	Silver Buttonwood	Crapemyrtle	Royal Poinciana	Live Oak
	<i>(Conocarpus erectus var. sericeus)</i>	<i>(Lagerstroemia indica)</i>	<i>(Delonix regiai)</i>	<i>(Quercus virginiana)</i>
Diameter (DBH)	4"	8"	18"	20"
Rainfall Intercepted	125 gallons/year	547 gallons/year	2,221 gallons/year	3,394 gallons/year
*Based on an analysis utilizing the USDA Forest Service’s i-Tree MyTree benefits tool (www.itreetools.org)				

CARBON SEQUESTRATION AND STORAGE

As sunlight strikes the Earth’s surface, it is reflected back into space as infrared radiation (heat). Greenhouse gases (GHG) absorb some of this infrared radiation and trap this heat in the atmosphere, increasing the temperature of the Earth’s surface. Many chemical compounds in the Earth’s atmosphere act as GHGs, including methane (CH4), nitrous oxide (N2O), carbon dioxide (CO2), water vapor, and human-made gases/aerosols. As GHGs increase, the amount of energy radiated back into space is reduced, and more heat is trapped in the atmosphere. An increase in the average temperature of the earth may result in changes in weather, sea levels, and land-use patterns, commonly referred to as climate change. In the last 150 years, since large-scale industrialization began, the levels of some GHGs, including CO2, have increased by 25%¹¹. Trees absorb atmospheric carbon and reduce GHGs. The carbon-related function of trees is measured in two ways: storage

(total stored in tree biomass) and sequestration (the rate of carbon absorbed per year). Urban trees act as a sink of CO2 by storing excess carbon as biomass (e.g. trunk, branches, leaves, roots) during photosynthesis. The amount of CO2 stored is proportional to the biomass of the tree¹².

Benefits*	Silver Buttonwood	Crapemyrtle	Royal Poinciana	Live Oak
	<i>(Conocarpus erectus var. sericeus)</i>	<i>(Lagerstroemia indica)</i>	<i>(Delonix regiai)</i>	<i>(Quercus virginiana)</i>
Diameter (DBH)	6"	8"	16"	20"
Carbon Dioxide (CO2) Sequestered (Absorbed)	73 pounds/year	179 pounds/year	124 pounds/year	983 pounds/year
Carbon dioxide stored	111 pounds over lifetime	590 pounds over lifetime	3,493 pounds over lifetime	5,877 pounds over lifetime
*Based on an analysis utilizing the USDA Forest Service’s i-Tree MyTree benefits tool (www.itreetools.org)				

Urban trees reduce atmospheric carbon dioxide (CO2) in two ways:

1. Directly – Through growth and the sequestration of CO2 as wood and foliar biomass.
2. Indirectly – By lowering the demand for heating and air conditioning, thereby reducing the emissions associated with electric power generation and natural gas consumption.

In Miami Beach, a royal poinciana (16” DBH) growing along a residential street can absorb (sequester) 209 pounds of atmospheric CO2 per year and over its lifetime store 5,368 pounds, reducing the amount returning to the atmosphere as a GHG.

The City of Miami Beach is working on establishing targets to reduce GHG emissions; tree planting and preservation should be considered a strategy to help in achieving those targets.

URBAN HEAT ISLAND AND ENERGY

An urban heat island occurs, when impervious surfaces, like roads, buildings and sidewalks, in a city trap and retain heat causing air temperatures to be hotter than nearby areas that are less built up. According to the Environmental Protection Agency (EPA), a city with extensive areas of impervious surfaces can be 1-3 degrees Fahrenheit warmer than surrounding areas during the day, and up to 22 degrees Fahrenheit warmer at night¹³. With over 61% of the land area covered by impervious surfaces in Miami Beach, urban heat island impacts can be significant and may include:

- respiratory difficulties (e.g. asthma), heat stroke, and heat-related mortality. According to the Center of Disease Control and Prevention heat related illnesses across the United States caused more deaths from 1979-2003 than hurricanes, lightning, tornadoes, floods and earthquakes combined¹⁴.
- increased energy consumption needed for cooling homes and businesses, resulting in higher energy bills;
- elevated air pollution and greenhouse gases from plants supplying power to meet the increased energy demands
- increased ground level ozone created by chemical reactions of atmospheric gases and compounds with sunlight and heat.

Shade from trees reduces the amount of radiant energy absorbed and stored by impervious surfaces, while transpiration releases water vapor from tree canopies cooling the surrounding area. Through shade and transpiration, trees and other vegetation within an urban setting modify the environment and reduce heat island effects.

A royal poinciana (16” DBH) saves approximately 421 Kilowatt hours (kWh) of electricity that would otherwise be used for air conditioning, representing a savings of over \$50 per year.

Benefits*	Silver Buttonwood	Crapemyrtle	Royal Poinciana	Live Oak
	<i>(Conocarpus erectus var. sericeus)</i>	<i>(Lagerstroemia indica)</i>	<i>(Delonix regiai)</i>	<i>(Quercus virginiana)</i>
Diameter (DBH)	4"	8"	16"	20"
Energy Savings (A/C)	30 kWh	26 kWh	92 kWh	113 kWh
Energy Savings Value	\$5.23	\$3.89	\$16.25	\$18.96
*Based on an analysis utilizing the USDA Forest Service’s i-Tree MyTree benefits tool (www.itreetools.org)				

AIR QUALITY

Ozone (O3) is naturally found in the upper atmosphere where it protects Earth from the sun’s ultraviolet radiation. While it is beneficial in the upper atmosphere, at ground level O3 is an air pollutant that causes serious harm to human health. Ground level O3 is formed by a chemical reaction between nitrogen oxides (NOx), volatile organic compounds (VOCs) and sunlight; add heat and O3 formation is exacerbated. VOCs are a class of carbon-based particles emitted from automobile exhaust, lawnmowers, and other human activities. The 2019 American Lung Association State of Air report gave Miami-Dade County a “C” grade for ozone and noted there were 5 days where ozone levels were “unhealthy for sensitive populations.”¹⁵

Trees serve an important function in improving air quality, reducing air pollutants and helping ameliorate the public health effects of air pollution. Trees intercept and filter particulate matter (PM10) from the air, including dust, ash, pollen, and smoke. They absorb harmful gaseous pollutants like ozone (O3), nitrogen dioxide (NO2), and sulfur dioxide (SO2); and reduce O3 formation by shading surfaces and reducing air temperatures. Scientists have also found that some tree species may absorb more volatile organic compounds (VOCs) than previously known¹⁶.

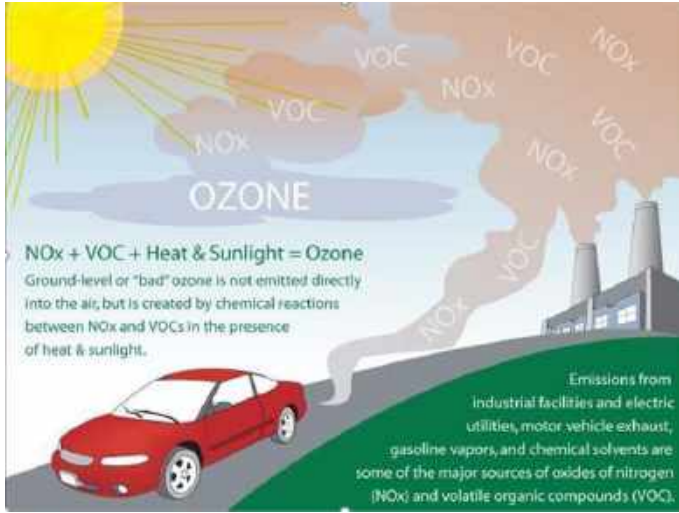
A royal poinciana (16” DBH) in Miami Beach can remove nearly 1 pound of ozone from the air each year.

Benefits*	Silver Buttonwood	Crapemyrtle	Royal Poinciana	Live Oak
	(<i>Conocarpus erectus</i> var. <i>sericeus</i>)	(<i>Lagerstroemia indica</i>)	(<i>Delonix regia</i>)	(<i>Quercus virginiana</i>)
Diameter (DBH)	4"	8"	16"	20"
Ozone removed from air	0.9 ounces/year	3.5 ounces/year	14 ounces/year	25 ounces/year
*Based on an analysis utilizing the USDA Forest Service’s i-Tree MyTree benefits tool (www.itreetools.org)				

BENEFITS TO WILDLIFE

Trees provide critical habit for birds, mammals, reptiles, insects, fish and other aquatic species. Their flowers offer pollinators, like honeybees, a valuable source of pollen and nectar; and their canopies provide food and shelter to a variety of wildlife.

Many threatened or endangered species are endemic to south Florida and require the specialized habitat the region provides. Several of these threatened and endangered species could potentially inhabit Miami Beach’s urban forest, including, the Miami tiger beetle (*Cicindelidia floridana*), the red-cockaded woodpecker (*Picoides borealis*), Florida bonneted bat (*Eumops floridanus*) and the Florida scrub-jay (*Aphelocoma coerulescens*). The Miami tiger beetle and red-cockaded woodpecker prefer slash pine and longleaf pine, respectively; the City should look for opportunities to plant these tree species in parks and open



SOURCE: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



Florida scrub-jay (Aphelocoma coerulescens)
Photo Credit: Florida Fish and Wildlife Conservation Commission

spaces to attract these species. The Florida bonneted bat roosts in crevices and tree cavities and may be present in Miami Beach. Regularly planting live oak trees and maintaining the availability of short young oak trees in the urban forest could potentially provide habitat for the threatened Florida scrub-jay.

Miami Beach is along migration routes of several temperate songbird species that use the city’s trees for shelter and food during their migration. The city has also become home to several birds native to South America, including the chestnut-fronted macaw, the scaly-headed parrot, and several species of parakeet. These South American bird species were imported to Miami Beach as pets and have either escaped or were released into the wild. The ecological impacts of these species have not been determined, but as with other non-native inhabitants, there is a risk that these birds, which use tree cavities as nests, may out-compete native species for this habitat.

AESTHETIC AND SOCIAL BENEFITS

The aesthetic and social benefits of trees, while perhaps the most difficult to measure, may provide some of the greatest community contributions.

These contributions include:

- beautifying the community
- increasing shade, privacy and creating a sense of place
- providing opportunities for recreation and increasing walkability
- improving mental and physical health
- reducing violence
- increasing property values.

While some tree benefits and services are intangible and/or difficult to quantify (e.g. impacts on physical/psychological health, crime and violence), studies have provided empirical evidence of their benefits to residents and the community.^{17,18,19,20}

Research has shown:

- trees promote business by stimulating more frequent and extended shopping, and a willingness to pay more for goods and even parking²¹.
- that a well-landscaped residential yard can increase property values by as much as 10%;
- a well-maintained street tree can add 3-15% in value to a home and continue to appreciate in value over time⁴. In Miami Beach a well-maintained street tree can increase a home’s value by more than \$35,000!*



*Based on the median home value in Miami Beach of \$443,4000 (US Census 2014-18) and an 8% increase in home value

SCOPE AND PURPOSE

The purpose of the City of Miami Beach’s Urban Forestry Master Plan (UFMP/Plan) is to maximize the benefits trees provide to the city by creating a sustainable and strategic framework to guide the management, maintenance, growth and preservation of the urban forest through the lens of climate adaptation and resilience. It focuses on building a resilient tree canopy that mitigates the impacts of climate change by prioritizing shade trees, selecting salt tolerant species, and setting neighborhood tree canopy cover goals based on available planting locations and innovative technologies.

The UFMP aims to:

- illustrate the value and climate mitigation benefits of Miami Beach’s trees and urban forest.
- create a shared vision for the future of Miami Beach’s urban forest to inspire the community in the care, planting and protection of shade trees.
- provide guidance to improve tree species selection and planting through the utilization of the Urban Canopy Toolbox.
- ensure climate change, sea level rise and impacts of saltwater intrusion are considered in urban forest care, planting and maintenance activities.
- enhance the health, sustainability, and resilience of the urban forest.
- maximize the benefits that the urban forest provides to the community, residents, visitors and the greater region by prioritizing the planting of shade trees.
- promote community, stakeholder and regional engagement, involvement, and appreciation of the urban forest.
- establish benchmarks and metrics to monitor the success of Plan implementation.

The UFMP provides goals, targets, recommendations and actions to promote climate resilience, species diversity, sustainable canopy cover, and community outreach and engagement. They apply not only to public trees but also to those growing on private property, in recognition of the important contributions private trees make to the sustainability of Miami Beach’s urban forest, and the overall resilience of the community.

The UFMP is designed to be flexible and dynamic allowing for implementation based on the needs of the urban forest, changing city priorities, future climate adaptation efforts, and available funding and resources.

PLANNING PROCESS

The development, organization and structure of the Miami Beach’s UFMP is based on an understanding of what we have, what we want, how we get there, and how are we doing. This structure, termed “adaptive management,” is commonly used for resource planning and management²² and provides a useful conceptual framework for managing a community’s urban forest resource.

During the planning process the Indicators of a Sustainable Urban Forest^{23,24}, were utilized to look beyond tree data and analysis (“The Trees”) to also understand how the urban forest is managed (“The Management”) and the network of stakeholders that influence and impact it (“The Players”).

Each component, “The Trees”, “The Players”, and “The Management” has a set of Indicators that were assessed to determine the current sustainability of Miami Beach’s urban forest and urban forestry program. City staff and the City’s UFMP consultants, Davey Resource Group, Inc. (DRG) and Calvin Giordano and Associates (CGA), assessed the city’s current level of performance on each Indicator and coupled with analysis of the tree inventory data and urban tree canopy assessment created a picture of the current state of Miami Beach’s urban forest. The set of Indicators used during the assessment were customized to meet the needs of the City of Miami Beach.

Indicators of a Sustainable Urban Forest		Assessed Performance Level		
		Low	Medium	High
The Trees	Urban Tree Canopy			
	Equitable Distribution			
	Size/Age Distribution			
	Condition of Public Trees - Streets, Parks			
	Condition of Public Trees - North Beach Oceanside Park			
	Trees on Private Property			
	Species Diversity			
	Suitability			
	Soil Volume			
The Players	Neighborhood Action			
	Large Private/Institutional Landholder Engagement			
	Green Industry Involvement			
	City Commission and Committee Engagement			
	City Department/Agency Cooperation			
	Funder Engagement			
	Utility Engagement			
	Developer Engagement			
	Public Awareness			
The Mgmt Approach	Regional Collaboration			
	Tree Inventory			
	Canopy Assessment			
	Management Plan			
	Risk Management Program			
	Maintenance of Publicly-Owned Trees (ROWS)			
	Planting Program			
	Tree Protection Policy			
	City Staffing and Equipment			
	Funding			
	Disaster Preparedness & Response			
	Communications			

FIGURE A: INDICATORS OF A SUSTAINABLE URBAN FOREST





**WHAT DO WE
HAVE?**



WHAT DO WE HAVE?

LOCATION AND CLIMATE

Miami Beach is a barrier island located in Miami-Dade County in southeastern Florida. The city measures approximately 7 square miles and is a mixture of natural and man-made islands that separate the Biscayne Bay to the west and the Atlantic Ocean to the east.

Miami Beach sits on a porous bedrock foundation known as the Miami Limestone, which can be found at or near the soil surface. Soils within the city are classified as urban land by the USDA Natural Resource Conservation Service. These soils are human made having been modified during development and lacking the structure, profile,

and physical properties of native soils. The lack of a native soil structure, and the location and porous nature of the Miami Limestone bedrock influences the species composition of trees within the city.

The climate is considered subtropical, receiving over 50 inches of rain on average each year. It is characterized as having warm, wet summers and mild, dry winters. The average high temperature in August is 89 degrees Fahrenheit; and the average low temperature in January is 74 degrees Fahrenheit²⁵.

AERIAL VIEW OF MIAMI BEACH, CIRCA 1920.
SOURCE: CITY OF MIAMI BEACH





IMPACTS OF CLIMATE CHANGE

The Southeast Florida Climate Change Compact updated their regional sea level rise projects in 2019 based on data from the National Oceanic and Atmospheric Administration, the US Army Corp of Engineers and the Intergovernmental Panel on Climate Change. Sea levels are estimated to increase²⁶:

- 8-12 inches by 2030
- 17-31 inches by 2060
- 33-74 inches by 2100

Flooding and sea level rise impacts are not only caused by the overland flow of water. Groundwater easily moves through the porous Miami Limestone bedrock that lies beneath the city allowing salty groundwater to migrate to the surface, causing flooding and damage to trees and other vegetation.

Increasing temperatures and their effect on the urban heat island is another climate change impact that is putting Miami Beach at risk. According to the National Weather Service, 2015 and 2017 tied for the hottest year on record in Miami; and globally, July 2019 was the hottest month on record, according to the European Union’s Copernicus Climate Change Service.

The Urban Land Institute completed a Stormwater Management and Climate Adaptation Review of Miami Beach in 2018 that included resilience strategy recommendations to address flooding and other issues. The recommendation identified the important role that trees can play in mitigating stormwater runoff and reducing flooding in Miami Beach.

The City of Miami Beach is a partner in the Greater Miami & The Beaches collaboration with Miami-Dade County and the City of Miami. The partnership has developed the Resilient305 Strategy which provides actions and strategies to combat regional resilience challenges identified in the region. Tree planting has been identified in several plan actions as a strategy to mitigate the effects of climate change and build a more resilient region.

THE URBAN FOREST RESOURCE

Miami Beach’s urban forest is made up of all of the trees, palms, and woody vegetation growing along streets, swales, in public parks and on private property. A subset of the overall urban forest is the community tree resource, which is comprised of the publicly owned trees on city rights-of-way, in parks and on other City-owned properties.

To gain a comprehensive understanding of the urban forest and its role mitigating stormwater runoff, the City of Miami Beach partnered with the Green Infrastructure Center (GIC) to conduct an urban tree canopy (UTC) assessment. The assessment, completed in 2018, evaluated 2017 aerial imagery from the National Agriculture Imagery Program (NAIP) to measure the extent of tree canopy and other landcover across the city. Tree canopy is measured as the layer of leaves, branches and stems of trees and other woody plants that cover the ground when viewed from above. The amount and distribution of leaf surface area is the driving force behind an urban forest’s ability to produce benefits to the community²⁷; as canopy increases, so do the benefits. Understanding the location and extent of tree canopy is important to developing and implementing sound management strategies.

The results of the UTC provide a clear picture of the extent and distribution of tree canopy within Miami Beach. The data enhances the City’s GIS database and provides opportunities to analyze the tree canopy in conjunction with other geographic, demographic, and socio-economic data layers. Analysis can be performed on a variety of scales from the whole city down to the individual parcel level. This information provides a foundation for making informed decisions about management and policies affecting Miami Beach and the urban forest by:

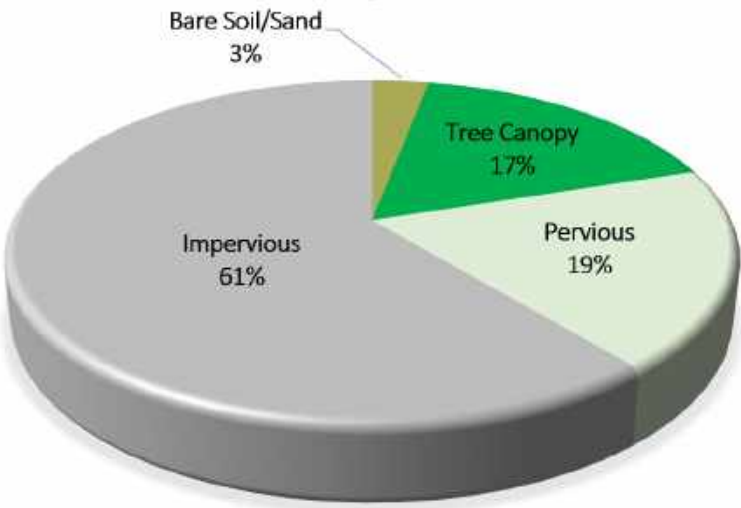
- benchmarking the location and extent of tree canopy along with other primary land cover.
- assessing canopy and landcover changes over time.
- identifying and prioritizing potential planting sites based on City climate adaptation strategies.
- detecting opportunities to enhance trails and sidewalks with contiguous tree canopy.

The data, combined with existing best management practices, emerging research and climate adaptation/mitigation strategies can help Miami Beach identify and assess urban forest opportunities and find a balance between growth and preservation.

URBAN TREE CANOPY AND LAND COVER SUMMARY

The City of Miami Beach’s land area (excluding water) measures approximately 7 square miles (~4,934 acres). Davey Resource Group, Inc. (DRG) conducted an analysis of the urban tree canopy assessment and land cover data developed by the GIC; the following information characterizes existing tree canopy land cover in Miami Beach:

- 17% (795 acres) of existing canopy coverage, including trees and woody shrubs
- 61% impervious surfaces, including roads, parking lots, and structures (3,013 acres)
- 19% pervious surfaces, including grass and bare soil
- 3% of the land area is covered in sand.
- A potential of 26.2% canopy cover is possible if all possible planting areas (38,617 sites) on public and private property are considered suitable for planting.
- 79% (620 acres) of tree canopy cover is on private residential property
- The average tree canopy in parks is 28%
- Miami Beach’s tree canopy provides a cumulative annual value of \$847,252 or \$9.24 per capita by providing the following ecosystem benefits to the community²⁸



ENVIRONMENTAL SERVICES

To determine the ecosystem benefits and services that the urban forest provides to the Miami Beach community, an i-Tree Canopy and i-Tree Hydro analysis were conducted utilizing the city’s urban tree canopy data. i-Tree Canopy and i-Tree Hydro are components of the USDA Forest Service’s i-Tree suite of tools that quantifies the benefits and services trees provide to a community. i-Tree Canopy analysis utilizes tree canopy data to measure the benefits that trees provide; while i-Tree Hydro utilizes land cover data to model the effects that changes in tree canopy and impervious surface have on local hydrology. Based on current tree canopy cover, Miami Beach’s trees provide a cumulative, annual monetary value of \$847,252 or \$9.24 per capita by providing the following ecosystem benefits to the community:

- **Carbon.** Sequestering over 7,797 tons of carbon and reducing the amount returning to the atmosphere as a greenhouse gas. **Resource Value: \$361,370.**
- **Stormwater.** Intercepting and absorbing 42 million gallons of stormwater and reducing the amount entering the city’s storm sewer system. **Annual value: \$427,141.**
- **Air Pollution.** Removing 99,000 pounds of ozone, 8,440 pounds of nitrogen dioxide, 7 pounds of sulfur dioxide, and 3,380 pounds of carbon monoxide from the atmosphere, helping to reduce atmospheric warming, and improving air quality, and public health effects from air pollution. **Annual Value: \$39,507.**
- **Air Quality.** Trapping and removing nearly 47,000 pounds of particulate matter from the air and improving air quality and public health. **Annual value: \$19,234.**

See Appendix A for the methodology used to calculate tree benefits.



Tree Canopy by Storm Basin Miami Beach, FL

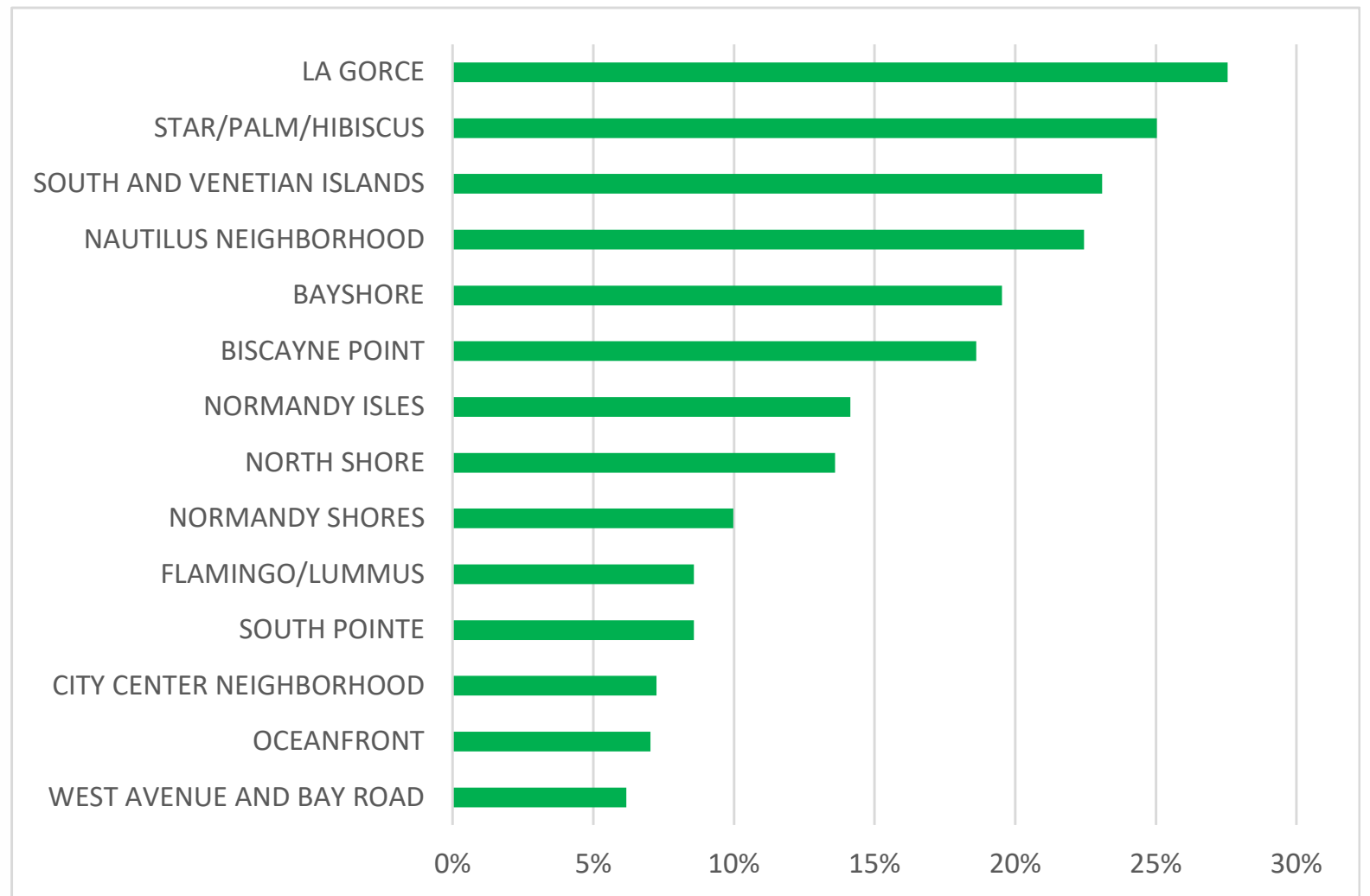


TREE CANOPY BY STORM BASIN

An analysis was conducted to measure tree canopy cover by storm basin (see Tree Canopy by Storm Basin Map). This information can be used to identify areas of the city where stormwater management systems may be overtaxed or challenged by normal storm events. By comparing these areas with canopy cover, tree planting opportunities can be identified that can help reduce pressure on these existing stormwater systems and increase the ability to manage stormwater in the area.

TREE CANOPY COVER COMPARISON

Miami Beach's canopy cover is considerably lower than other cities in Florida and Georgia with Tallahassee, Florida having nearly 3.5 times the amount of canopy cover as Miami Beach. An urban tree canopy assessment completed in 2016 by the University of Florida and Florida International University found that canopy cover in Miami-Dade Urban Development Boundary was 19%²⁹. Understanding regional canopy cover canopy can provide greater context for urban forest planning in Miami Beach.



Tree Canopy by Neighborhood Miami Beach, FL

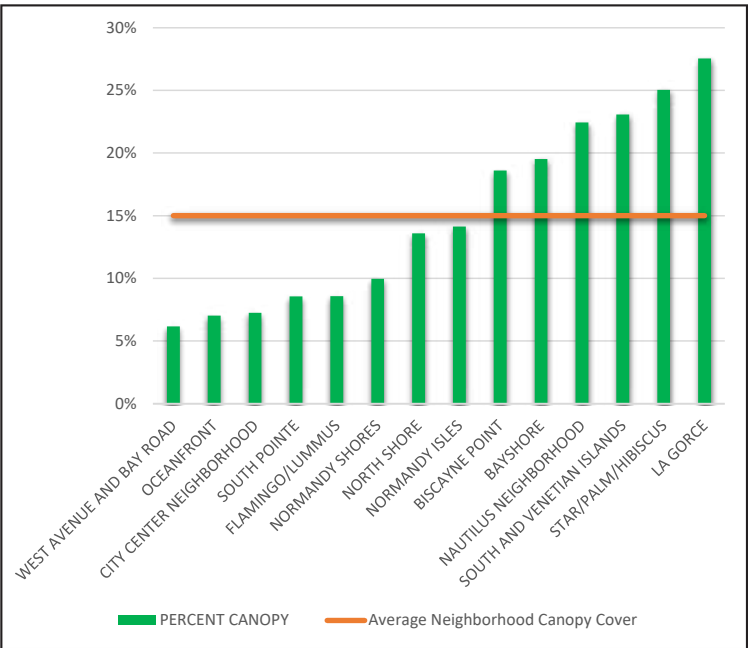


URBAN TREE CANOPY BY NEIGHBORHOOD

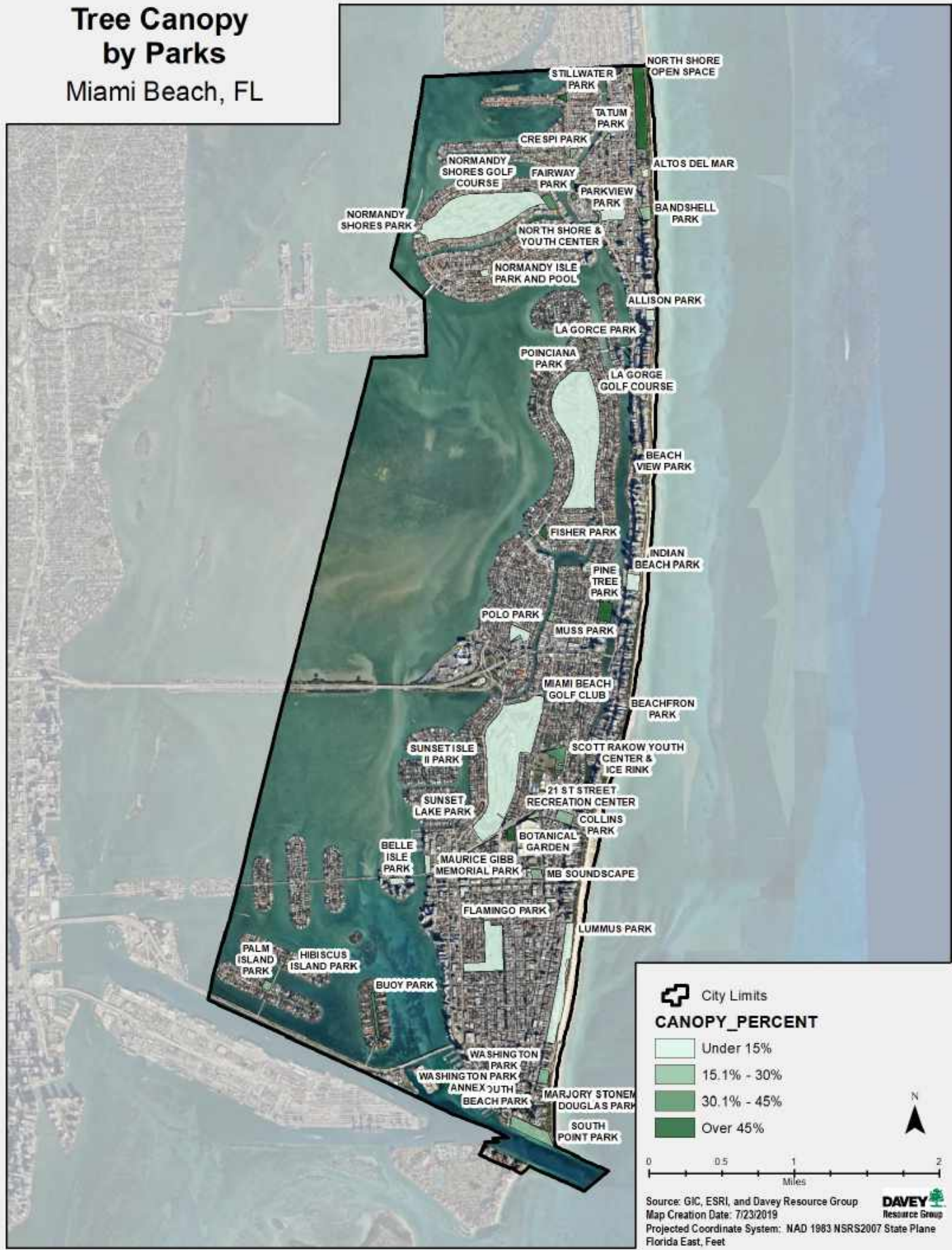
Across the city, single and multi-family residential land uses make up the largest land use category covering approximately 62% of the land. With 78% of all the urban tree canopy on these lands, they are a critical component to maintaining and growing Miami Beach’s urban forest.

NEIGHBORHOOD	PERCENT CANOPY
WEST AVENUE AND BAY ROAD	6%
OCEANFRONT	7%
CITY CENTER NEIGHBORHOOD	7%
SOUTH POINTE	9%
FLAMINGO/LUMMUS	9%
NORMANDY SHORES	10%
NORTH SHORE	14%
NORMANDY ISLES	14%
BISCAYNE POINT	19%
BAYSHORE	20%
NAUTILUS NEIGHBORHOOD	22%
SOUTH AND VENETIAN ISLANDS	23%
STAR/PALM/HIBISCUS	25%
LA GORCE	28%

While canopy cover is highest in residential areas, the amount of canopy cover in each neighborhood is not equal. An analysis of tree canopy by neighborhood found tree canopy cover ranges from 6% to 28% with an average canopy cover of 15%.



Tree Canopy by Parks Miami Beach, FL



TREE CANOPY IN PARKS, RECREATION FACILITIES, AND GOLF COURSES

Miami Beach has 43 public park, recreation facilities and golf courses that cover 563 acres. The average canopy cover of these areas is 28%. Poinciana Park has the highest overall tree cover (72%) followed by Washington Park Annex (70%), La Gorce Park (63%) and Pine Tree Park (63%). Beachfront Park and Normandy Isle Park and Pool had the lowest canopy cover both at 1%.

Miami Beach’s largest publicly owned park, recreation facility or golf course is Miami Beach Golf Course at 126 acres, with 10% canopy cover. The largest park is Lummus Park at 33 acres with 13% canopy cover. The City should explore opportunities to increase canopy cover on publicly owned parks, recreation facility grounds and golf courses by identifying land that is not programmed for activities and planting trees.

PARK OR RECREATION FACILITY	ACRES	CANOPY ACRES	CANOPY PERCENT
LA GORCE GOLF COURSE	129.48	17.17	13%
MIAMI BEACH GOLF CLUB	126.03	12.48	10%
NORMANDY SHORES GOLF COURSE	104.07	5.98	6%
LUMMUS PARK	32.86	4.29	13%
FLAMINGO PARK	32.65	4.57	14%
NORTH SHORE OPEN SPACE	27.92	16.57	59%
SOUTH POINT PARK	14.97	3.28	22%
NORTH SHORE & YOUTH CENTER	7.79	1.07	14%
SCOTT RAKOW YOUTH CENTER & ICE RINK	7.77	2.48	32%
PINE TREE PARK	6.96	4.35	63%
POLO PARK	6.79	0.93	14%
INDIAN BEACH PARK	6.41	0.56	9%
COLLINS PARK	5.67	1.38	24%
MARJORY STONEMAN DOUGLAS PARK	4.02	1.12	28%
BUOY PARK	3.93	1.32	34%
FAIRWAY PARK	3.83	1.22	32%
BANDSHELL PARK	3.72	0.74	20%
ALLISON PARK	3.10	0.43	14%
BELLE ISLE PARK	3.04	0.34	11%
MB SOUNDSCAPE	3.01	0.86	29%
MAURICE GIBB MEMORIAL PARK	2.89	0.34	12%
BOTANICAL GARDEN	2.80	1.62	58%
PALM ISLAND PARK	2.07	0.33	16%
FISHER PARK	1.71	0.81	48%
ALTOS DEL MAR	1.70	0.13	8%
NORMANDY ISLE PARK AND POOL	1.63	0.02	1%
STILLWATER PARK	1.49	0.76	51%
21 ST STREET RECREATION CENTER	1.47	0.25	17%
CRESPI PARK	1.42	0.32	22%
MUSS PARK	1.33	0.32	24%
NORMANDY SHORES PARK	1.15	0.12	11%
BEACH VIEW PARK	1.04	0.38	36%
TATUM PARK	0.93	0.23	24%
BEACHFRONT PARK	0.90	0.01	1%
SOUTH BEACH PARK	0.85	0.16	19%
PARKVIEW PARK	0.77	0.35	45%
SUNSET ISLE II PARK	0.73	0.22	30%
WASHINGTON PARK	0.33	0.14	43%
POINCIANA PARK	0.33	0.24	72%
HIBISCUS ISLAND PARK	0.29	0.11	40%
SUNSET LAKE PARK	0.28	0.08	30%
LA GORCE PARK	0.21	0.13	63%
WASHINGTON PARK ANNEX	0.18	0.13	70%

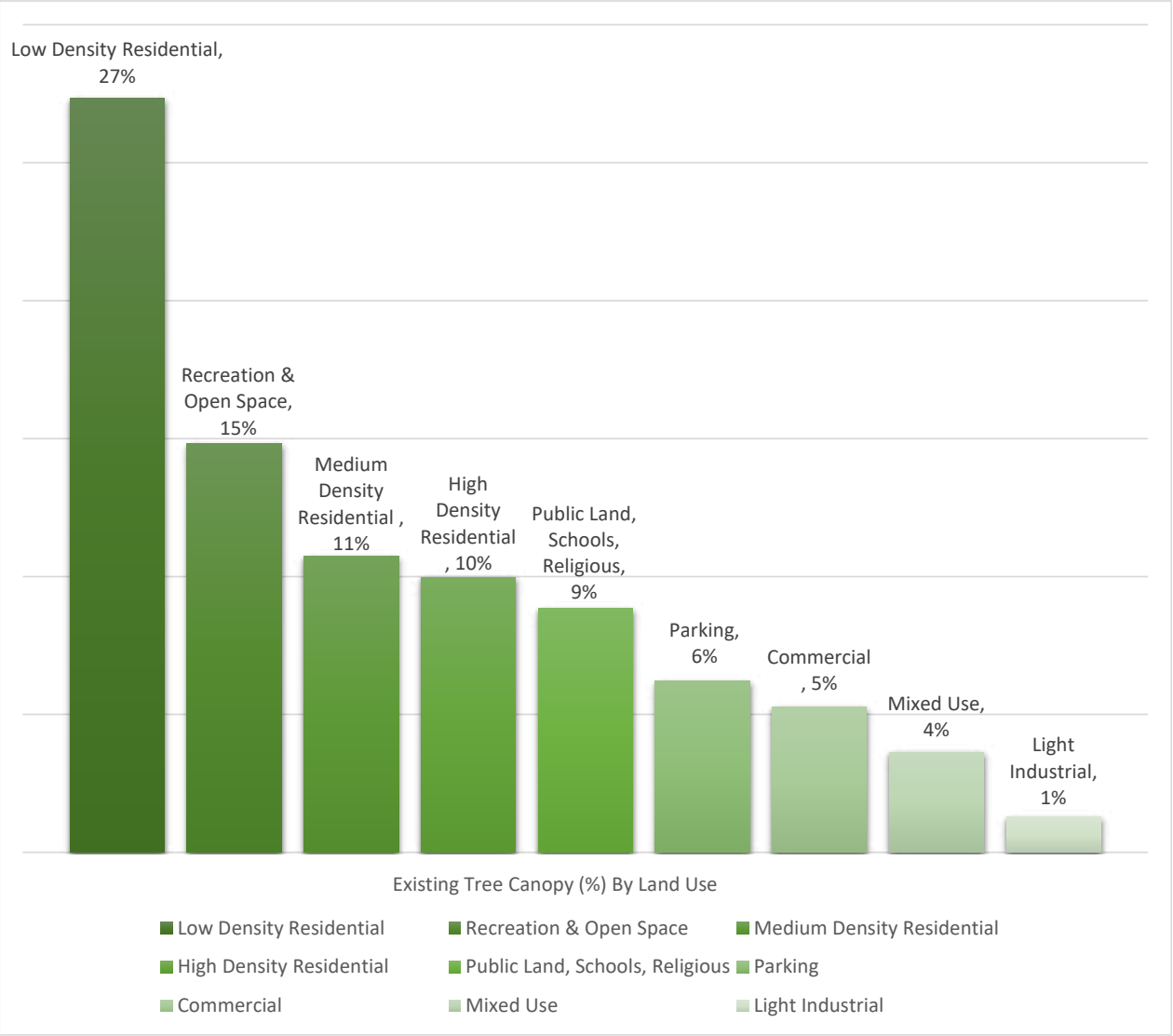


TREE CANOPY BY LAND USE

One way to explore urban tree canopy (and understand its potential) is to look at how it relates to land use and zoning. Zoning is the practice of mapping designated zones to regulate the use, form, design and compatibility of property development to manage and direct development. Tree canopy can vary widely between different zoning classification. The zoning classifications in Miami Beach include residential, recreation/open space, public/religious/schools, parking, commercial, mixed use and light industrial.

Residentially zoned parcels make up the largest proportion of the City’s area (3,067 acres, or 62%) and contain 78% of the city’s tree canopy cover. Light Industrial areas make up the smallest land use category (31 acres, or <1%) and have only 1% of the city’s canopy cover.

Land Use	Total Acres	Tree Canopy Acres	Percent of Total Canopy Cover
Residential (Low, Medium & High Density	3067	620	79%
Recreation/Open Space	741	110	14%
Public/Schools/Religious	249	22	3%
Parking	37	2	0.3%
Commercial	313	17	2%
Mixed Use	313	6	1%
Light Industrial	31	6	1%



HISTORICAL CANOPY CHANGE ANALYSIS

A historical change analysis was performed to compare the percentage of tree canopy and impervious surface between 1941, 1969 and 2017 in Miami Beach. The years for analysis were selected by the City of Miami Beach and were based, in part, on available aerial imagery.

Miami Beach’s tree canopy has fluctuated over time with a high of 20% in 1941 (highest year analyzed) and 14% in 1969 (lowest). While Miami Beach’s urban tree canopy is trending upward with a 3% increase in canopy between 1969 and 2017, the amount of impervious surfaces, like roads, buildings, and sidewalks more than doubled between 1941 (28%) and 2017 (61%). Impervious surfaces repel water and do not allow it to soak into the

ground, which leads to flooding during storm events and poor water quality in Biscayne Bay, the Atlantic Ocean, and local canals and waterways. These surfaces can also create an urban heat island by trapping and retaining heat and making Miami Beach’s day and nighttime temperatures hotter than surrounding communities.

Photos A and B, illustrate how changes in land use have increased impervious surfaces, impacted canopy cover and altered available space for trees, in two small areas in North Beach and South Beach.

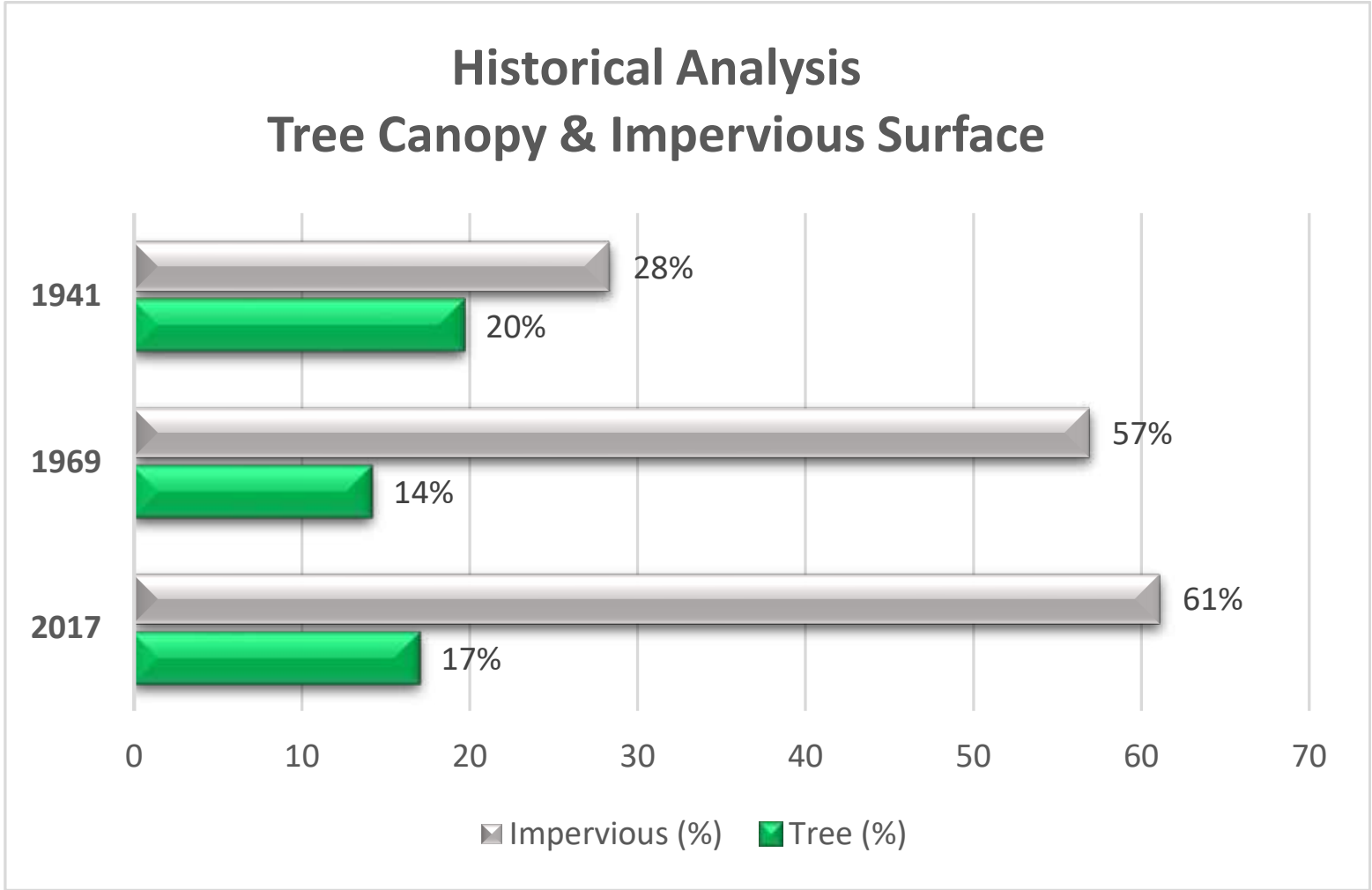


PHOTO A: AREA IN SOUTH BEACH



PHOTO B: AREA IN NORTH BEACH



URBAN HEAT ISLAND

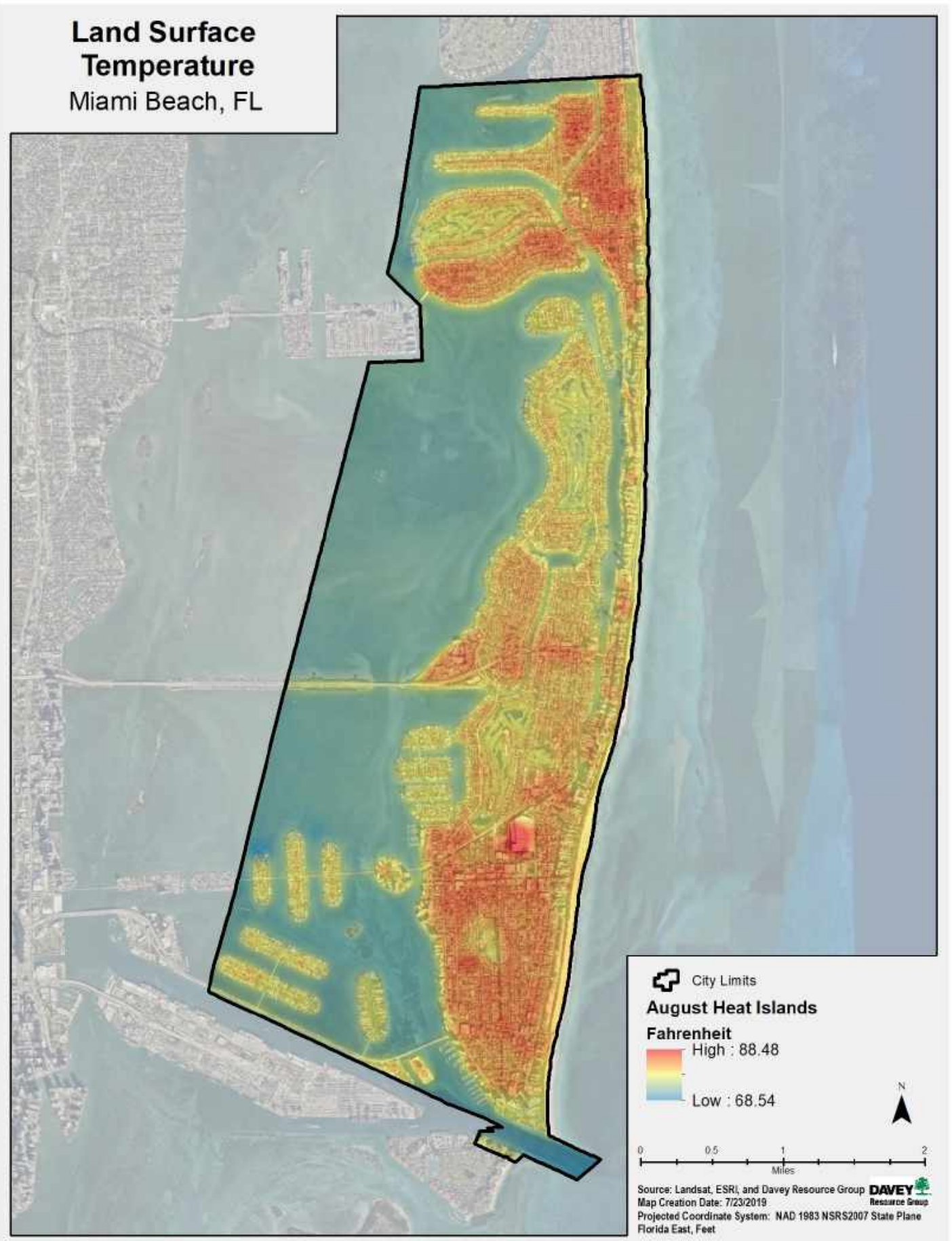
An urban heat island occurs, when impervious surfaces in a city, like roads, buildings and sidewalks, trap and retain heat causing air temperatures to be hotter than nearby areas that are less built up. According to the Environmental Protection Agency (EPA), urban areas with extensive areas of impervious surfaces can be 1-3 degrees Fahrenheit warmer than surrounding areas during the day, and up to 22 degrees Fahrenheit warmer at night³⁰.

To understand the effects that impervious surfaces and temperatures has on Miami Beach, an urban heat island analysis was conducted. The analysis modeled the surface temperature of Miami Beach during one of the city’s hottest months, August, identifying areas of the city where surface temperatures were highest and the urban heat island effects were the greatest. The Land Surface Temperature map (Figure C) represents temperature along a color gradient where areas in blue are coolest and those in red are hottest. While the city as a whole is experiencing warm temperatures

in August, areas in North Beach and South Beach, shown in red, are suffering the greatest urban heat island impacts, including:

- respiratory difficulties (e.g. asthma), heat stroke, and heat-related mortality. According to the Center of Disease Control and Prevention heat related illnesses across the United States caused more deaths from 1979-2003 than hurricanes, lightning, tornadoes, floods and earthquakes combined³¹.
- increased energy consumption needed for cooling homes and businesses, resulting in higher energy bills;
- elevated air pollution and greenhouse gases from plants supplying power to meet the increased energy demands

Focusing City efforts and outreach on tree planting and maintenance in areas most impacted by the effects of the urban heat island can help reduce the negative impacts caused by these elevated temperatures.

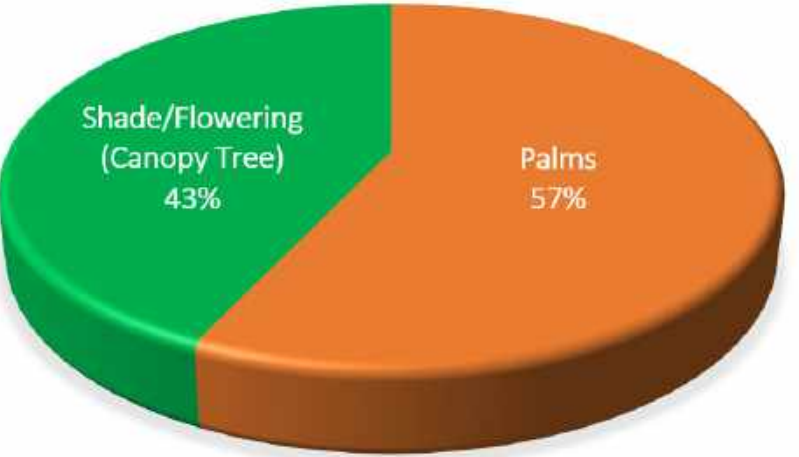
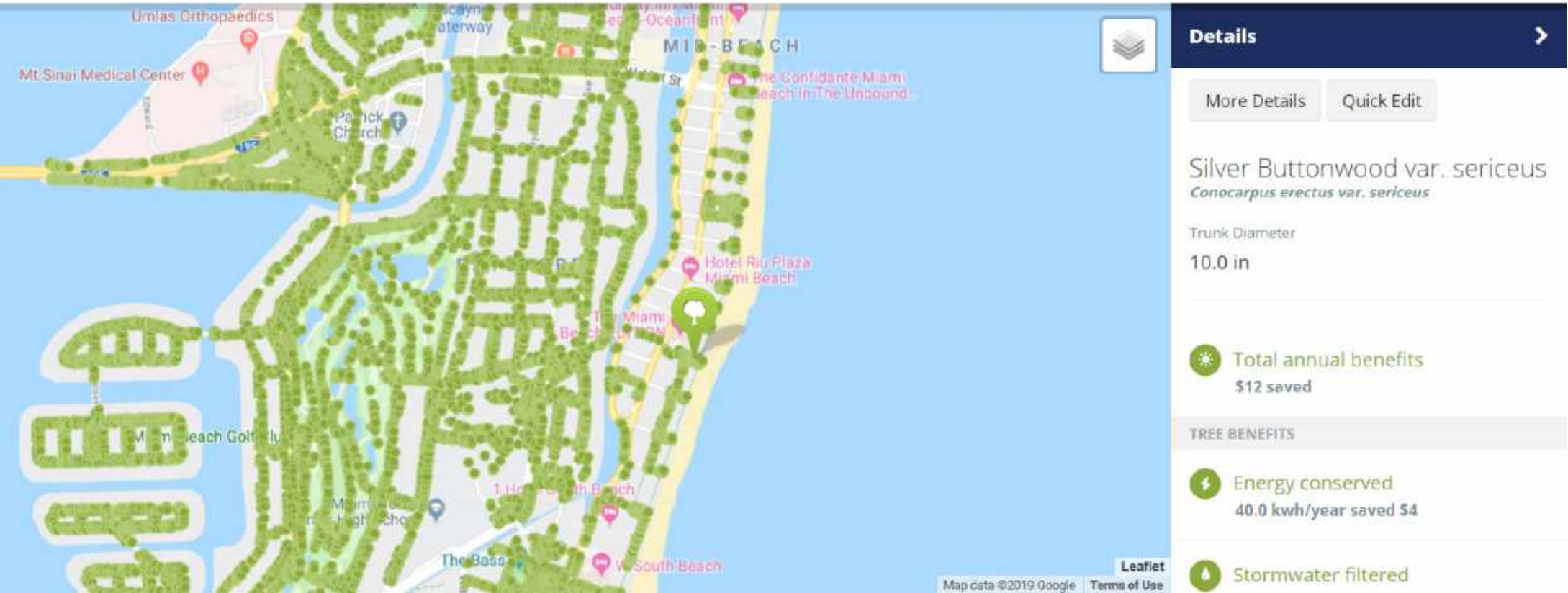


THE COMMUNITY URBAN FOREST RESOURCE (PUBLIC TREES)

The community urban forest is made up of public trees along rights-of-way/swales, in parks and city facilities. Since trees are relatively long-lived organisms, the community urban forest often develops into a combination of well-adapted, high performance species mixed with other species that over time have proven to be less desirable and require frequent care. As the urban forest evolves, managers must revise their objectives for individual tree species based on past performance and emerging prospects to make the most efficient use of City resources.

To better understand the composition of the city’s public tree resource, Miami Beach completed a public tree and palm tree inventory in 2017. The inventory gathered data on species, size, condition, and location of approximately 48,600 trees and palms growing along streets, in swales/medians, public parks and golf courses and other city properties. The inventory is updated on a 5-year cycle, where 1/5 of the street trees are updated each year.

The inventory data collected during the 2017 inventory provides a good basis for understanding the resource, however it lacks critical information on risk rating to aide in identifying hazards and prioritizing work; maintenance recommendations; and it does not include an inventory of North Beach Oceanside Park.



CITY OF MIAMI BEACH'S GIS-BASED STREET AND PARK TREE INVENTORY

SPECIES DIVERSITY

In general, public tree population diversity is measured using the 10-20-30 street tree diversity rule, where public tree populations are comprised of no more than:

- 30% of any family (e.g. *Fagaceae* – Beech family (Oak belongs to this family)
- 20% of any genus (e.g. *Quercus* – Oak)
- 10% of any species (e.g. *Quercus virginiana* – Live Oak)

Miami Beach’s urban forest is comprised of 302 unique species, including 212 species of shade/ornamental trees and 90 species of palms. While there is a large number of different species growing within the city, the number of shade/ornamental trees and palms are not evenly distributed among the 302 species. In fact, 5 species represent 44% of the total tree population – see orange box in Figure D.

To truly understand species diversity in Miami Beach, it is important to look at the composition of shade/ornamental (canopy) trees versus palms. Palms, while an iconic part of Miami Beach’s landscape, have moved from being an accent plant to a major component of the city’s urban forest. Arecaceae, the family of landscape palms, makes up over 55% of the public tree population, far exceeding the 30% guideline; and 3 of the 5 top species within the city are palms (coconut palm, cabbage palm and royal palm). Maps I and II detail the distribution of palm and shade/ornamental trees in the city. The large number of palms not only impacts the diversity of species in the city’s public tree population, making it vulnerable to diseases and pests; it also effects the quantity and type of benefits the urban forest can provide. As Table 3 demonstrates, a maturing live oak tree provides nearly 7 times the annual benefits that a maturing cabbage/sabal palm provides.

A large diversity of tree and palm species is critical to the resilience and sustainability of Miami Beach’s urban forest. The unique challenges that Miami Beach’s urban forest faces, including, rising groundwater (saltwater inundation), sea level rise, flooding, increasing temperatures, limited growing space for trees in the right-of-way, and pests (see Species Vulnerability) need to be considered when selecting species, to ensure that the right tree is planted in the right location to maximize its growth, longevity and benefits.

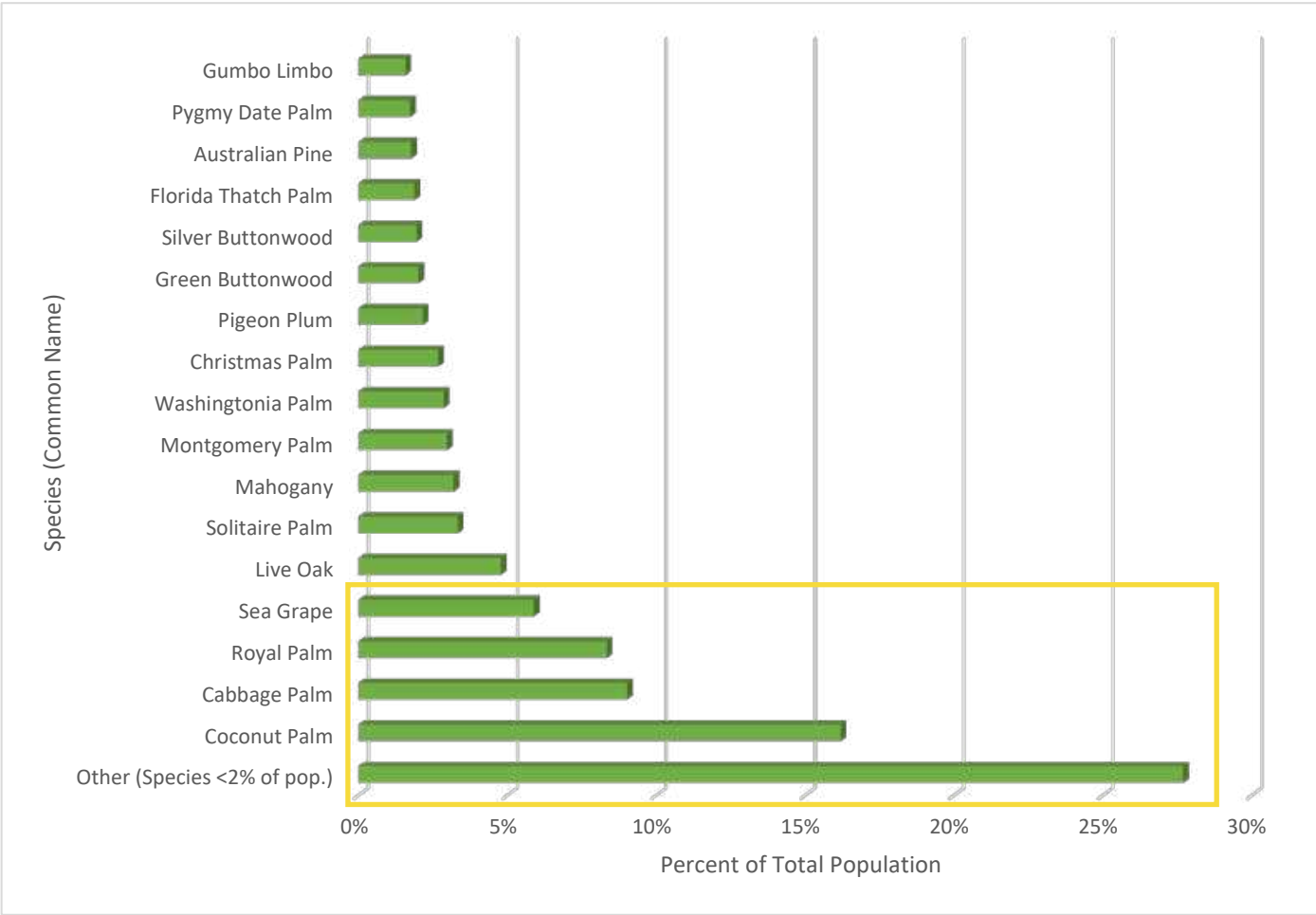
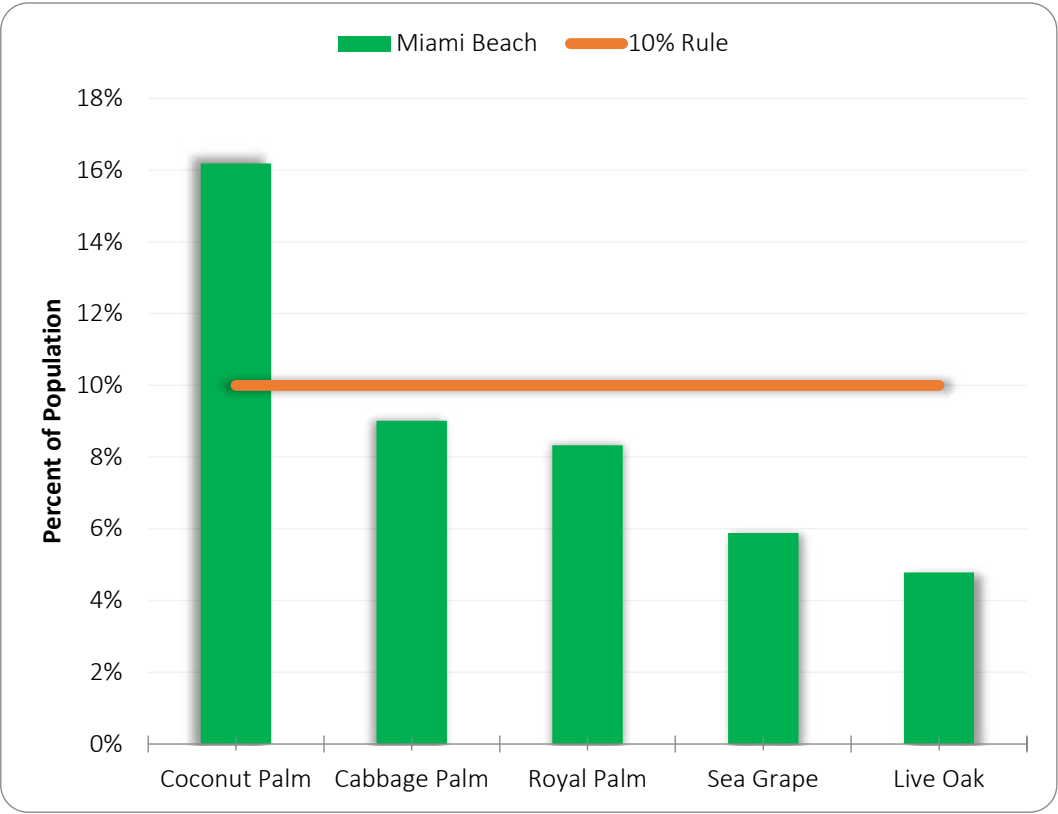
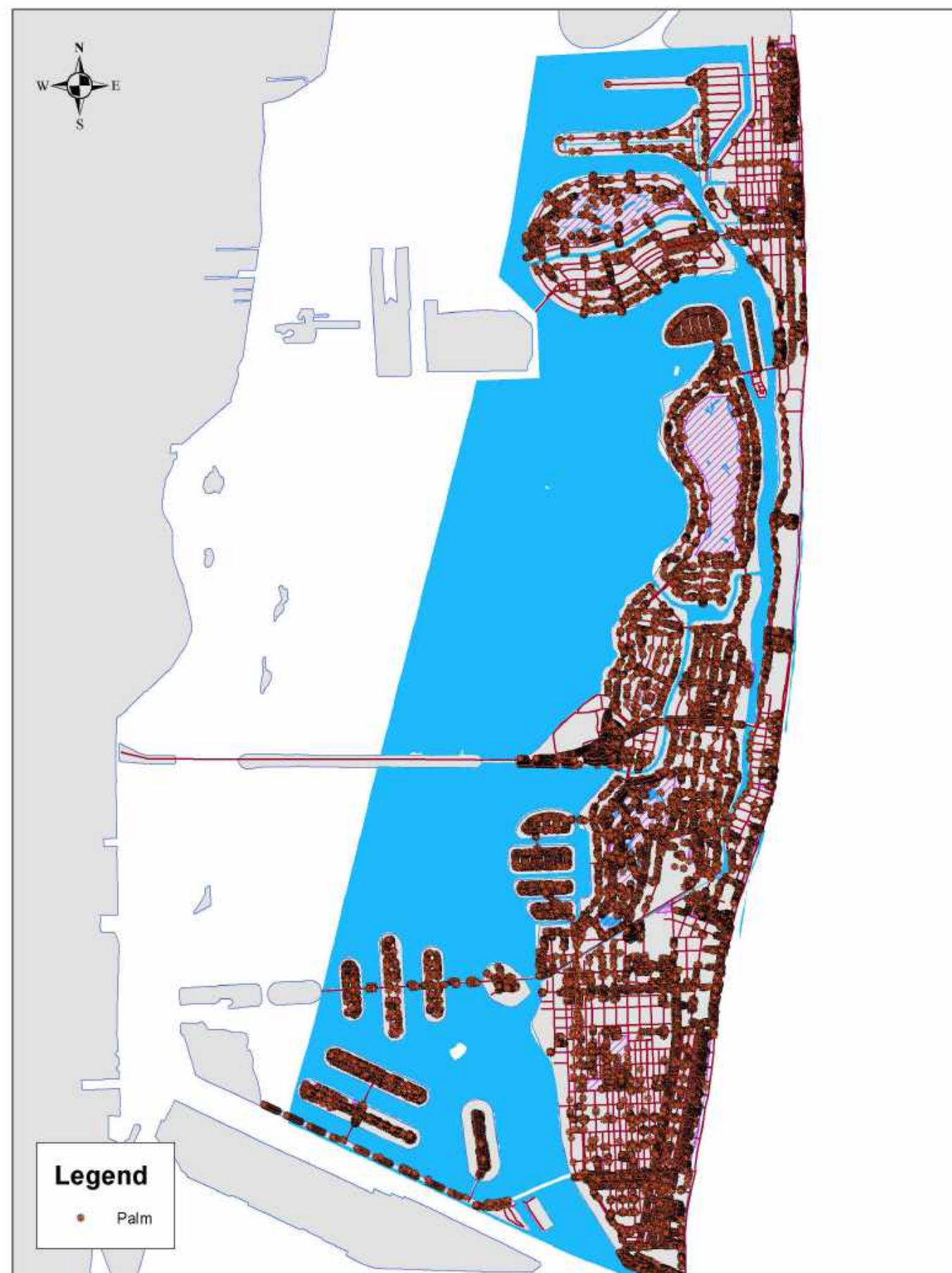


FIGURE D: SPECIES COMPOSITION OF MIAMI BEACH’S URBAN FOREST ALL PUBIC SHADE/ORNAMENTAL TREES AND PALMS

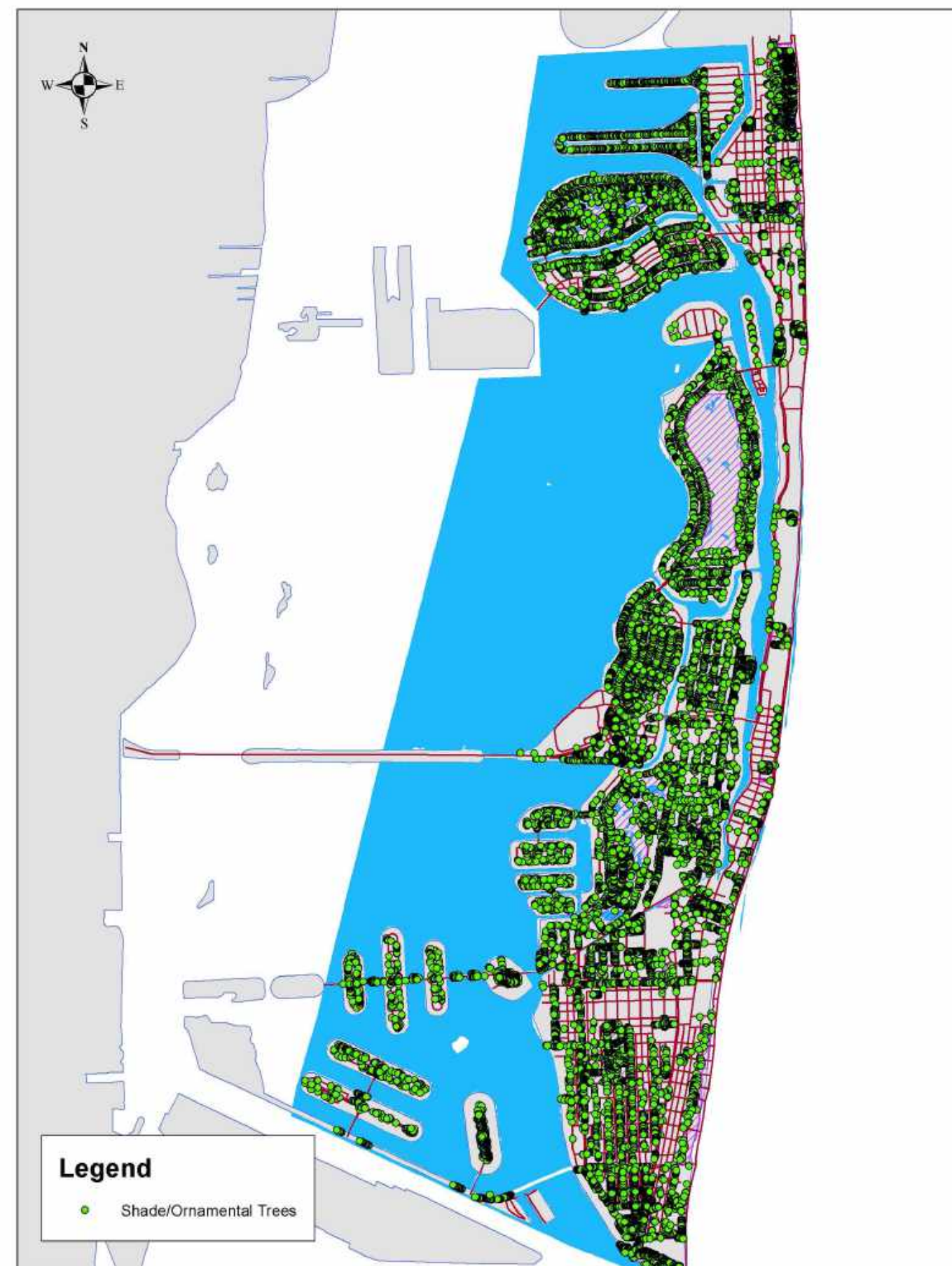
FIGURE E: TOP 5 MOST ABUNDANT TREE AND PALM SPECIES IN MIAMI BEACH MEASURED AGAINST THE 10% SPECIES DIVERSITY RULE. ALL PUBIC SHADE/ ORNAMENTAL TREES AND PALMS

Benefits*	Shade Tree	Palm
	Live Oak, <i>Quercus virginiana</i>	Sabal Palm, <i>Sabal palmetto</i>
Diameter (DBH)	16"	16"
Carbon Dioxide (CO2) Sequestered (Absorbed)	510 pounds/year	2.71 pounds/year
Rainfall Intercepted	725 gallons/year	81 gallons/year
Ozone removed from air	20 ounces/year	1.70 ounces/year
Carbon dioxide stored	3,214 pounds over lifetime	26 pounds over lifetime
Energy Savings (A/C)	60 kWh	26 kWh
Energy Savings Value	\$10.00	\$4.60
Annual Value of Benefits	\$31.00	\$6.48
*Based on an analysis utilizing the USDA Forest Service’s i-Tree MyTree benefits tool (www.itreetools.org) - v. 2.4.16		





MAP I: PALM DISTRIBUTION IN MIAMI BEACH



MAP II: SHADE/ORNAMENTAL TREE DISTRIBUTION IN MIAMI BEACH

SPECIES VULNERABILITY
CLIMATE CHANGE

Miami Beach’s urban forest faces challenges related to climate change including rising groundwater (saltwater inundation), sea level rise, flooding and increases in temperature. According to data from that National Aeronautics and Space Administration (NASA) if the current levels of greenhouse gases continue to be emitted into the Earth’s atmosphere – Miami Beach can expect to have 72 more days above 95 degrees Fahrenheit by 2100^{32, 33}. These challenges will have an impact on the species composition of Miami Beach’s urban forest, as not all the species currently growing in Miami Beach will be able to adapt to these effects of climate change.

The USDA Forest Service has developed the Climate Change Tree Atlas which utilizes climate change models to measure the current and future distribution of 134 tree species in the eastern United States. Unfortunately, the Atlas does not currently contain many of the species growing in Miami Beach’s urban forest, however, it does provide a list of tree species in the Everglades ecoregion^{3, 34}, which includes Miami Beach. Table 4 shows several tree species that grow in Miami Beach and their predicted vulnerability to climate change. Species vulnerability in the Climate Atlas is based on a multi-faceted modeling approach that includes utilization of the Modification factors (ModFacs) scoring system to predict how a species will respond to outside disturbances and biological factors and how this might affect its future distribution. Information on the Climate Change Atlas can be found on the USDA Forest Service website at www.fs.fed.us/nrs/atlas.

TABLE 4: CLIMATE CHANGE VULNERABILITY OF TREE SPECIES IN MIAMI BEACH. SOURCE: USDA FOREST SERVICE CLIMATE CHANGE TREE ATLAS

Species	Model Reliability	Climate Vulnerability Highlights	% of Miami Beach Public Trees
Live Oak	Moderate	Significant loss predicted, 15-43%	5%
Laurel oak	High	Loss predicted, up to 30%	<1%
Redbay	High	Minimal loss predicted, ~10%	<1%
Baldcypress	Moderate	Possible minimal loss	<1%
Slash pine	High	Possible minimal loss	<1%
Southern Magnolia	Moderate	No projected change	<1%
Pecan	Low	No projected change	<1%
White oak	High	No projected change	<1%



PESTS AND DISEASES

With its close proximity to a major U.S. port, large urban center and a highly mobile population, Miami Beach’s urban forest is susceptible to pest and disease problems and is at high risk for future pest introductions. This, coupled with the current changes in climate, make the community vulnerable to novel pests and diseases. Miami Beach should stay alert to the following pests and diseases that are of most concern to the community forest asset:

Ganoderma butt rot:

Trunk rot caused by the fungus *Ganoderma zonatum* is a lethal disease of palms. This pathogen is difficult to detect because it compromises internal tissues of the trunk and foliar symptoms appear after the pathogen has caused significant rot. *Ganoderma butt rot* spreads by spores and infected plant materials. Methods to control the disease are limited to sanitation practices such as sterilizing pruning equipment and quickly disposing of infected materials. This pathogen can infect many species of palms and is the most common disease compromising palms in Florida³⁵.

Lethal yellowing:

Lethal yellowing is a palm disease vectored by a sap feeding insect called a plant hopper. When infected plant hoppers insert their mouthparts to feed on the palm tree tissues, they also secrete a phytoplasma (a kind of wall-less bacteria). Lethal yellowing can be identified by symptoms including premature fruit drop and discolored or dead leaves. Foliar symptoms first appear on the oldest leaves. Lethal yellowing is one of the most threatening diseases for Miami Beach to be aware of because it rapidly kills many kinds of palms. Damage is primarily seen on coconut palm, one of the most widely planted species in Miami Beach.

Lethal bronzing:

Like lethal yellowing, lethal bronzing is palm disease that is vectored by a sap feeding insect called a plant hopper. When infected plant hoppers insert their mouthparts to feed on the palm tree tissues, they also secrete a phytoplasma (a kind of wall-less bacteria). This disease is relatively new to Florida, first identified in Hillsborough County, Florida in 2006³⁶ Symptoms of the disease include premature fruit drop and discolored or dead leaves. Foliar symptoms first appear on old leaves closest to the ground, eventually moving to younger leaves and finally the spear leaf. Once it has infected the spear leaf the palm, the heart or bud has died, and the palm will die. Like lethal, yellowing, this is one of the most threatening diseases for Miami Beach’s urban forest due to the large number of palms planted throughout the city.

Fusarium wilt:

Canary island date palm wilt (caused by the fungus *Fusarium oxysporum* f. sp. canariensis) and fusarium wilt of queen and Mexican fan palm (caused by *Fusarium oxysporum* f. sp. palmarum) both threaten Miami Beach’s urban forest. The common name of each disease is indicative of the species of palm they infect, but they overlap in their biology, symptomology, and control. In palms, *Fusarium* wilt rapidly kills trees by disrupting the water-conducting tissues. First the pathogen attacks older leaves, typically one side of the leaf desiccates and turns brown. Then the pathogen moves to other parts of the canopy. *Fusarium* wilt of palms is easily spread through wind transported spores, but also persists in plant tissues and soil. Effective controls for fusarium wilts are lacking, but sanitation measures can help prevent these diseases³⁷.

Granulate ambrosia beetle:

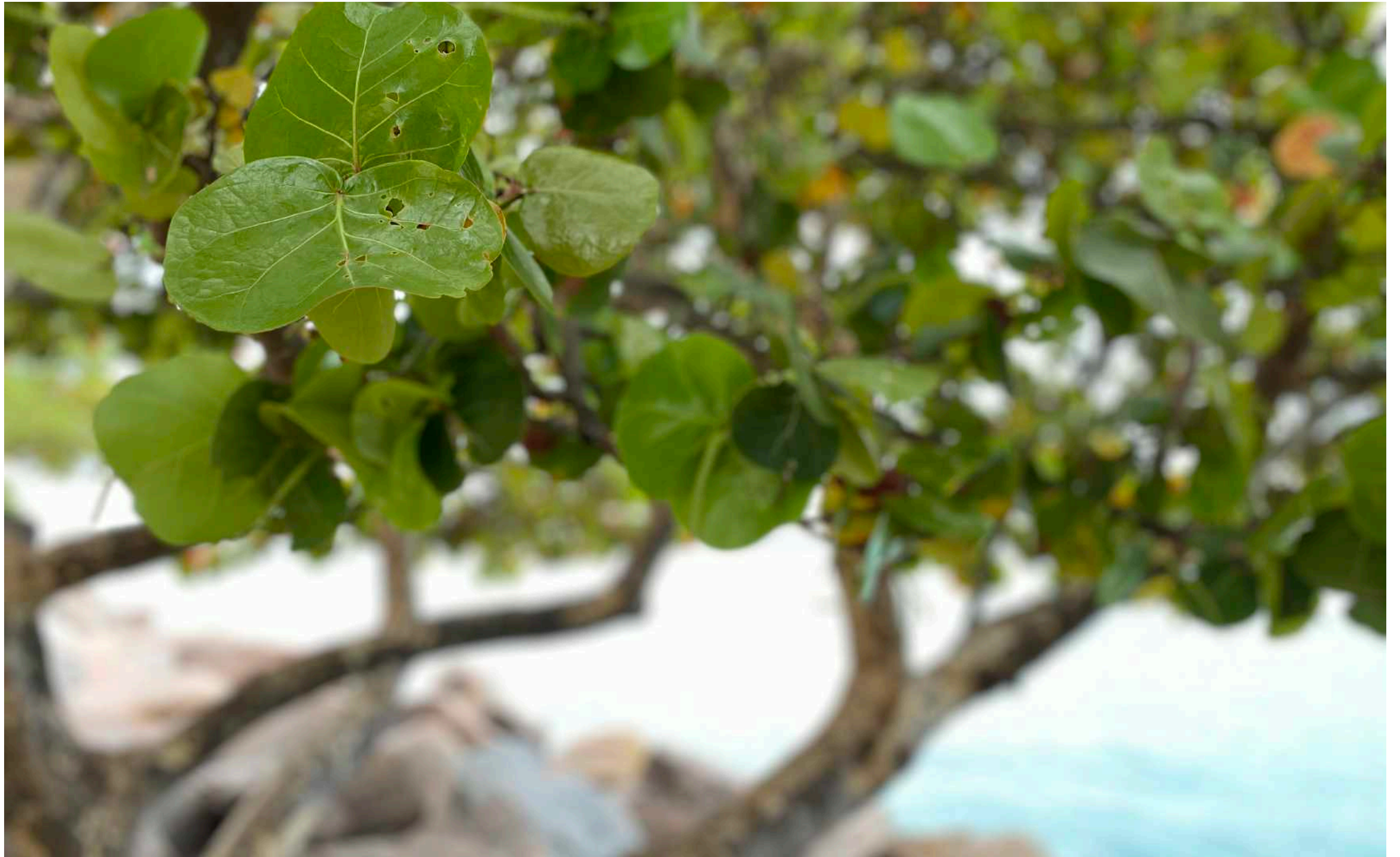
The granulate ambrosia beetle (*Xylosandrus crassiusculus*) was first detected in South Carolina in the 1970s, and has since spread throughout the state of Florida. This beetle feeds on heartwood tissues, but secondary cankers can form on the bark where beetle entrance and exit wounds occur. This ambrosia beetle has the potential to colonize healthy or stressed trees³⁸ (Atkinson et al. 2000) and has a large host range. Known hosts that are commonly planted in Miami Beach include Australian pine and mahogany³⁹.

Gypsy moth:

The gypsy moth (*Lymantria dispar*) was first brought from Europe to Massachusetts for its potential in silk production in 1869. Escaped moths became significant pests in the northeastern United States and have continually expanded their range. During outbreaks, caterpillars chew on leaves in incredible numbers, resulting in defoliation of the entire tree canopy⁴⁰. Their feeding damage weakens the tree host and renders it more vulnerable to other pests and diseases, especially if defoliation occurs several years in a row. The gypsy moth is known to feed on hundreds of species of trees and shrubs. As oaks are one of their preferred hosts, Miami Beach’s live oaks are of most concern.



LETHAL BRONZING
PHOTO CREDIT: DAYTONA BEACH NEWS- JOURNAL



SIZE AND AGE

The size distribution of trees and palms in Miami Beach’s urban forest can serve as a general predictor of the relative age of the resource. To maintain a sustainable urban forest, the tree population should be distributed across a variety of size classes (measured at 4.5’ above ground level – diameter at breast height, DBH) working towards achieving the recommended distribution of:

- 0-8” DBH (Young) - 40% of public tree population
- 9-17” DBH (Established) - 30% of public tree population
- 18-24” DBH (Maturing) - 20% of public tree populations
- Over 24” DBH (Mature) - 10% of public tree population

An analysis of size/age distribution of the public tree inventory found Miami Beach’s trees are young (0-8” DBH) trending towards established (9-17” DBH), with trees in the maturing category (18-24” DBH) below the recommended target of 20%. The analysis looked at public shade/ornamental trees only (Figure F), palms only (Figure G) and public shade/ornamental trees and palms – (Figure H) and all three analyses shared a similar trend line. Due to redevelopment and impacts from high winds/hurricanes, Miami Beach’s tree canopy consistently trends towards a younger age distribution. In order to ensure a sustainable urban forest and ensure canopy cover does not diminish Miami Beach should focus management activities on preservation and care of existing maturing and mature trees.

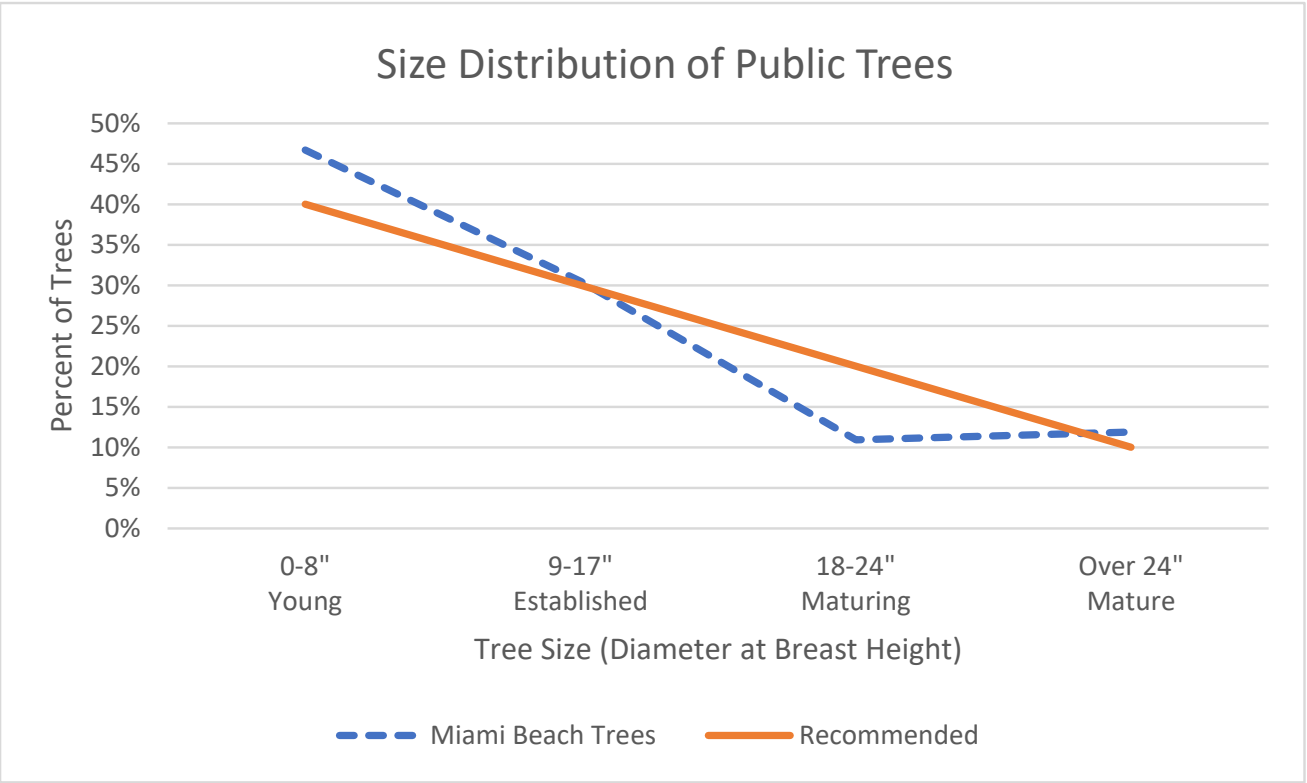


FIGURE G: SIZE/AGE DISTRIBUTION - PALMS

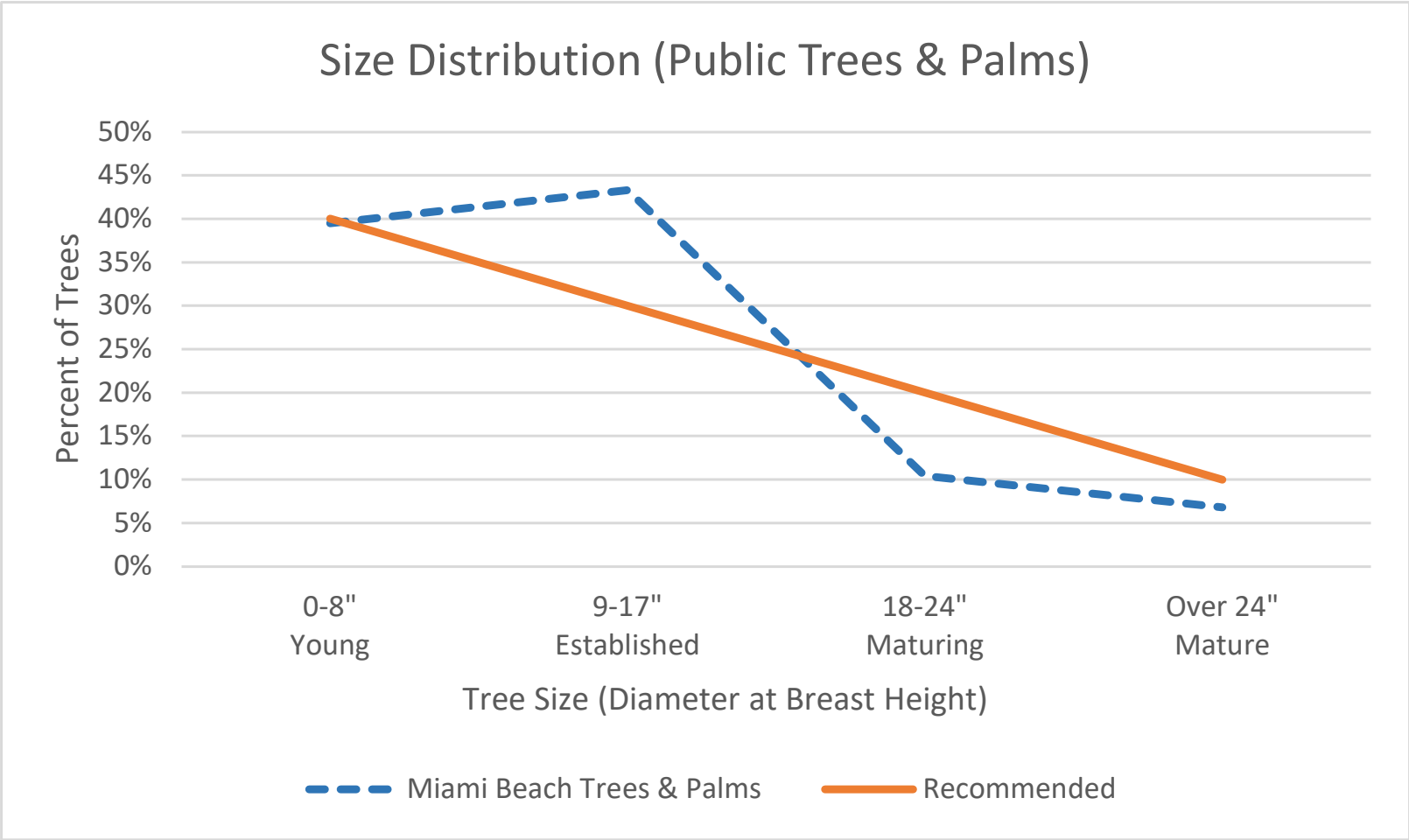


FIGURE F: SIZE/AGE DISTRIBUTION - PUBLIC TREES

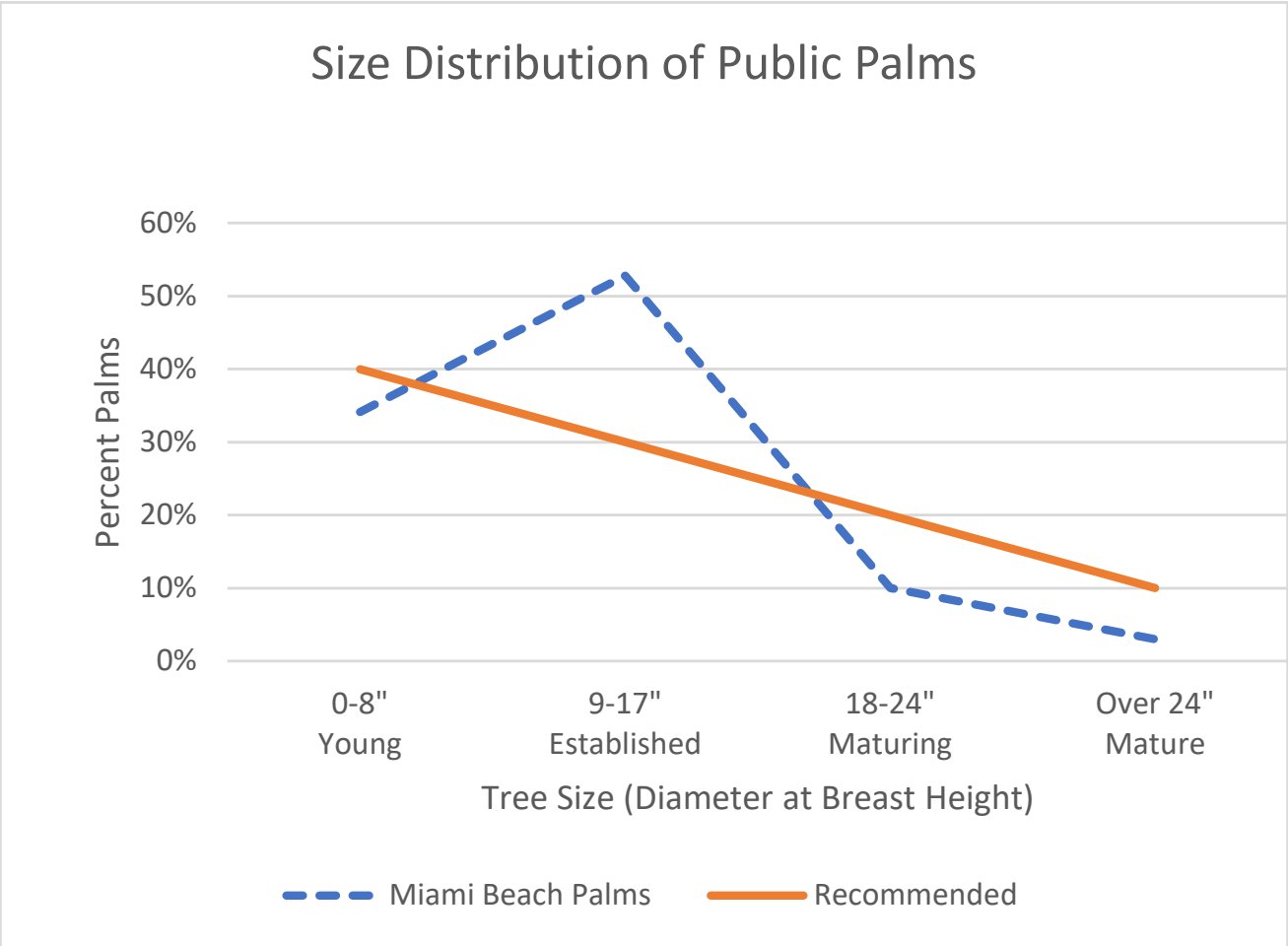


FIGURE H: SIZE/AGE DISTRIBUTION - TREES AND PALMS

STREET TREE STOCKING

A street tree stocking level analysis was conducted utilizing the UTC assessment and the City of Miami Beach’s street tree inventory data. Stocking level, in an urban forest, measures the proportion of existing street trees compared to the total number of possible/potential tree planting spaces and can help to determine tree planting needs and budgets. Davey Resource Group recommends a stocking level of at least 90%, where no more than 10% of the planting sites in the right-of-way are vacant.

For this analysis the current tree canopy by street segment was assessed (Map III) and then the possible tree planting locations by street segment were identified (Map IV). Possible planting locations are those sites identified as vacant or currently available for tree planting and do not include sites that could be retrofitted to allow for tree planting. The street tree stocking level analysis should be utilized along with the urban heat island assessment to prioritize street tree planting; and identify areas that could be retrofitted for tree planting in areas with a high need for tree canopy but low available planting locations.



MAP III: TREE CANOPY PERCENTAGE BY STREET SEGMENT



MAP IV: POSSIBLE NUMBER OF TREE PLANTING SPACES BY STREET SEGMENT



MAINTENANCE

In accordance with the City of Miami Beach Code, Section 46-62.6, the primary responsibility for the maintenance of trees and vegetation in the right-of-way/swale (ROW) is the adjacent property owner. In a few limited areas, primarily commercial districts, the City’s Greenspace Management Division, is responsible for the maintenance of ROW trees, however this is a small number of trees and the vast majority of public ROW trees are the responsibility of the adjacent property owner.

Property owners are required to obtain a permit from the City’s Urban Forestry Division for the planting or removal of any ROW tree. However, not all property owners/residents apply for a permit leading to tree care activities that do not meet city standards and leave ROW trees vulnerable to decay, insects, diseases, and storm damage.

Tree care activities that occur under City-approved permits or by City staff/contractors, are completed on a reactive basis and not through a proactive or routine maintenance program.

Lack of a routine and systematic maintenance program for all ROW trees puts the urban forest at risk, impacting their health, condition, and storm-readiness. Trees pruned on a routine basis develop proper form and structure which leads to a variety of benefits, including ⁴¹:

- Lower cost per tree trimmed compared to reactive pruning done in response to storm damage, sight clearance or immediate hazards.
- Early identification and correction of insect/disease problems leading to fewer tree mortalities.
- Reduction in storm related tree damage.
- Lower future maintenance costs.
- Reduction in tree-related service requests and improved customer service
- Development of a healthy, sustainable and resilient urban forest.

Miami Beach should evaluate options for assuming the tree maintenance responsibility for all trees in the ROW/swale to ensure proper care and to promote the long-term health of this important component of the city’s urban forest.

URBAN FOREST MANAGEMENT

The care and maintenance of the City’s community tree resource is provided by a combination of City staff, contracted professional services and private property owners. The City has three divisions that have tree care, maintenance and management responsibilities. While each division (detailed below) has a unique set of duties, they each have International Society of Arboriculture Certified Arborists on staff and actively coordinate and collaborate on urban forestry activities.

Urban Forestry Division | Environment and Sustainability Department

Regulatory division responsible for overseeing tree permits, ordinance enforcement, private development plan reviews and internal/ external project coordination. The Urban Forestry Division was started in 2015 when the City adopted their own tree protection ordinance. The City’s Urban Forester, who was previously in Greenspace Management is now housed in the Urban Forestry Division.

Greenspace Management | Public Works Department

Responsible for landscape maintenance in medians, parking lots, coastal areas, non-park city facilities, and select rights-of-way. Greenspace Management oversees city crews and contractors that perform routine landscape maintenance, including lawn care, trimming, edging, hedging and tree care.

Park Maintenance | Parks & Recreation Department

Responsible for managing and maintaining the city’s park system. Parks Maintenance oversees contractors that perform all routine landscape maintenance, including tree maintenance.

LEVEL OF SERVICE ANALYSIS

A level of service analysis (LOS) was completed to develop an initial understanding of the costs that the City of Miami Beach may incur if they took over maintenance responsibilities of all right-of-way/swale trees and palms. Two scenarios were developed based on current inventory data. A 3-year scenario, where all trees would be pruned on a 3-year pruning cycle and a 5-year scenario, where all trees would be pruned on a 5-year pruning cycle. In both scenarios, palms would be pruned 2-4 times per year depending on species.

Scenario Notes: Tree pruning, and removal costs are provided as a reference and are based on general, average contractor costs in South Florida for tree/stump removal and pruning to thin deadwood and raise canopies. To determine actual City of Miami Beach costs detailed tree pruning specifications along with the number, size and location of trees and palms should be developed and provided to tree care contractors for estimates.

1. Number of Trees: The following have been factored into the number of trees to be pruned each year:

- After Year 1 - 3% of trees will move to the next diameter class
- At Year 3 and after - Trees planted two years prior are added to the 8” diameter or less pruning cycle trees

2. Costs: After Year 1 - include a 2% cost increase

3. Tree Planting not included

Scenario: 3- Year Pruning Cycle	Year 1		Year 2		Year 3	
	Number Tree/Palm	Cost	Number Tree/Palm	Cost	Number Tree/Palm	Cost
Canopy Tree Pruning (3 Year Cycle)	3,950	\$ 629,775	3891	\$ 633,840.50	4,332	\$ 676,919
Palm Pruning (Depending on species p	16,732	\$2,227,680	16732	\$2,227,680.00	16,732	\$ 2,227,680
Tree & Stump Removal	119	\$ 46,900	126	\$ 50,145.00	131	\$ 49,729
Palm & Stump Removal	157	\$ 39,981	156	\$ 40,994.00	154	\$ 40,591
TOTAL	20,958	\$2,944,336	20905	\$2,952,659.50	21,349	\$ 2,994,919

Scenario: 5-Year Pruning Cycle	Year 1		Year 2		Year 3		Year 4		Year 5	
	Number Tree/Palm	Cost	Number Tree/Palm	Cost	Number Tree/Palm	Cost	Number Tree/Palm	Cost	Number Tree/Palm	Cost
Canopy Tree Pruning (3 Year Cycle)	2,370	\$ 377,865	2299	\$ 373,859.00	2,759	\$ 414,182	3,225	\$ 458,376	3,691	\$ 505,428
Palm Pruning (2x or 4x per year deper	16,732	\$2,227,680	16732	\$2,227,680.00	16,732	\$ 2,227,680	16,732	\$ 2,227,680	16,732	\$ 2,227,680
Tree & Stump Removal	119	\$ 46,900	126	\$ 50,145.00	131	\$ 49,729	137	\$ 49,318	143	\$ 48,900
Palm & Stump Removal	157	\$ 39,981	156	\$ 40,994.00	154	\$ 40,591	153	\$ 40,217	154	\$ 40,094
TOTAL	19,378	\$2,692,426	19313	\$2,692,678.00	19,776	\$ 2,732,182	20,247	\$ 2,775,591	20,720	\$ 2,822,102



TREE AND PALM MAINTENANCE LEVELS OF SERVICE

Palms require more intense and frequent maintenance than shade/ornamental trees. Depending on the species, palms require pruning 2-4 times per year to remove dead/dying fronds, address clearance issues and remove coconuts. While, a shade/ornamental tree, once properly pruned can be pruned once every 2-3 years.

STREET AND PUBLIC PROPERTY

Greenspace Management maintains medians, parking lots, coastal areas, non-park city facilities, and select rights-of-way.

- Shade/ornamental trees pruned once per year or as needed. Pruning focused on the removal of deadwood and addressing clearance issues.
- Palms pruned 2-4 times per year depending on species. Pruning focused on removing dead/dying fronds, addressing clearance issues and removing coconuts.
- No plan/program is in place to require private property owners to maintain the ROW/swale trees they are responsible for on a routine basis.

PARKS

Parks and Recreation facilities

- Shade/ornamental trees: one structural prune per year
- Palms pruned 4 times per year depending on species. Pruning focused on removing dead/dying fronds, addressing clearance issues and removing coconuts.

CITY STAFF AND CONTRACTORS

City Staff

A total of 9 City staff in the Urban Forestry, Greenspace and Parks Maintenance divisions are currently involved in city tree planning, management and maintenance activities on a daily basis. Leadership within the three divisions collaborate on projects and share resources when necessary but there is no formal policy on resource sharing. The City has a dedicated, full-time urban forester position, which is housed within the Urban Forestry Division under Environment and Sustainability Department.

While Miami Beach utilizes contractors for tree care consulting, inventory updating and tree care activities to meet workload demands, city staffing needs were identified during the planning process. A tree inspector position to aid in tree ordinance enforcement and to serve as an in-field liaison is needed to meet workload demands in the Urban Forestry Division. In Park Maintenance, a dedicated 3-person in-house tree crew is needed to handle emergency and priority tree maintenance activities.

City Staff Training

The science of arboriculture and the management of urban forests are domains that are recognized as special areas of expertise. Credentials are increasingly requested by municipalities as evidence of competency, and bachelor’s degrees in Forestry, Urban Forestry, Environmental Sciences, and Horticulture are often the base requirements for leadership roles in urban forest management.

Professional credentials can demonstrate competency; the most widely accepted credentials in Florida come from the International Society of Arboriculture (ISA), Florida Nursery, Growers and Association (FNGLA) and Florida Landscape Inspectors Association (FLIA). The following designations/credentials have been obtained by City staff:

- Certified Arborist (ISA)
- Certified Horticulturist (FNGLA)
- Certified Landscape Technician (FNGLA)
- Certified Landscape Maintenance Technician (FNGLA)
- Certified Landscape Inspector (FLIA)
- Certified Pesticide Applicator (FL Department of Agriculture and Consumer Services)
- Landscape Inspector’s Association of Florida
- ISA Tree Risk Assessment Qualified

The City is committed to having qualified and well-trained staff. They provide or support staff in training opportunities related to tree care, landscape maintenance, and chainsaw training. In 2018, the City provided a training course for staff interested in taking the ISA Certified Arborist exam. The training was offered to Urban Forestry, Greenspace Management and Parks staff, and other City departments.

Division	Total Number of Staff	Staff Dedicated to Tree Care, Management and Planning	ISA Certified Arborists
Urban Forestry	3	3	2
Greenspace Management	20	4	3
Park Maintenance	105	5	1

CONTRACTORS

Miami Beach utilizes contractors for a large portion of the tree care, maintenance and planting activities that occur on City properties, parks, medians, and limited rights-of-way. The current City contracts include all landscape and maintenance activities, from lawn mowing and edging to tree care and litter removal. While this practice may provide contract efficiencies, tree maintenance activities require a specialized skill set and knowledge base that some landscape contractor crews may not possess. While City contracts require that an International Society of Arboriculture Certified Arborist be on staff, it does not mandate that one be on every crew doing landscape maintenance/tree care work within the city. This can lead to poor tree care practices that can damage or harm city trees and puts the safety of the workers and public at risk. Contracts that are specific to tree maintenance, care, and removal activities that provide detailed work specifications, safety considerations, equipment needs, and required worker certifications can minimize these risks and ensure that tree care activities are performed in accordance with current industry standards.



EQUIPMENT AND TOOLS

While the City contracts out the majority of tree care and maintenance work, they do maintain a fleet of vehicles and tools for tree care and maintenance activities.

- **Urban Forestry:** Small number of hand tools for tree planting; measuring devices for inspections.
- **Greenspace Management:** Three bucket trucks (1 large; 2 small), chipper, grapple truck, mini-excavator, stump grinder, 2 water trucks, chainsaws and other small tree maintenance equipment.
- **Parks Maintenance:** Chainsaws and pole pruners.

Tools and equipment are loaned between Divisions, as needed, however there is not a policy in place that formalizes this arrangement.

FUNDING

Stable and predictable funding is important for the effective and sustainable management of the urban forest. Trees are living organisms that are constantly growing, changing and responding to their environment. Their health and structure are influenced by a variety of biotic and abiotic factors, including nutrition, available water, pests, disease, wind, and humidity. With regular monitoring and maintenance, the negative consequences of these external influences on tree health and structure can be mitigated and the benefits and longevity increased.

Young trees benefit from early structural pruning and training. Simple, minor corrections can be applied cost effectively when a tree is young; however, if left unattended, these structural issues can increase the City’s liability and be expensive to correct as trees mature. Eventually they may be impossible to correct without causing greater harm to the overall health of the tree.

Consistent funding is also critical for effective management of trees as they near the end of their life cycle. Over-mature trees often require more frequent inspection and removal of dead or dying limbs to reduce the risk of unexpected failure. A stable budget allows urban forest managers to program the necessary tree care at the appropriate life stage when it is most beneficial and cost effective.

A total urban forestry budget for the City of Miami Beach has been difficult to determine because Parks Maintenance and Greenspace Management previously bundled tree care with other landscape services within their budgets and contracts. Without a separate line item for tree care, a total budget cannot be determined. In general, however, the FY 2019 Greenspace Management budget was \$4.9 million, which covered all activities the Division’s responsible for, including tree care; the FY19 Parks Maintenance landscape contracts, which include all landscape maintenance activities including tree care, totaled approximately \$1.2 million. The Urban Forestry Division’s operating budget is approximately \$150-175,000 per fiscal year.

Sources of Funding

The following sources of funding are utilized by each division for tree care, planting and landscape maintenance activities.

- **Urban Forestry:** General fund, the Tree Trust Fund. donations to the Commemorative Tree program, State of Florida Urban and Community Forestry grants and Neat Streets Miami Initiative funding.
 - *The Tree Trust Fund* was established in 2015 and generates revenue from tree permit plan review fees, inspection fees, code violations, fines, contributions, and mitigation. It has a current balance of approximately \$500,000.
 - *The Commemorative Tree Program* established in 2016 allows people to donate a tree to the City of Miami Beach to commemorate a person or special event.
- **Greenspace Management:** General fund, special assessment districts and the parking fund.
- **Parks Maintenance:** General fund, revenue generated from recreation fees, rental income and the City’s public golf course.

In 2018, city residents approved a \$439 million General Obligation Bond (G.O. Miami Beach) to improve the quality of life, economy and resilience of Miami Beach. The G.O. Bond program includes \$5 million to implement a street tree master plan and plant up to 5,000 trees citywide to increase canopy cover, the timeline for full implementation is 2025. The Urban Forestry Division is responsible for implementing the G.O. bond tree planting project.

STORM RESPONSE AND DISASTER PREPAREDNESS

As a coastal community, Miami Beach has a robust storm response and disaster preparedness program. The Urban Forestry Division has developed a Hurricane Plan that outlines the tasks to be completed pre-event, provides procedures for different storm events, outlines response and recovery activities and provides detailed lists of items that should be in personal and City go-bags

TREE CITY USA

The Arbor Day Foundation’s Tree City USA program recognizes communities who have made a commitment to managing their urban forest. To achieve Tree City USA status a community must demonstrate they have met the four core standards of quality and urban forest management:

1. Maintain a tree board or department that is legally responsible for the care of city trees.
2. Enact a community tree ordinance which provides clear guidance for planting, maintaining, and removing trees from streets, parks, and other public places.
3. Document the spending of at least \$2 per capita toward the planting, care, and removal of city trees.
4. Celebrate Arbor Day!

The City of Miami Beach has been designated as a Tree City USA since 2006.

REGULATIONS AND POLICIES

The development of Miami Beach’s Urban Forestry Master Plan included a comprehensive review of the City’s urban forestry and landscape policies, ordinances and standards. They provide the foundation for the City’s urban forestry program, establishing the regulatory framework for protection and preservation of the tree canopy and setting standards for planting and care. The following provides a summary of the review and key findings.

Chapter 46, Division II: Tree Preservation and Protection

Overall, the City of Miami Beach has a comprehensive and relatively strong tree preservation ordinance, especially with new ordinance changes adopted in October 2019. The main goals and objectives of the ordinance, promoting canopy cover, increasing species diversity and tree preservation align with the goals, recommendations and action steps of the UFMP.

Chapter 126, Section 126-5: Landscape Requirements

The landscape requirements in Chapter 126 are comprehensive and stringent. The code maximizes the number of trees that can be planted by requiring a maximum average spacing of 20 feet. While this can place trees close together, over time this will increase the

amount of canopy cover. The tree planting requirements allow palms to be planted, however, they cannot be counted towards meeting the required number of trees on site. Due to the overabundance of palms throughout the city, this requirement encourages residents, developers and businesses to plant more shade trees, increasing canopy cover and tree benefits while allowing palms to be planted as accent plants.

The code also requires a minimum of 2 lot trees to be planted within the “energy conservation zone” of a lot. This encourages the planting of trees to shade buildings and provide the maximum amount of energy savings. This section could be improved by providing illustrations or better defining where the “energy conservation zone” is on a property.

Chapter 126 provides landscape specifications and requirements for private property and right-of-ways . This chapter establishes that the care and maintenance of ROW/ swale trees is the responsibility of the adjacent property owners.

Chapter 126 could be enhanced by referencing tree care and maintenance guidelines/ best management practices from the International Society of Arboriculture or guides/ brochures developed by the City.

Urban Forest Division: Policies and Procedures

The Urban Forestry Division has established a series of polices and procedures related to planning, maintaining and preserving the tree canopy. These policies include:

- Plan Review
- Heritage Tree Program
- Commemorative Tree Program Guidelines
- Hazardous/Emergency Tree Removal
- Mitigation Guidelines
- Tree Removal
- Tree Relocations
- Enforcement Guidelines
- Tree Removal Permit Application Process
- Tree Work Permit
- Urban Forestry Division: Tree Work Permit Application Denial
- Urban Forestry Division: Tree Work Permit Inspections

The policies and procedures provide excellent guidance to city staff and the community on urban forestry related issues. The City should consider developing detailed guides on tree planting, care and maintenance to support Chapter 46 and 126 requirements.

Enforcement Challenges

While City staff works diligently to ensure that trees are preserved during development projects and as part of Tree Work Permit applications, there are more activities than current city staff can address.

The City’s Code Compliance Division assists the Urban Forestry Division in enforcing city codes related to tree protection and preservation, however, Code Compliance is responsible for enforcing all city codes and tree care and preservations violations are not currently a high enforcement priority. Code compliance officers are not experts in urban forestry and arboriculture and rely on the Urban Forestry Division to provide technical assistance on ordinance violations.

Tree Work Permits 2018

- 700 Tree Work Permits received
- Inspections Required:
 - Initial Inspection (1)
 - Quarterly Permit Inspections (up to 4)
 - Final Inspection (1)
 - 1 year follow-up inspection (1)

If each permit requires all 7 inspections - the two-person Urban Forestry staff in 2018 would be required to perform **4,900 inspections per year**. That is **18 inspections per day** in addition to their other job duties and responsibilities.



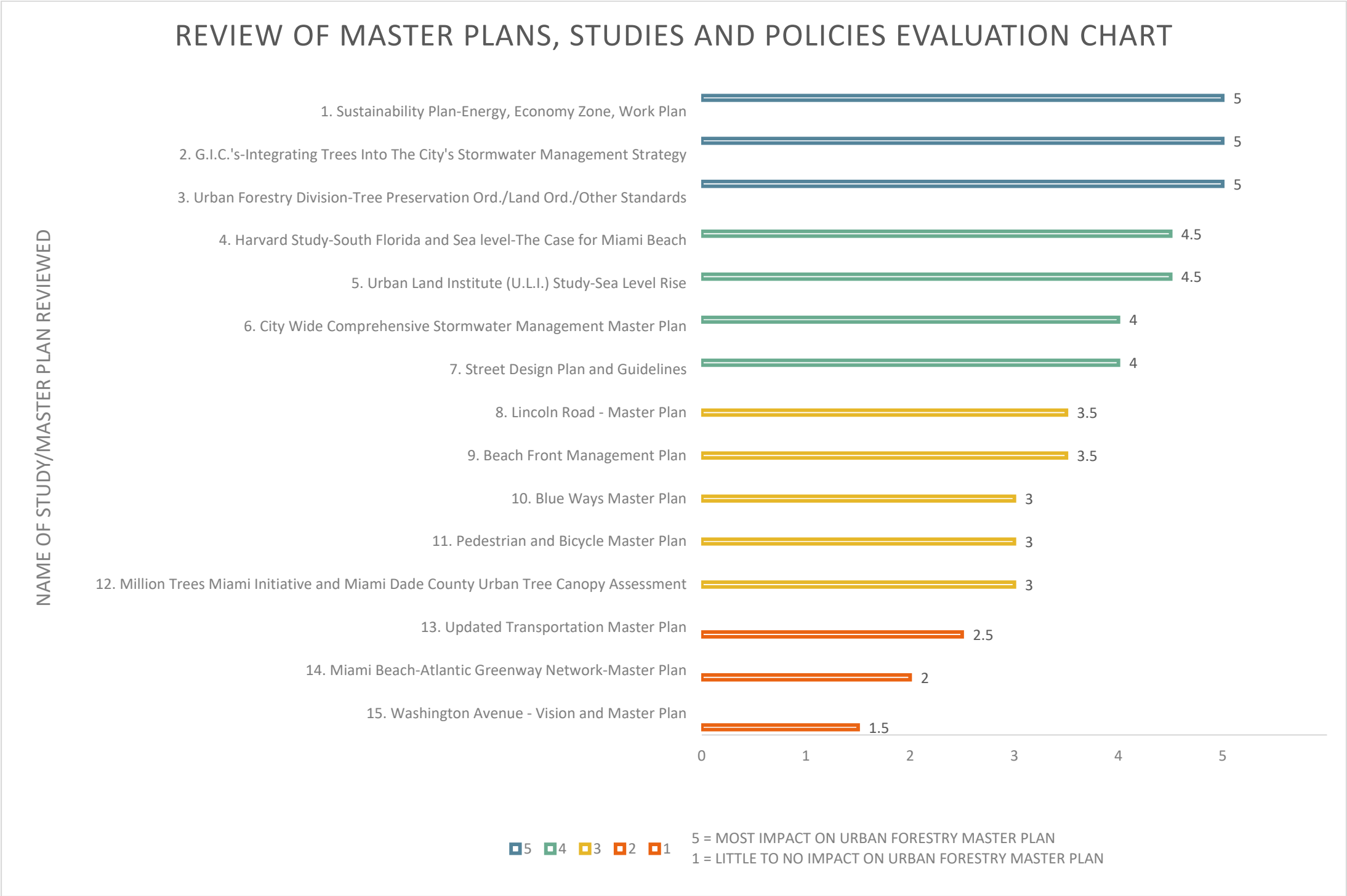
CITY PLANS

Across the City of Miami Beach, divisions and departments are actively working to improve and enhance the services provided to the Miami Beach community. To enhance these services, plans, studies and strategies are developed and implemented. While collaboration and engagement across City departments and divisions is strongly encouraged, there are times when Urban Forestry/Greenspace Management/Park Maintenance may not be engaged, and avoidable tree damage or removal occurs. At other times engagement does occur, but the priorities of the program/plan/project conflict with urban forestry goals to preserve, protect and enhance the city’s tree canopy. In most of these cases, the priorities of the project take precedence over urban forestry goals.

A review of select City master plans, studies and policies was conducted to evaluate the influence that each will have on the Urban Forestry Master Plan. The graphic above summarizes the results of the evaluation. A large majority of the master plans, studies and policies reviewed will have an impact, either positively or negatively, on the implementation of the Urban Forestry Master Plan.

Studies, plans and policies that ranked highest include the 2010 Sustainability Plan, Urban Forestry Division Policies and the 2018 Green Infrastructure Center’s urban tree canopy and stormwater study. These studies will have a positive impact on implementation of the UFMP because the recommendations and actions align with the purpose of the UFMP to increase tree canopy cover, focus on preservation and protection of mature trees and increasing the climate mitigation benefits that shade trees can provide to the community.

The studies, plans and policies that may have a negative impact on UFMP implementation include the Washington Avenue Vision and Master Plan, the Updated Transportation Master plan and the Atlantic Greenway Network Master Plan. They ranked lowest because trees and tree planting were not mentioned, considered or incorporated as design elements or considered an important element in improving user/pedestrian experience.



COMMUNICATION AND OUTREACH

The City of Miami Beach provides outreach and communication to the public on tree planting and urban forestry issues through its website and by holding events, like free tree giveaways. However, the effectiveness of these communication and outreach effort is not known; and engagement about the benefits of trees and the role the community plays in their planting, preservation, protection, and care has been lacking.

REGIONAL COLLABORATION AND COORDINATION

Sustainability and climate resilience are important issues for communities in South Florida and Miami Beach actively collaborates with regional partners to develop and implement a unified vision.

The City of Miami Beach is a partner in the Greater Miami & The Beaches collaboration with Miami-Dade County and the City of Miami. The partnership has developed the Resilient305.

In 2010, the Southeast Florida Regional Climate Change Compact, a partnership of Broward, Miami-Dade, Monroe and Palm Counties was formed to help collaborate and coordinate on climate adaptation and mitigation strategies. The Compact still exists today and now includes representation from the four counties, plus local municipalities in the region, including the City of Miami Beach. The compact developed a Climate Action Plan that includes recommendation NS-14 to promote urban tree canopy.

**WHAT DO WE
WANT?**



WHAT DO WE WANT?

INDICATORS OF A SUSTAINABLE URBAN FOREST REPORT CARD

The Indicators of a Sustainable Urban Forest were utilized during the UFMP development process to comprehensively understand and assess the current state of Miami Beach’s urban forest. The Indicators help to look beyond tree data and analysis (“The Trees”) to also understand how the urban forest is managed (“The Management”) and the network of stakeholders that influence and impact it (“The Players”). For each component, “The Trees”, “The Players”, and “The Management” a list of Indicators and metrics are used to assess the city’s current performance level related to that component.

The report cards detail the City of Miami Beach’s current performance level for each of the Indicators. The Indicators were assessed by City of Miami Beach staff and the City’s UFMP consultant team of Davey Resource Group, Inc. and Calvin, Giordano and Associates. The results were used to set the baseline of where Miami Beach’s urban forest is today; identify gaps in the program and areas of improvement; and were the basis for setting UFMP goals, recommendations, targets and action steps.

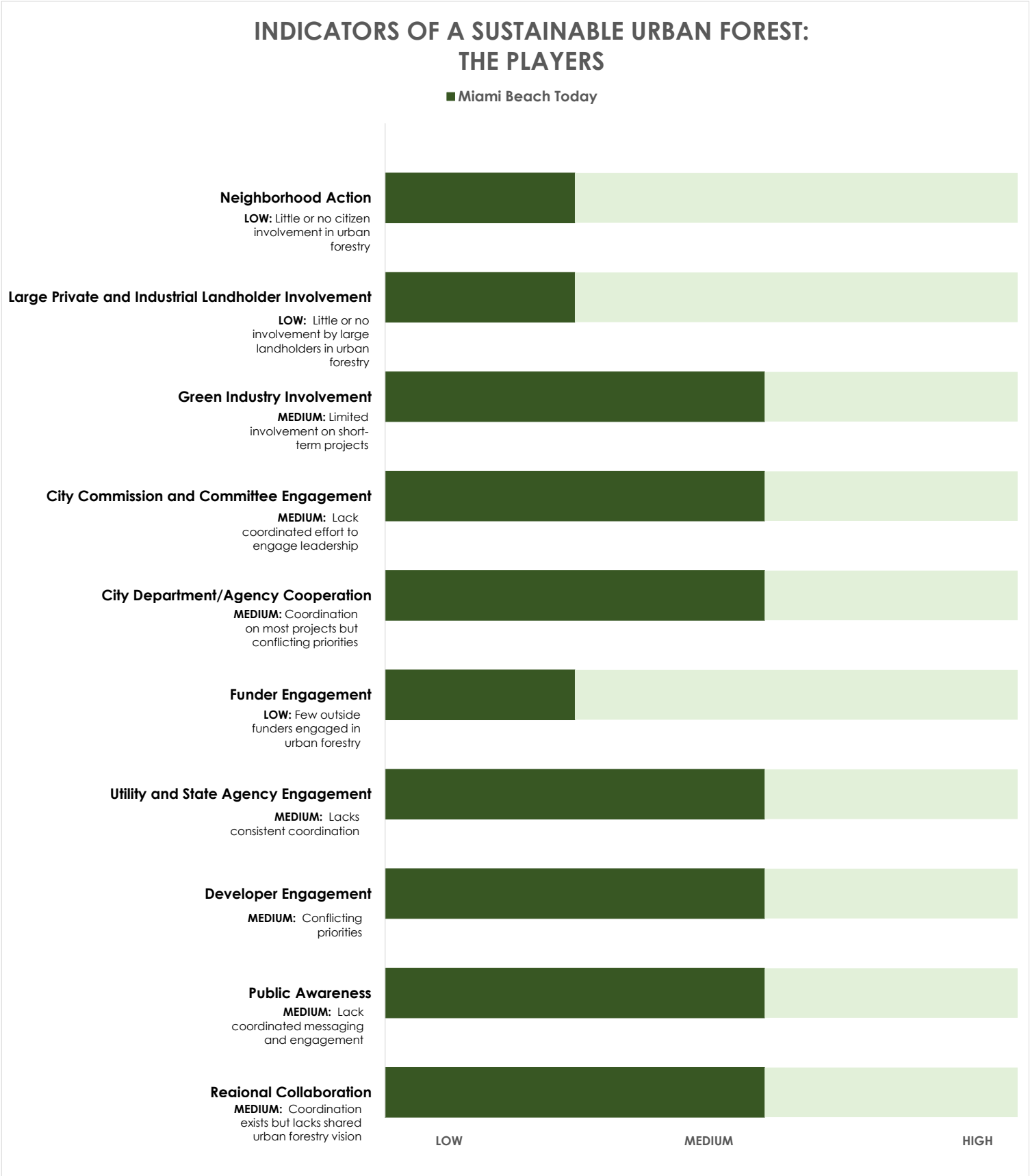
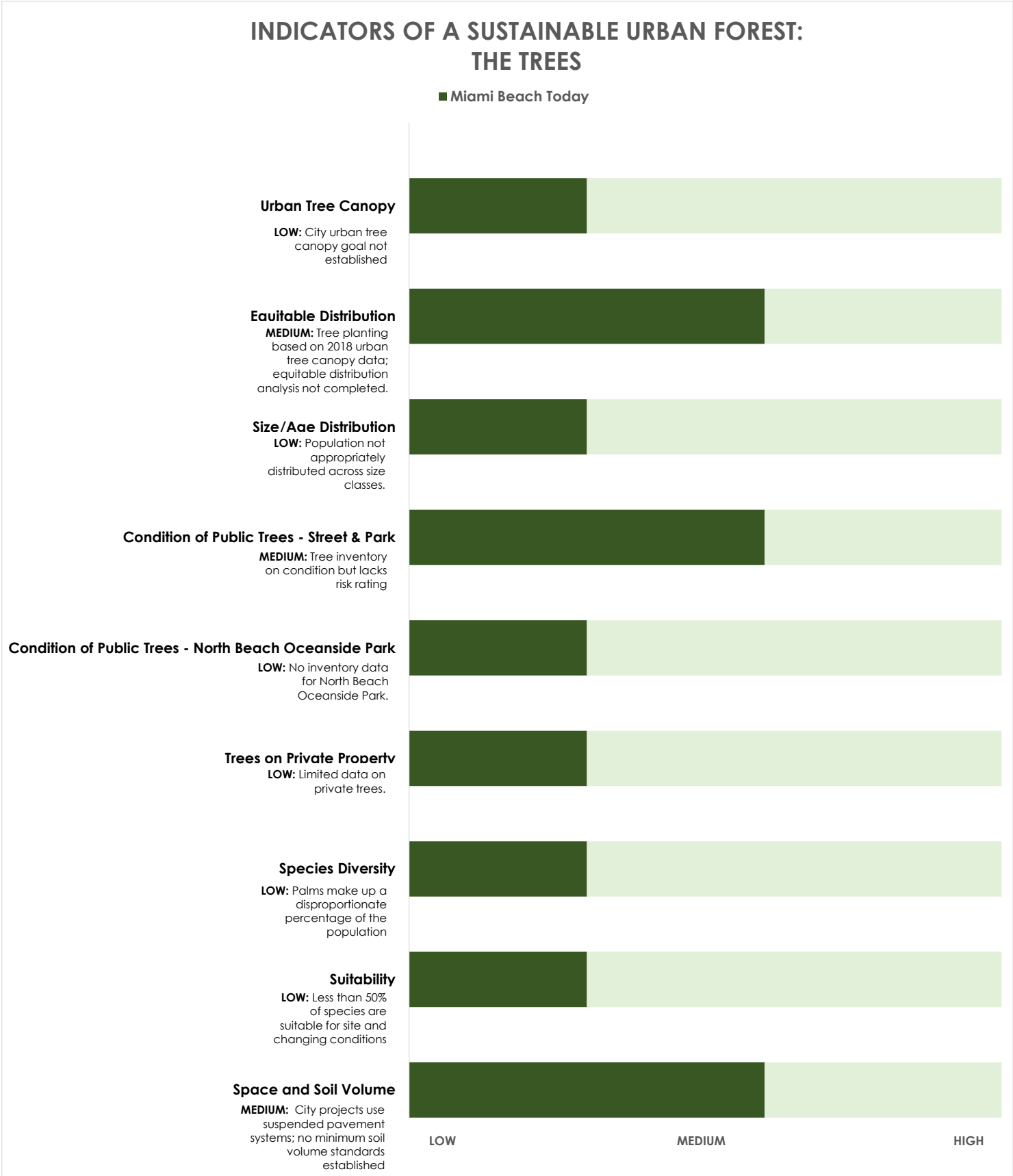
City Staff and Public Engagement

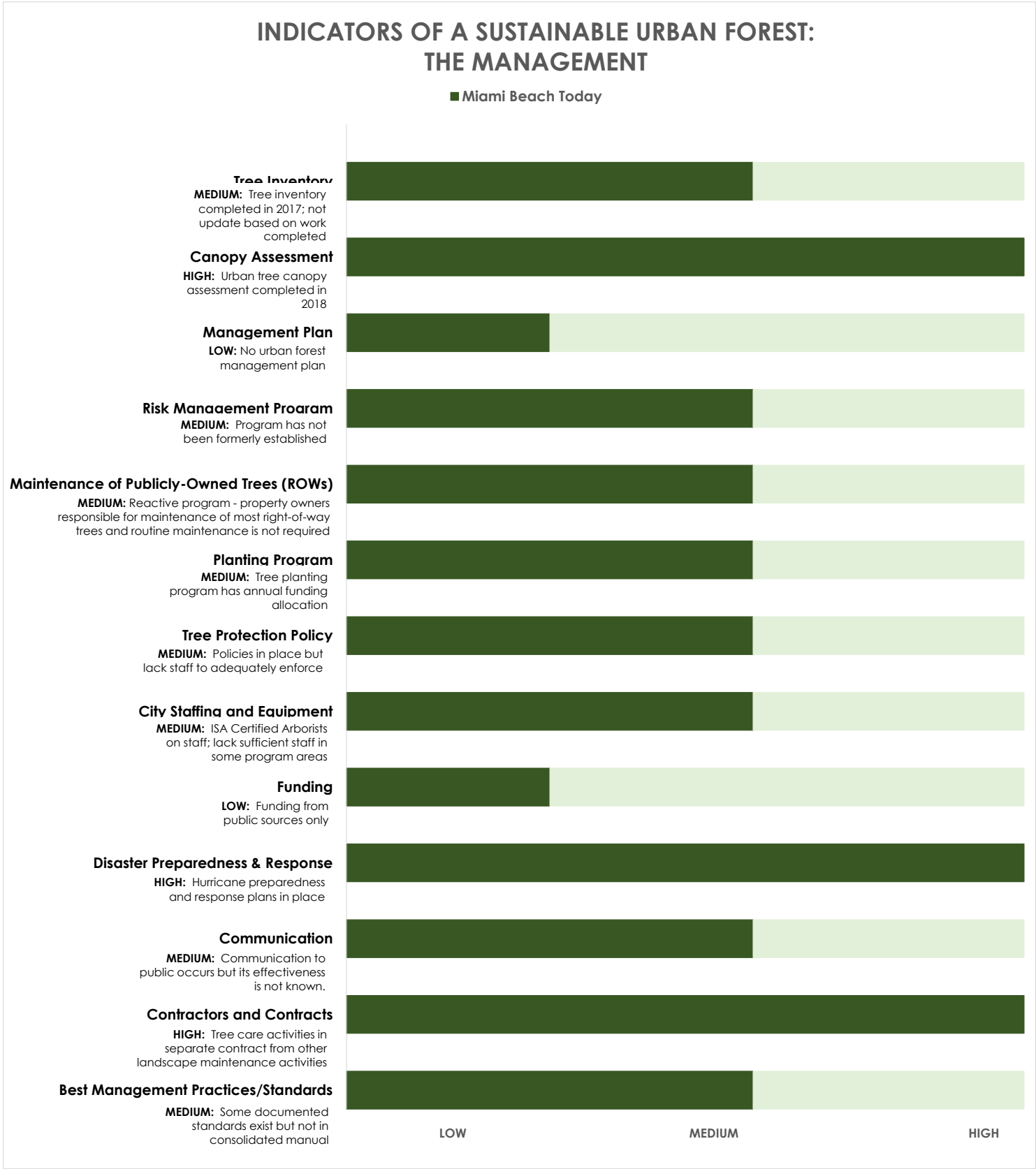
City of Miami Beach residents and staff were engaged during the planning process to understand the needs, challenges and opportunities they see related to trees and the urban forest. Outreach and engagement occurred through public meetings, stakeholder interviews, and one-on-one conversations. The results of this engagement helped to define the framework for the Plan.

In general residents and City staff shared the following desired outcomes of the UFMP:

- Increase shade/ornamental trees in the urban forest, while reducing the palm population
- Focus efforts on the preservation and maintenance of existing shade/ornamental trees
- Collaborate and identify opportunities to preserve trees and add shade tree canopy on City and Florida Department of Transportation projects.
- Provide tools and strategies to assist engineers, landscape architects and designers in increasing shade tree canopy cover throughout the city.
- Increase outreach and education

Report Card: Indicators of a Sustainable Urban Forest





**HOW DO WE GET
THERE?**



HOW DO WE GET THERE?

The research into the City’s current and historical efforts in urban forestry has revealed opportunities to enhance the resilience of the urban forest resource as well as improve efficiency and effectiveness in tree maintenance and management. The criteria and indicators^{42 43} in this plan were used as a reference standard to assess the current state of Miami Beach’s urban forest and provide the framework for goals, targets, recommendations and action steps. The Plan’s recommendations are organized around three strategic goals which were developed through the lens of climate adaptation and resilience and are based on the components of a sustainable urban forest.

TREE CANOPY (TC): Protect and increase shade tree canopy to maximize the environmental, economic, health and climate mitigation services trees provide to Miami Beach.

PLAN & MANAGE (P&M): Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.

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.

The Targets were established based on urban forestry priorities established during the UFMP planning process: increasing tree canopy cover; proper tree care and maintenance and collaboration and engagement. The Green Infrastructure Center (GIC) urban tree canopy assessment reported that the city has 26% potential tree canopy, if all currently available “potential planting sites” are planted. As stated in the GIC report, potential planting sites are identified based on an assessment using aerial imagery, and only about 50% of these sites are typically suitable for planting once the sites are field-evaluated. The 22% canopy target was developed, assuming that approximately 50% of the possible planting locations are suitable and available for tree planting.

GOALS		
TREE CANOPY (TC)	PLAN & MANAGE (P&M)	CONNECT & ENGAGE (C&E)
Protect and increase shade tree canopy to maximize the environmental, economic, health and climate mitigation services trees provide to Miami Beach.	Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.	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.
TARGETS		
TREE CANOPY	PLAN & MANAGE	CONNECT & ENGAGE
Achieve 22% tree canopy cover city-wide by 2040.	Implement a 5-year urban forest maintenance plan by 2021. By 2050, palms should make up no more than 25% of the public tree population.	Release an annual State of Miami Beach Urban Forest Report beginning in 2021.
RECOMMENDATIONS		
TREE CANOPY	PLAN & MANAGE	CONNECT & ENGAGE
<p>TC #1: Track, quantify, evaluate and report on tree canopy cover trends, including amount and annual benefits.</p> <p>TC #2: Develop canopy cover targets and tree planting/preservation plans for neighborhoods that are below the city-wide neighborhood canopy cover average of 15%.</p> <p>TC #3: Conduct a tree canopy equity analysis to prioritize outreach and planting efforts in areas of the city where tree canopy is not equitably distributed</p> <p>TC #4: Develop a routine maintenance and preservation program focusing on public canopy (shade) trees greater than 18” DBH</p> <p>TC #5: Utilize the Urban Forest Master Plan Design Toolkit to identify opportunities for tree planting on city projects (e.g. infrastructure, utility, transportation, non-motorized transportation); improve diversity; and ensure that species are suited to the changing site conditions of Miami Beach, including, salt water inundation, flooding, sea level rise, climate change, and invasive pests.</p> <p>TC #6: Establish and adopt preferred minimum soil volume standards to achieve optimum size of mature trees.</p>	<p>P&M #1: Systematically and routinely update the street and park tree inventory assessing and updating diameter, condition, maintenance need, and risk rating of each tree.</p> <p>P&M #2: Explore opportunities to develop a proactive tree maintenance program and transfer all right-of-way/swale tree maintenance responsibility to the City of Miami Beach.</p> <p>P&M #3: Track and report on tree care, planting, and maintenance activities completed each year.</p> <p>P&M #4: Focus tree planting program on locations that advance city canopy cover goals, planting priorities, and climate adaptation efforts.</p> <p>P&M #5: Establish a tree inspector position responsible for enforcing city tree ordinances and serving as an in-field liaison between private, public and utility contractors and City departments.</p> <p>P&M #6: Establish a 3-person City Parks crew dedicated to tree care and emergency tree maintenance.</p> <p>P&M #7: Continue to contract out tree maintenance, care, and removal activities separately from litter removal and other landscape maintenance services.</p> <p>P&M #8: Adopt and implement an urban forest best management practices manual.</p> <p>P&M #9: Review Urban Forest Division Hurricane plan annually and revise, as needed.</p>	<p>C&E #1: Create and implement a public communication, outreach, and marketing plan for the urban forest.</p> <p>C&E #2: Engage and strengthen partnerships with stakeholder groups and City leadership to increase awareness of the importance of the urban forest and the role they play in its health, growth, and sustainability.</p> <p>C&E #3: Establish and implement City policy/standard operating procedures (SOP) to document the process for engaging Urban Forestry, Greenspace Management and Park Maintenance on all City projects, programs, plans and initiatives.</p> <p>C&E #4: Develop and implement a funding program to support additional forestry services, special urban forestry initiatives, and programs to address needs of the urban forest</p> <p>C&E #5: Continue to foster relationships and identify regional leaders to advocate for trees and the important role they play in the sustainability and climate resilience of the region.</p>

TREE CANOPY (TC)		
Protect and increase shade tree canopy to maximize the environmental, economic, health and climate mitigation services trees provide to Miami Beach.		
TARGETS		
Achieve 22% tree canopy cover city-wide by 2040.		
RECOMMENDATIONS & ACTIONS	RESOURCES & TIMELINE	IMPLEMENTATION LEAD
TC #1: Track, quantify, evaluate and report on tree canopy cover trends, including amount and annual benefits.		
ACTION: Conduct a comprehensive tree benefit analysis utilizing ground surveys and the i-Tree Eco application to establish solid baseline data of the benefits both public and private trees provide to the city. Complete every 5 years. ACTION: Complete a high-resolution urban tree canopy (UTC) assessment in 2022 and conduct historical trend and benchmarking analysis of the urban forest metrics identified in the UFMP. Complete a UTC every 5 years.	RESOURCES: Funding, City staff, Consultant TIMELINE: 2020, 2021 <i>Estimated Costs: i-Tree Eco \$10-\$50,000 dependent on size and analysis scope; UTC assessment \$15-30,000 based on project scope.</i>	Urban Forestry Division
TC #2: Develop canopy cover targets and tree planting/preservation plans for neighborhoods that are below the city-wide neighborhood canopy cover average of 15%.		
ACTION: Utilize data from the urban tree canopy assessment and analysis to identify neighborhoods that are below the city-wide canopy cover average of 15% and establish achievable targets for each neighborhood and a timeline to achieve it. ACTION: Develop tree planting and preservation plans for ROW/swale tree planting for neighborhoods below the 15% average canopy cover. Utilize GIS and tree inventory data to identify possible tree planting locations and large trees for preservation activities. ACTION: Create and implement strategies focusing on private property tree planting to encourage residents to help in achieving their neighborhood’s canopy cover target.	RESOURCES: Funding, City staff, Private property owners TIMELINE: 2020-2030	Urban Forestry Division
TC #3: Conduct a tree canopy equity analysis to prioritize outreach and planting efforts in areas of the city where tree canopy is not equitably distributed.		
ACTION: Identify meaningful metric(s) to measure equity in tree canopy distribution in Miami Beach (e.g. rental vs. owner-occupied, median household income, tree benefits per capita, urban heat island index, and human health indicators) ACTION: Conduct analysis overlaying the equity metric GIS layers with the urban tree canopy layer.	RESOURCES: Funding, City staff, Consultant TIMELINE: 2020	Urban Forestry Division
TC #4: Develop a routine maintenance and preservation program focusing on public canopy (shade) trees greater than 18” DBH		
ACTION: Utilize the City’s tree inventory to identify all city ROW and park trees greater than 18” DBH and develop a 2-year inspection and maintenance cycle focused on preservation. ACTION: Utilize the City’s tree inventory to identify all city ROW and park trees 9-17” DBH and develop a 3-year routine pruning and maintenance cycle. ACTION: Create annual budgets with identified funding sources for each program ACTION: Develop tree pruning and care specifications to be included in tree care/landscape contracts	RESOURCES: Funding, City staff, Tree Care Contractors TIMELINE: 2020-2023	Urban Forestry Division Greenspace Management Division Parks Maintenance Division

Tree Canopy (TC) - (Continued)		
Protect and increase shade tree canopy to maximize the environmental, economic, health and climate mitigation services trees provide to Miami Beach.		
Targets		
Achieve 22% tree canopy cover city-wide by 2040.		
Recommendations & Actions	Resources & Timeline	Implementation Lead
TC #5: Utilize the Urban Forest Master Plan Design Toolkit to identify opportunities for tree planting on city projects (e.g. infrastructure, utility, transportation, non-motorized transportation); improve diversity; and ensure that species are suited to the changing site conditions of Miami Beach, including, salt water inundation, flooding, sea level rise, climate change, and invasive pests.		
ACTION: Share Toolbox with engineers, landscape architects and designers to assist in identifying opportunities for increasing shade tree canopy cover as part of City infrastructure projects. ACTION: Promote and utilize the Toolbox’s species lists to increase the planting of shade/flowering canopy tree species (non-palms) to increase species diversity within the city ACTION: Consider implementing moratoriums on the planting of certain palm and tree species, genera or families that are above the 10-20-30 diversity rule. ACTION: Develop public education and outreach materials to promote the Toolbox and communicate the City’s tree diversity goals.	RESOURCES: City staff TIMELINE: As soon as possible	Urban Forestry Division Greenspace Management Division Park Maintenance Division Planning
TC #6: Establish and adopt preferred minimum soil volume standards to achieve optimum size of mature trees.		
ACTION: Utilize the UFMP Toolbox to establish preferred minimum street tree soil volume requirements and add to city code and urban forestry best management practices manual. ACTION: Utilize suspended pavement systems for all reconstruction and new infrastructure projects on both public and private property to meet minimum soil volume requirements. See UFMP Toolbox. ACTION: Educate city departments, contractors and developers about minimum street tree soil volume requirement and methods outlined in the UFMP Toolbox that can be utilized to achieve minimums (e.g. suspended pavement, structural soil, linear planting beds).	RESOURCES: City staff TIMELINE: As soon as possible	Urban Forestry Division Engineering/Capital Improvement Division Planning

PLAN & MANAGE (P&M)		
Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.		
TARGETS		
Implement a 5-year urban forest maintenance plan by 2021.By 2050, palms should make up no more than 25% of the public tree population		
RECOMMENDATIONS & ACTIONS	RESOURCES & TIMELINE	IMPLEMENTATION LEAD
<p>P&M #1: Systematically and routinely update the street and park tree inventory assessing and updating diameter, condition, maintenance need, and risk rating of each tree.</p>		
<p>ACTION: Review attributes collected during yearly tree inventory update program, add risk rating and maintenance needs and revise other attributes, as needed.</p> <p>ACTION: Develop a risk management policy based on risk assessment tree inventory findings, citizen requests, and staff/contractor inspections and establish minimum timelines to address risk.</p> <p>ACTION: Ensure that adequate budget resources are allocated to continue the routine inventory update program where 1/5 of the city is updated each year.</p> <p>ACTION: Develop and implement a standard operating procedure (SOP)/policy for updating the street and park tree inventory following tree maintenance activities conducted by city staff and contractors. SOP should identify inventory attributes required to be updated, who is responsible for completing the inventory updates, and establish a timeline for completion.</p> <p>ACTION: Review current street tree inventory system to ensure it facilitates data sharing between City departments, allows for updating as work gets completed, generates production, and resource reports and can be shared with the non-city stakeholders to facilitate stakeholder engagement efforts.</p> <p>ACTION: Add data from the North Beach Oceanside Park tree inventory to the city’s GIS street and park tree inventory and include park in routine inventory update schedule.</p> <p>ACTION: Utilizing data from tree inventory updates, conduct an i-Tree Eco assessment of the city’s public trees every 5 years to measure changes in the benefits and condition of the city’s publicly managed urban forest.</p>	<p>RESOURCES: City staff and/or Consultants, Funding, Tablets/iPads for in-field tree inventory updates</p> <p>TIMELINE: As soon as possible</p> <p><i>Estimated Costs: To update 1/5 of tree inventory \$40-60,000 per year</i></p>	<p>Urban Forestry Division (Lead) Greenspace Management Division (Support) Park Maintenance (Support) Risk Management (Support)</p>
<p>P&M #2: Explore opportunities to develop a proactive tree maintenance program and transfer all right-of-way/swale tree maintenance responsibility to the City of Miami Beach.</p>		
<p>ACTION: Create a 5-year urban forest maintenance and budget plan based on inventory and risk assessment data that focuses on a goal of proactively caring, maintaining and growing Miami Beach’s public street and park trees.</p> <p>ACTION: Create level of service (LOS) scenarios to determine costs to transfer maintenance responsibility (i.e. tree pruning, tree removal, stump removal and planting) of right-of-way trees to the City of Miami Beach. See Appendix A for LOS scenarios to serve as a guide and initial starting point for creation of the City of Miami Beach’s LOS analysis.</p> <p>ACTION: Evaluate LOS scenarios and broader city goals for mitigating sea level rise, improving pedestrian experiences and building a climate resilient community to compare how each maintenance approach (property owner vs. city) helps or hinders achievements of the broader city goals</p> <p>ACTION: Engage the public and private property owners during the LOS analysis to gain input and feedback.</p>	<p>RESOURCES: City staff</p> <p>TIMELINE: As soon as possible</p>	<p>Urban Forestry Division Greenspace Management Division Risk Management (Support)</p>

PLAN & MANAGE (P & M) - CONTINUED		
Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.		
TARGETS		
Implement a 5-year urban forest maintenance plan by 2021.By 2050, palms should make up no more than 25% of the public tree population		
RECOMMENDATIONS & ACTIONS	RESOURCES & TIMELINE	IMPLEMENTATION LEAD
P&M #3: Track and report on tree care, planting, and maintenance activities completed each year.		
ACTION: Investigate using a GIS-based tree/asset management software system (e.g. TreeKeeper; Cityworks, PubWorks) to manage, track, and report on tree maintenance and planting activities. ACTION: Develop standard operating procedure (SOP) for entering, completing, and closing work orders, and how data is managed and tracked. ACTION: Hire an intern in the Urban Forestry Division to input private tree data from tree permit applications and private development projects into Open Tree Map.	RESOURCES: City staff, Funding (intern & asset management software) TIMELINE: As soon as possible	Urban Forestry Division Greenspace Management Division
P&M #4: Focus tree planting program on locations that advance city canopy cover goals, planting priorities, and climate adaptation efforts.		
ACTION: Utilize the Green Infrastructure Center’s tree planting calculator to identify the number of trees needed to be planted on public and private property to meet canopy cover targets. ACTION: Develop 5-year street tree planting plan for the G.O. Bond program focusing on gaps in tree canopy, equity, flood mitigation, urban heat island reduction, climate adaptation and other city planting priorities. Utilize the DRG canopy analysis data to correlate canopy percentages per street with stocking levels per street to aid in plan development. ACTION: Continue free tree giveaway program and explore the development of other programs to encourage, support, and incentivize private property tree planting. ACTION: Create outreach materials to educate community on the benefits of trees, city tree planting goals, proper tree planting, post planting care, and establishment (e.g. watering, mulching, and young tree pruning. ACTION: Develop, plan and participate in school Arbor Day celebrations to promote the benefits of trees and the importance of tree planting to the next generation of community leaders. ACTION: Engage non-profit organizations and regional partners to support and help promote private property tree planting. ACTION: Identify and secure funding to support public and private tree planting efforts.	RESOURCES: City staff, Funding TIMELINE: As soon as possible	Urban Forestry Division (Lead) Greenspace Management Division (Support)

PLAN & MANAGE (P&M) - CONTINUED

Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.

TARGETS

Implement a 5-year urban forest maintenance plan by 2021.By 2050, palms should make up no more than 25% of the public tree population

RECOMMENDATIONS & ACTIONS	RESOURCES & TIMELINE	IMPLEMENTATION LEAD
P&M #5: Establish a tree inspector position responsible for enforcing city tree ordinances and serving as an in-field liaison between private, public and utility contractors and City departments.		
ACTION: Develop position description for tree inspector position outlining the tree related experience, education and certifications required for the position. Identify which Division should house position ensure maximum effectiveness in enforcing tree protection and preservation ordinances and policies and procedures. ACTION: Utilize position description and demonstrated need to justify position and secure funding to hire the position.	RESOURCES: City staff, Funding (position) TIMELINE: 2021	Urban Forestry Division (Lead) Code Compliance Division (Support)
P&M #6: Establish a 3-person City Parks crew dedicated to tree care and emergency tree maintenance.		
ACTION: Develop position descriptions for Park tree care crew members outlining the tree related experience, education and certifications required for the position. ACTION: Utilize position description and demonstrated need to justify positions and secure funding to establish a City Parks tree care crew.	RESOURCES: City staff, Funding (position) TIMELINE: 2021	Parks and Recreation (Lead) Urban Forestry Division (Support)
P&M #7: Continue to contract out tree maintenance, care, and removal activities separately from litter removal and other landscape maintenance services.		
ACTION: Review tree bid document tree care and maintenance specifications annually to ensure contractors are performing work based on the best available science and research. Engage Green Industry partners (e.g. Florida Chapter ISA, FGNLA) in reviewing tree care specifications ACTION: Share tree pruning specifications with other city Divisions/Departments for use in bids/ contracts.	RESOURCES: City staff TIMELINE: 2021	Urban Forestry Division Greenspace Management Division Park Maintenance

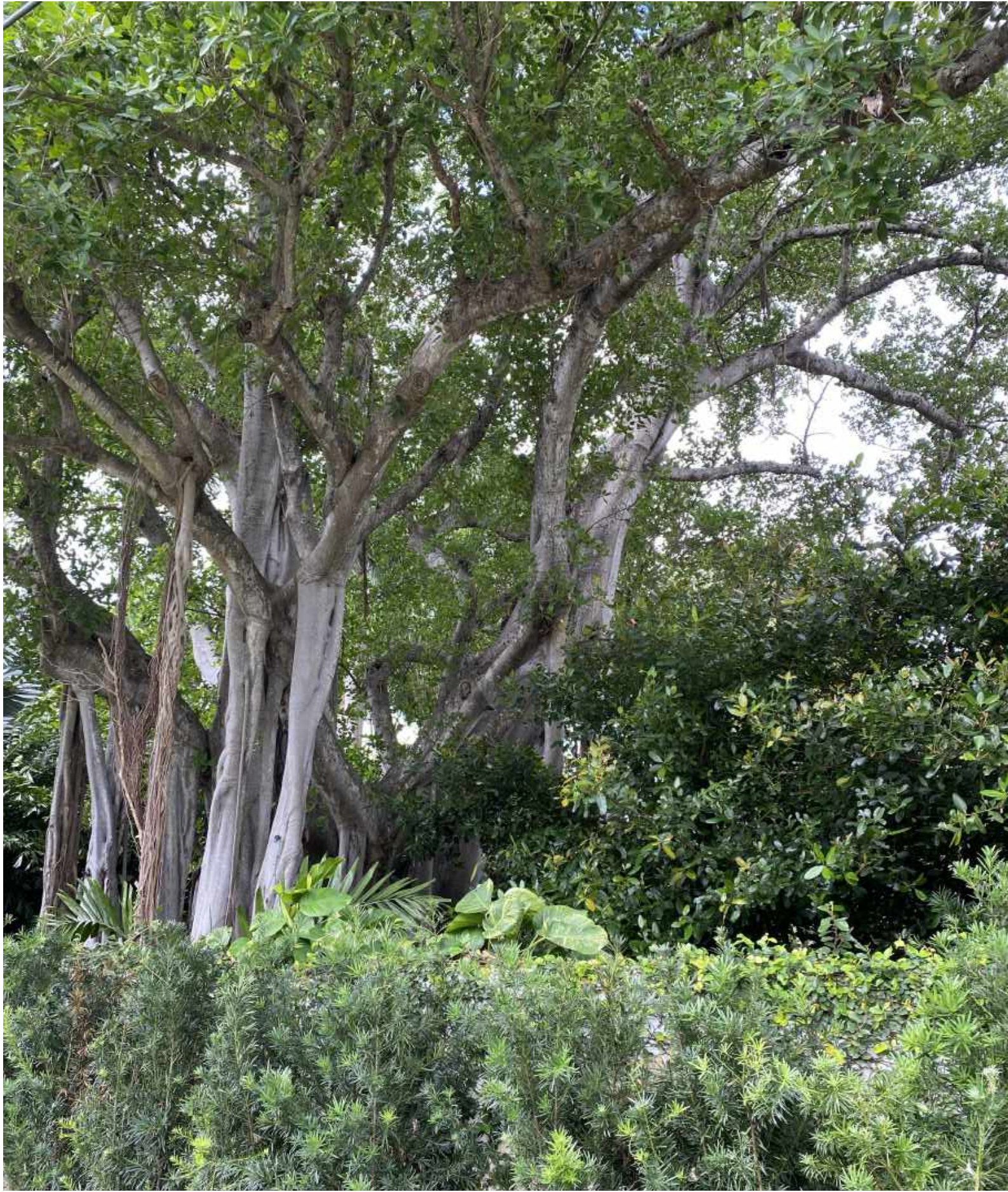
PLAN & MANAGE (P & M) - CONTINUED		
Sustainably plan and manage the urban forest to help mitigate the effects of climate change and support Miami Beach’s climate adaptation efforts.		
TARGETS		
Implement a 5-year urban forest maintenance plan by 2021.By 2050, palms should make up no more than 25% of the public tree population		
RECOMMENDATIONS & ACTIONS	RESOURCES & TIMELINE	IMPLEMENTATION LEAD
<p>P&M #8: Adopt and implement an urban forest best management practices manual.</p>		
<p>ACTION: Identify tree care activities that need best management practices (BMPs), which may include species selection and tree diversity; site selection and minimum soil volumes; proper tree planting; post planting care; watering; mulching; tree protection and construction; tree preservation.</p> <p>ACTION: Review research and publications on generally accepted industry best management practices related to trees, urban forest maintenance and management activities that support city priorities.</p> <p>ACTION: Engage Green Industry partners ((e.g. Florida Chapter ISA, FGNLA) in the development of the BMPs and provide opportunities for their review and feedback.</p> <p>ACTION: Publicize and communicate BMP manual to internal and external users. Explored developing an interactive webpage on the City’s website where BMP manual can be accessed.</p>	<p>RESOURCES: City staff</p> <p>TIMELINE: 2020-2021</p>	<p>Urban Forestry Division Greenspace Management Division Park Maintenance</p>
<p>P&M #9: Review Urban Forest Division Hurricane plan annually and revise, as needed.</p>		
<p>ACTION: Develop a routine cycle to review and update plan.</p> <p>ACTION: Regularly train city staff (all City Divisions) on the Urban Forest Division Hurricane plan procedures and provide timely communication of plan updates.</p>	<p>RESOURCES: City staff</p> <p>TIMELINE: 2020</p>	<p>Urban Forestry Division (Lead) Greenspace Management Division (Support) Park Maintenance (Support)</p>

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.		
TARGETS		
Release an annual State of Miami Beach Urban Forest Report beginning in 2021.		
RECOMMENDATIONS & ACTIONS	RESOURCES & TIMELINE	IMPLEMENTATION LEAD
C&E #1: Create and implement a public communication, outreach, and marketing plan for the urban forest.		
ACTION: Develop cohesive and consistent messaging related to specific urban forestry or tree care topics, which may include benefits of tree, proper tree planting, watering, young tree pruning, tree permitting requirements, etc. ACTION: Review current tree/urban forestry related outreach and educational materials. Revise and develop materials based on City priorities. ACTION: Involve and engage the City’s Marketing and Communication department to assist in the development and implementation of the public community, outreach and marketing plan. ACTION: Develop and implement a strategy for regular dialogue with the community about the urban forest using a mix of communication tools ACTION: Utilize new communication/engagement strategies and identify those that have been successfully utilized by the City in the past. Communication and engagement strategies could include: Tree Festivals or Arbor Day celebrations; “Ask the Arborist” booth at local events (e.g. Farmer’s Market); Photo or poster contests celebrating trees. Display entries in public spaces; Citizen forester/pruner volunteer program; Presentation and workshop to local garden clubs, and other groups.	RESOURCES: City staff, Funding (Tree Trust Fund) TIMELINE: 2020-2021	Urban Forestry Division (Lead) Marketing and Communication Department (Co-Lead) Greenspace Management Division (Support) Park Maintenance (Support)
C&E #2: Engage and strengthen partnerships with stakeholder groups and City leadership to increase awareness of the importance of the urban forest and the role they play in its health, growth, and sustainability.		
ACTION: Identify key contacts within each stakeholder group. ACTION: Involve and engage the City’s Marketing and Communication department to assist in developing tailored engagement strategy for each stakeholder group. Prioritize development of engagement strategies based on the current needs of the urban forest and the urban forestry program. Engagement strategies for each stakeholder for each stakeholder group may include: CITY COMMISSION AND COMMITTEES - build awareness of the important role that trees and the urban forest play in meeting Miami Beach’s goals to be a climate-resilient and sustainable city and the actions they can take to support implementation of the Urban Forest Master Plan. NEIGHBORHOODS AND RESIDENTS – education on tree permit process, planting, care and proper pruning DEVELOPERS & LARGE LANDOWNERS - focus on tree planting, care, ordinance requirements and tree canopy UTILITY AND STATE AGENCIES - fostering a collaborative relationship and tree canopy cover GREEN INDUSTRY INVOLVEMENT - identify ways they can support implementation of the UFMP NON-PROFIT ORGANIZATIONS - focus on tree canopy goals and supporting tree planting effort	RESOURCES: City staff, Funding TIMELINE: As soon as possible	Urban Forestry Division (Lead) Marketing and Communication Department (Co-Lead) Greenspace Management Division (Support) Park Maintenance (Support)

CONNECT & ENGAGE (C&E) - CONTINUED		
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.		
TARGETS		
Release an annual State of Miami Beach Urban Forest Report beginning in 2021.		
RECOMMENDATIONS & ACTIONS	RESOURCES & TIMELINE	IMPLEMENTATION LEAD
C&E #3: Establish and implement City policy/standard operating procedures (SOP) to document the process for engaging Urban Forestry, Greenspace Management and Park Maintenance on all City projects, programs, plans and initiatives.		
ACTION: Develop list of all City department projects, programs and initiatives and identify how Urban Forestry, Greenspace and Parks should be engaged to preserve, protect and expand the City’s urban forest ACTION: Share the Urban Forest Master Plan with the City’s Capital Improvement, Engineering and Transportation Divisions to inform development and implementation of City plans and projects. ACTION: Host lunch and learn sessions or other programs to communicate, educate and engage City departments about the Urban Forest Master Plan and the roles they can play in its implementation.	RESOURCES: City staff from all Divisions and Departments TIMELINE: As soon as possible	Urban Forestry Division (Lead) Greenspace Management Division (Support) Park Maintenance (Support)
C&E #4: Develop and implement a funding program to support additional forestry services, special urban forestry initiatives, and programs to address needs of the urban forest		
ACTION: Prioritize UFMP Recommendations and Action Steps, identify which ones to address first and research funders and opportunities that will support implementation of these efforts. ACTION: Utilize marketing, outreach, and communication materials developed in C&E #1 to market efforts to potential funders. ACTION: Develop a system to track grant and philanthropic funding opportunities, allowing for quicker turnaround in pursuing grants when opportunities arise	RESOURCES: City staff TIMELINE: 2020	Urban Forestry Division (Lead) Greenspace Management Division (Support) Park Maintenance (Support)
C&E #5: Continue to foster relationships and identify regional leaders to advocate for trees and the important role they play in the sustainability and climate resilience of the region.		
ACTION: Continue to identify and engage key groups and individuals from Southeast Florida Climate Compact and other regional organizations that are developing and implementing climate resilience and sustainability strategies. Share Urban Forest Master Plan and identify specific recommendations and actions they can help advance. ACTION: Utilize marketing and outreach efforts development in Recommendation C&E #1 to provide outreach and educational materials about the Miami Beach Urban Forest Master Plan, the recommendations that help meet regional climate resilience and sustainability goals and how regional groups can support their implementation.	RESOURCES: City staff TIMELINE: On-going	Urban Forestry Division Sustainability and Environment Department



**HOW ARE WE
DOING?**



HOW ARE WE DOING?

The UFMP provides an overarching framework to guide the City of Miami Beach in the sustainable and strategic preservation, management, maintenance and growth of a resilient urban forest. It presents a high-level review of Miami Beach’s urban forest, its benefits, the City’s management program, historical context and the unique challenges it faces. Utilizing this information, the Plan connects the city’s vision of the urban forest with goals and recommendations to achieve it.

MONITORING AND MEASURING RESULTS

The UFMP is a living document that requires annual review and updates based on changes in the urban forest resource and city priorities, and new research and information.

Annual Plan Review and Update

The UFMP is an active tool that serves as a guide for management and planning decisions over the next 20 years. The goals, targets, recommendations, and actions should be reviewed yearly for progress and integration into annual work plans. The UFMP presents a long-range vision with timeframes that are intended to be flexible, to allow for adaptations in response to emerging opportunities, available resources, storm events, emergencies and changes in community priorities. Each year, specific areas of focus should be identified to inform budgets and resource allocations.

Resource Analysis

Miami Beach’s urban forest managers can update the tree resource analysis over time and in conjunction with inventory database updates. The benefits described in the UFMP are based on information from the 2017 street and park tree inventory and 2018 urban tree canopy assessment. Future studies can compare changes against these benchmarks, providing opportunities to evaluate changes in species diversity, benefits and the overall resource value. The UFMP recommends completing this analysis every five years to measure progress and success towards achieving plan goals, targets and recommendations.

Canopy Analysis

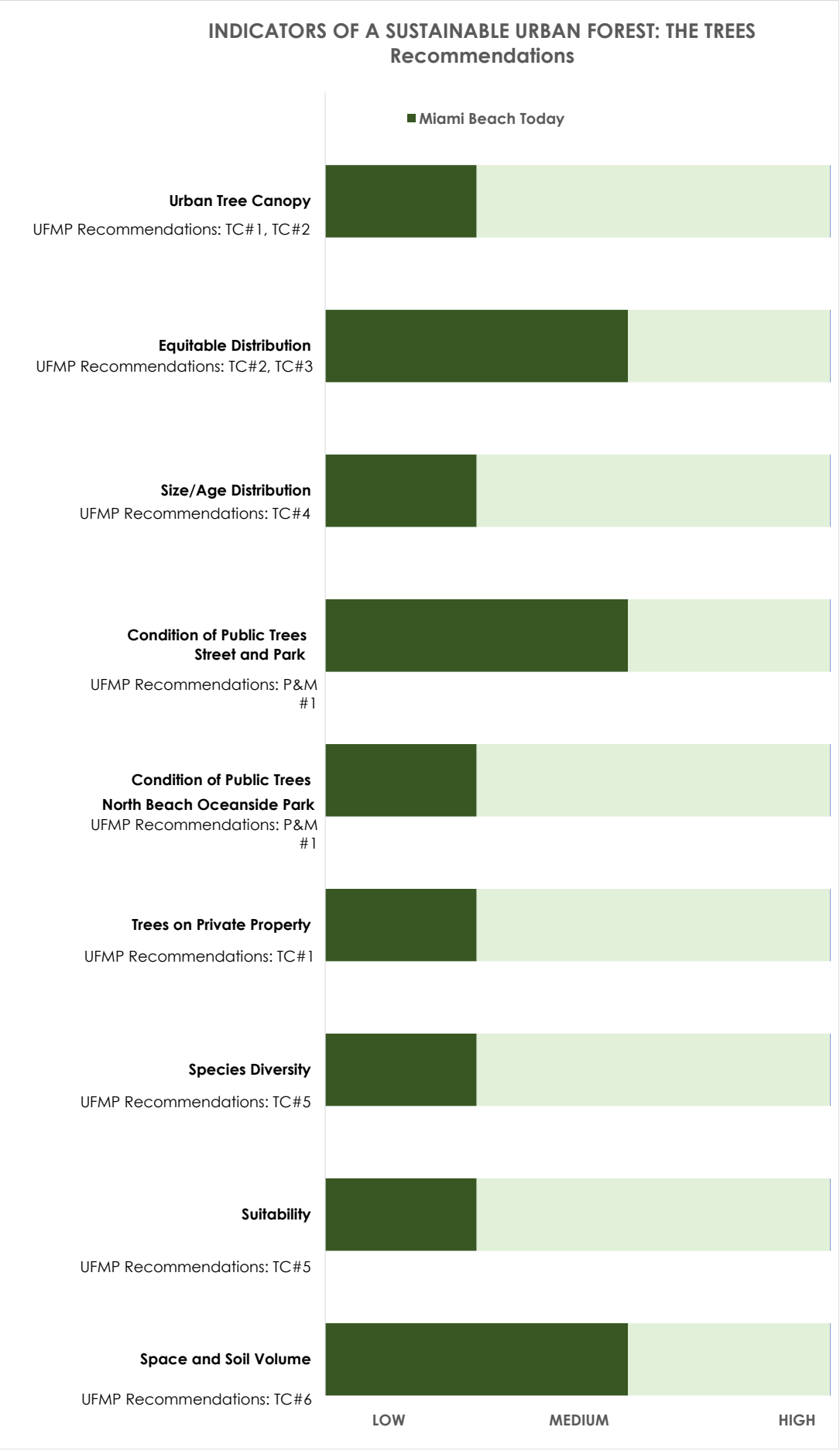
Canopy changes can occur gradually or suddenly. Using GIS analysis, Miami Beach can measure and illustrate changes to tree canopy and overall land cover, at a variety of scales from city-wide to neighborhood level. This information can be used to inform canopy goals and monitor attainment. A canopy study should be conducted every five years, or after major canopy-impacting events.

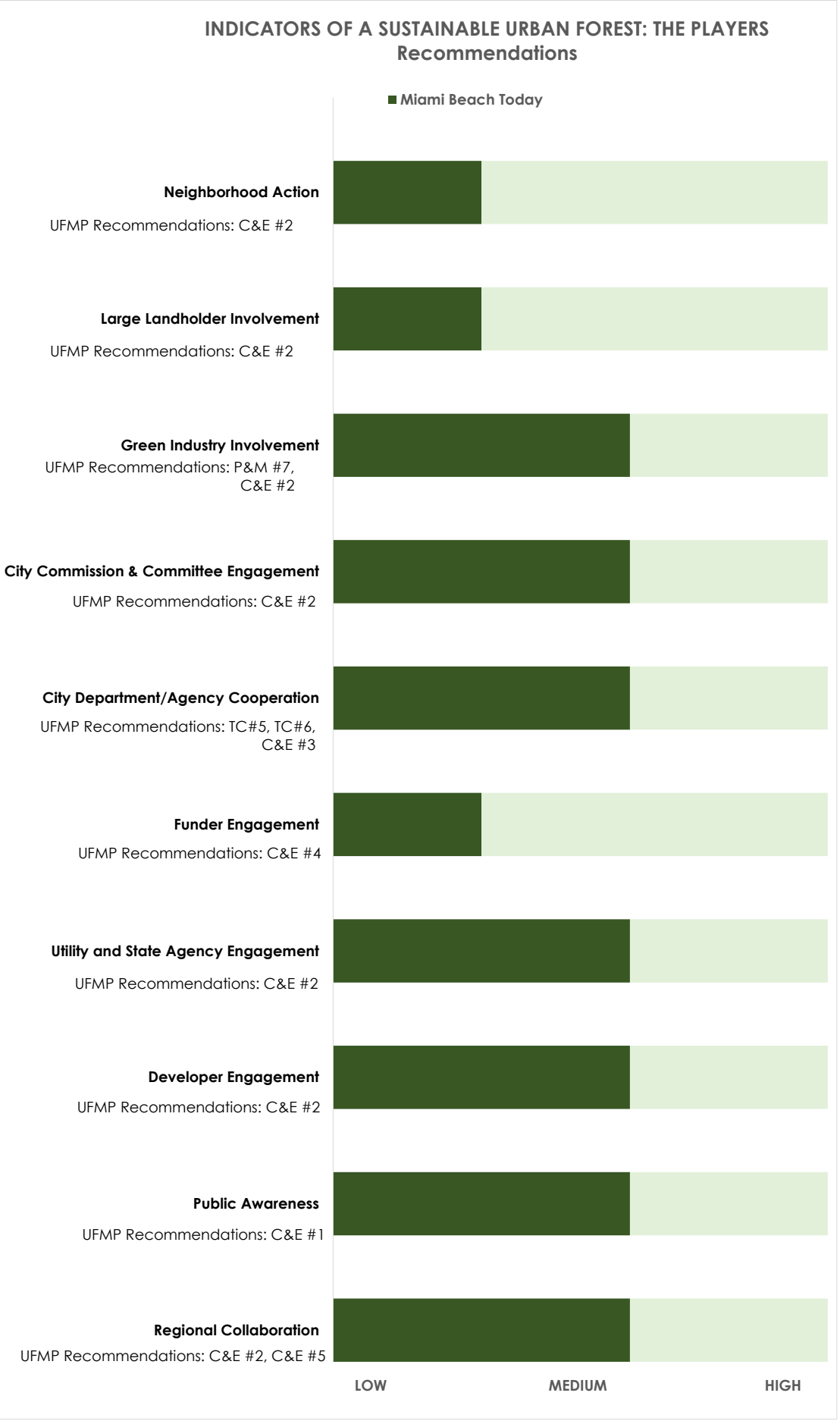
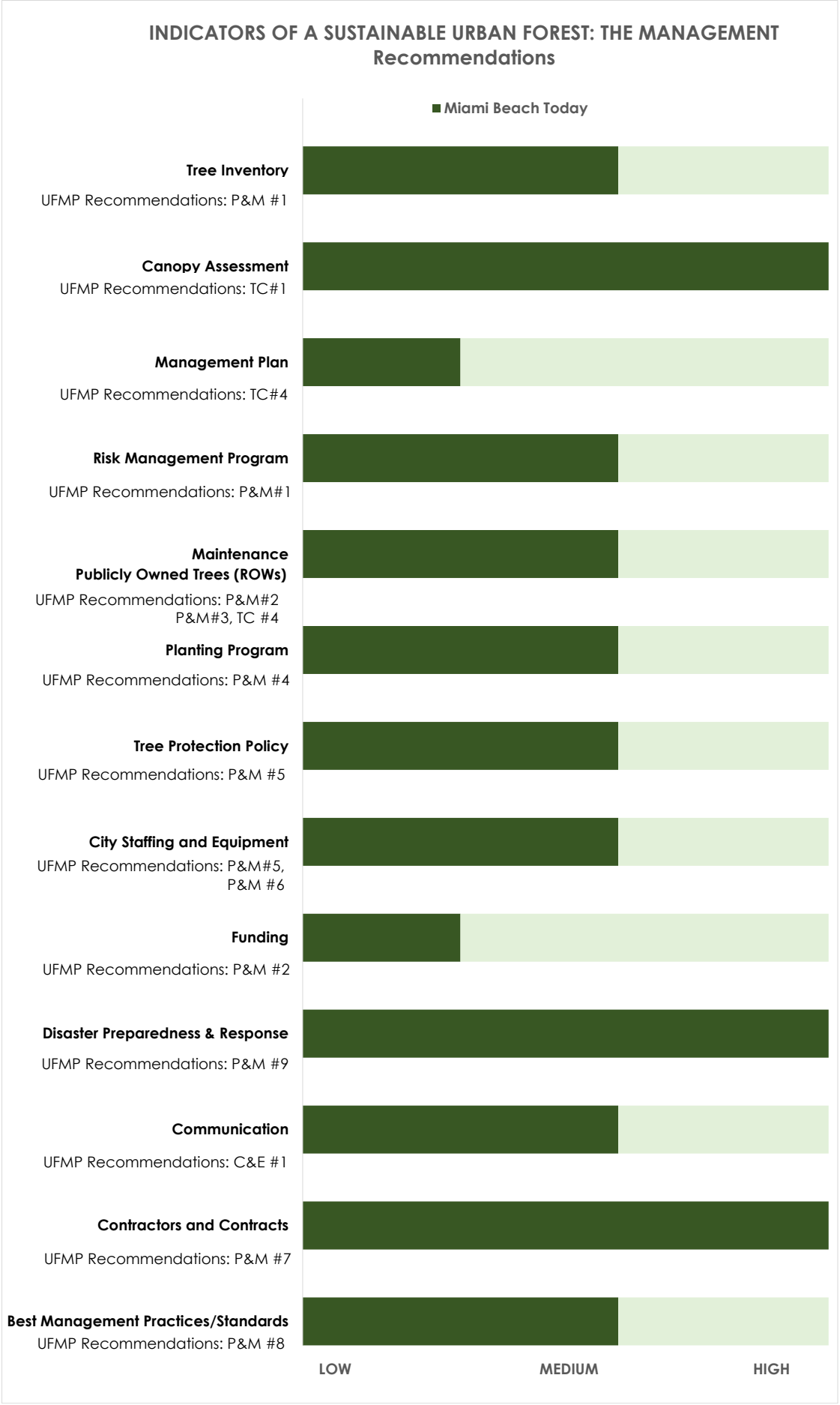
State of the Urban Forest Report

This report delivered to elected officials, key urban forest stakeholders and the community each year includes numbers of trees planted and removed, and changes to the overall community urban forest (e.g., structure, services, and value). It serves as a performance report for the community, and as an opportunity for engagement. The State of the Urban Forest report can highlight successful attainment of UFMP goals, targets and recommendations, as well as inform the community about any issues or challenges. This information can be integrated into the urban forest managers’ Annual Plan Reviews and be used to pursue additional project support and funding.

Indicators of a Sustainable Urban Forest

The assessment of the sustainable urban forest indicators at the beginning of the plan development process, established the baseline of where Miami Beach’s urban forest is today. The goals, targets, recommendations and action steps are tied to these indicators and are designed to move Miami Beach towards a high-performance level and achieving a sustainable urban forest. As the baseline metric, the indicators can be assessed periodically to measure progress in Plan implementation and to develop an annual State of the Urban Forest report to share program successes, challenges and opportunities with the community. The charts in this section provide the recommendations associated with each of the Indicators of a Sustainable Urban Forest.







SECTION II: DESIGN TOOLBOX

The City of Miami beach has made amazing strides towards fulfilling many of the City’s goals towards leading the state and the region in climate adaptation, resiliency preparation and planning, and incorporating sustainability practices and policies. The urban forestry master plan, together with the many recommendations included in the report, are another step in that positive direction. In this ‘Toolbox’ section, the document will target specific, design-related implementable components and strategies to move the city even closer to achieving those goals. A large and contributing component is how trees can be planned, planted and maintained in areas of the public right-of-way. Uniquely, because of the City’s urban pattern and its desirability as a preeminent destination in the southeast region of the US, there are many demands competing for space in the limited right-of-ways. This section seeks to establish strategies to facilitate good urban canopy policies to be put into practice.

The public right-of-ways and streets of Miami Beach are a challenging sort to readily promote and support a robust urban forest. The development patterns, predominantly in the South Beach and North Beach neighborhoods, are not readily conducive to planting street trees without the employment of substantial design and the use of green infrastructure, balanced with traditional grey infrastructure. Particularly to these two areas, the complete utilization of the public right of way for the accommodation of vehicular transit, parking, and at times bike lanes leaves space for minimum pedestrian sidewalks. Currently, as it stands, the majority of the public right of ways in the North Beach area are only 50-feet wide, while the ones in the South Beach area are either 55-feet wide (for west-east streets) or 65-feet wide (for north-south streets). Specific to the accommodation of urban trees within the limited available public right of ways, un-compacted soils and space for tree-root growth is minimal at best, or, for the most part, simply non-existing, but the challenges and competitiveness for available space isn’t limited to just mobility or connectivity. In addition to the physical limitations of ground surface area, urban canopies are spatially limited by either the presence of overhead powerlines that limit vertical clearances or the presence of building facades 25 feet or taller with minimal setbacks that also limit horizontal clearances. Both of these contribute to the minimization of the overall urban canopy.

Underground, the situation is not any better. The position and location of underground utilities beneath sidewalks obliterate opportunities for substantial tree planting. A ubiquitous road section design utilizing a traditional crowned approach requires that all drainage components and grey infrastructure be located at the interface of the roadway with the pedestrian areas. These are mediated within the densely urban areas of North Beach and South Beach and portions east of Indian Creek of Mid-Beach by traditional FDOT Type F curb-and-gutter assemblies. Elsewhere in areas categorized with a predominant single-family land use, the interface takes the shape of a pervious swale that is more forgiving for the accommodation of street trees. To complicate matters, the high velocity winds of hurricane storms and the over-saturation of the ground’s soils brought forth by the onslaught of torrential rains, together, are unforgiving to urban trees that are not structurally sound, whose canopies aren’t well-balanced, and whose roots aren’t well-established to properly anchor the tree. As such, investing in planting trees within the public right of way requires careful planning and focused engineering strategies in order to protect these investments.

The engineering strategies needed are not limited to balancing all the competitive elements needed to be housed within the public right of way; they also include the need to take into consideration the design needs of a streetscape designed to adapt to the impending rise of sea levels. As sea levels rise, areas within the city that are highly urbanized, will also see a rise of groundwater with increasing levels of salinity. The increase in salinity is directly resulting from the lack of adequate pervious land coverage areas. These reduce the ability of the substrate to become saturated and thus facilitates some of the upward climb of the denser, salt water. As groundwater with increased salinity rises and comes into contact with the root networks of trees and palms, it begins to choke the vegetation’s ability to extract freshwater and nutrients from the soil, eventually killing the plant.

In response to a prognosticated rise of the sea’s levels, the City is embarking on a prioritization of streets to eventually raise them so the crown of the road meets a minimum pre-determined elevation: currently, at the time of drafting this document, that elevation is set at +3.7 feet. As these modifications come on-line, it is important to recognize the impact these physical changes will have on trees; conversely, it is also important to recognize the impact of an established tree as a fixed elevation point around which the streetscape improvements need to be designed if the goal is to preserve as many trees as possible. As such, in the interim (between the time trees are planted and the roadway is raised, if the trees are planted first, then they should be planted in a manner that anticipates the raising of the street and its ability to be adaptive.

Because of all of the aforementioned reasons, coupled with the fact that adapting to sea level rise is in itself an adaptive process that is chasing a moving target (as forecasts for how much rise the sea levels will have varies on who analysis what set of data), this ‘Toolkit’ is not just an important component of this urban forestry master plan ... it is vital! In order to adequately utilize the financial resources of the City in a fiscally-responsible manner to maximize the investments made in the urban forest and in making every attempt to ensure its survival, engineering solutions to deal with traffic and drainage in the public right of ways cannot be singularly-focused only on the most optimized design for vehicular movement or drainage at the sacrifice of urban trees.

This ‘Toolbox’ will focus on three key topics:

SELECTING THE RIGHT TREE.

This section will lay out design considerations that should be made when selecting what species or characteristics of tree should be sought after in the design process. Lists of specific trees, both native and Florida-friendly, will be provided to serve as the underlying basis for establishing and promoting the overall diversity of vegetation throughout the City.

TREE PLANTING – AN URBAN STRATEGY.

This section will generally identify where specific species should be used in an overall, urban strategy, focused on establishing city-wide themes, vegetative wayfinding, and reinforce localized identities and economies. It will also provide case studies on how adaptation to sea level rise in three specific locations can be phased-in to ensure the continuity of canopy coverage, as the local vegetative environment slowly transitions and adapts.

TACTICS FOR PLANTING TREES.

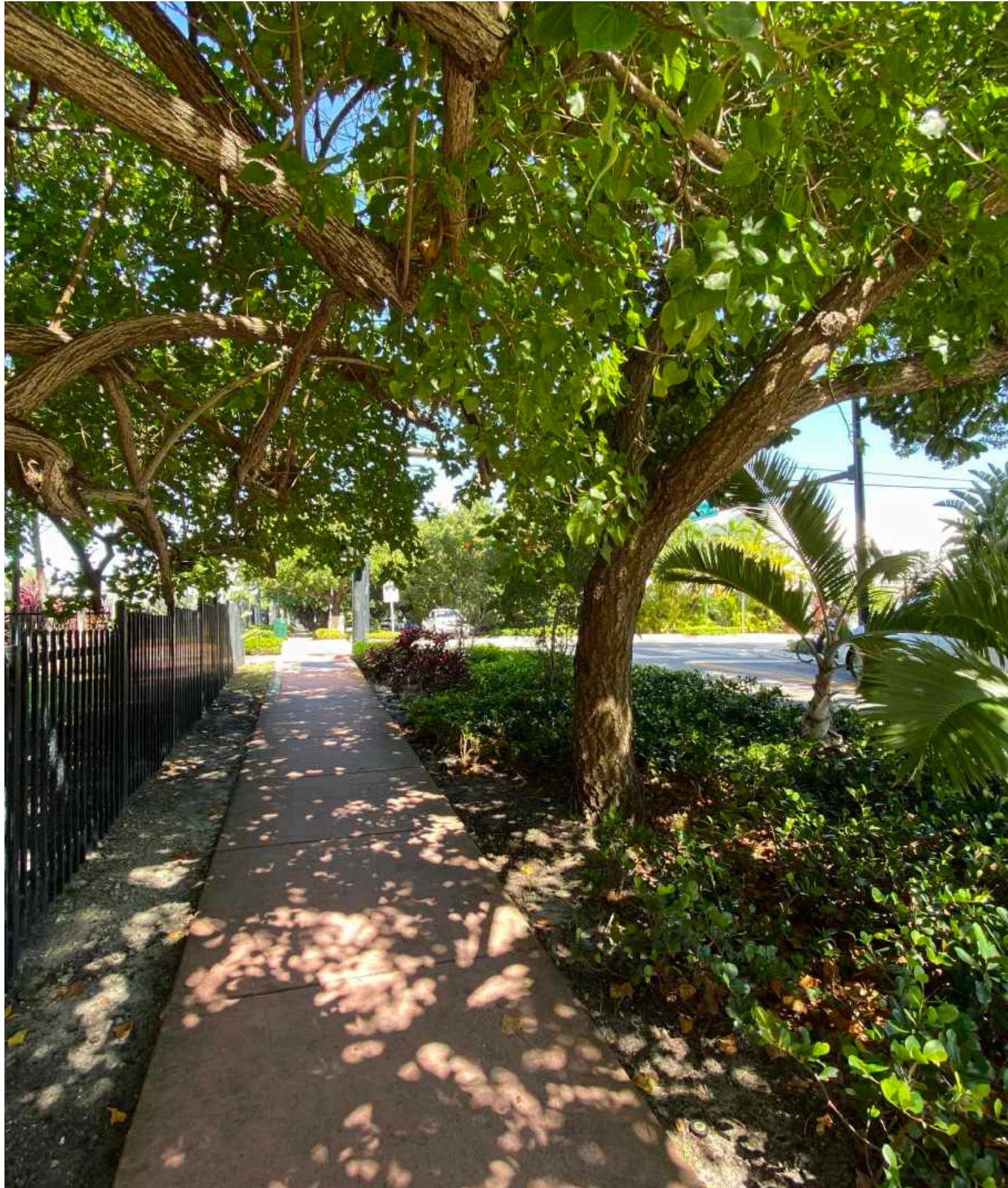
This section will focus, predominantly, on what design criteria need to be taken into account at the time of designing streetscapes, designing improvements within the public right of ways, or modifying existing roadways that consider the placement and survivability of trees. Recommendations will be made based on street types.

This Tool-kit is intended to be a ‘living’ document. As the future becomes uncertain and as Miami Beach and other cities around the world begin to exercise plans for modifying the built environment to prepare and pre-empt the oncoming impacts of climate change, it is recommended that this portion of the document be revisited and updated at least every 5 years between its adoption and 2030. This will allow the City to incorporate yet-unknown new technologies that may come on-line in the future and it will allow for opportunities to modify the document to reflect results from lessons learned in projects built throughout Miami Beach and elsewhere in the world.



TREE SELECTION





SELECTING THE RIGHT TREE

AN OVERVIEW OF CONSIDERATIONS FOR ADEQUATE TREE SPECIE SELECTION

The election of a specific tree species or type for use in any given location should be driven by a series of considerations that the receptor location poses. The different considerations need to weigh against each other to determine what is most important for that location for that given situation. As such, it is important to note at this juncture that no tree will be the “most” perfect fit for any given site, but rather its selection should be a compromise of the various priorities challenging the subject location. Taking into account these various issues at the time of selecting specie will increase the trees ability to adapt to the City’s urbanized qualities.

Miami Beach, different to other areas in Miami-Dade County, is a barrier island. As the effects of climate change come into being, the current conditions that are predominantly found on the seaward edge of the City may soon be the baseline climatic condition experienced throughout the entire island community. Therefore, it is important to look to nature and to identify what natural landscape habitats have evolved to deal with this type of environment, characterized by

- a high exposure of salinity in the ocean breeze,
- a high resin content in its trunk and branch wood to resist the perseverant and constant wind patterns typical of a barrier island,
- the ability to tolerate degrees of salinity in its groundwater,
- drought tolerance and the ability to grow in areas of extreme heat and high sun-exposure,
- the ability to sustain short bursts of saltwater inundation that can result from occasional storm surges, and
- the ability to grow in areas with medium to minimal soil volumes.

As such, the predominant landscape habitat that should serve as a foundation for the tree species palette is that of the Sub-tropical Maritime Hammock, whose canopy is predominantly made up of oaks, gumbo limbos, mangroves, buttonwoods, and several palm species. Secondary to the Sub-tropical Maritime Hammock, where the density of the built urban environment affords proper shielding and protection against the more extreme of the barrier island conditions, are vegetation that typically grow within the Sub-tropical Pine Rocklands with its more expansive palette of trees and palms.

Lastly, trees and palms native to Florida will provide the greatest chance of establishment and long-term survivability; however, this should not discard prominent Florida-friendly species that are well-adapted and well-suited to these conditions. It is important to note that as climate change, and specifically global warming modifies the historic boundaries between tropic and sub-tropical areas, a greater access to potential species may be granted in the years to come.

This Tool-kit takes into account a broad range of species from current Sub-tropical habitats around the world and Caribbean areas that are commercially available for consideration in their use throughout the City. Additionally, we have included species that are either Florida-friendly or appropriate for the City but not commercially available - the latter of which the City may consider to contract-grow.

CRITERIA AFFECTING ADAPTABILITY AND RESILIENCE IN URBAN CONDITIONS

In developing the *Master Tree and Palm Palette* list for the City’s urban forester, a series of criteria were considered when narrowing down the selections. These take into account several of the factors needed to ensure that selected trees and palms inherently have a better chance of surviving within the densely urban qualities of Miami Beach. The rationale is that by focusing on these more extreme conditions in the City, a list can be arrived at that can serve both the areas of highest constraints (as the North Beach and South Beach multi-family areas and the commercial and hotel use corridors) as well as those areas more forgiving to the growth of trees (single-family home use areas and the residential islands). As such, it is important that this list be re-visited every time the plan gets updated to either add or removed selected species based on availability or performance, respectively.

A matrix has been prepared to index several of these criteria and score the themes of consideration in order to ascertain what species are best adapted to urban qualities. These themes include the following list that represents the highest priorities of characteristics for survivability and climate change resilience specific to Miami Beach’s barrier island condition.

- 1. Drought and Urban Heat Island Tolerance
- 2. Leaf or Fruit Litter
- 3. Maintenance Required
- 4. Overall Longevity
- 5. Resilience to Relocation
- 6. Root System Characteristics
- 7. Salt Tolerance
- 8. Shade Cast
- 9. Storm and High-Wind Tolerance
- 10. Tolerance to Crown-Raising

For each of the above-referenced characteristics, a score has been assigned corresponding to its performance in each category. A value has been assigned, ranging between 1 (lowest) to 5 (highest), that best describes how that specific specie generally performs. All scores are then added together to determine an overall score with a highest possible cumulative point value of 50.

The overall scores for each species are then expressed as a Percentage of Likeliness of Adaptability and Resilience.

It is important to note that these scores only serve to identify the likeliness of any given specie to survive some of the harsh growing conditions in the more densely urban



areas of the City. This is assuming that every effort is made to provide the trees and palms with adequate volumes of soils for proper root growth, are regularly irrigated, and are properly maintained. A high score does not immediately mean that any specific specie is the most preferred specie election for any given situation. Additional design considerations need to be made to finally hone in on the appropriate specie and size specifications selection. These are further discussed in the next section of this chapter.

The matrix is not intended to be a vehicle to assume that corners can be cut at the time of adequately planning for future improvements. For example: if a specific specie ranks high in drought tolerance and in its root system characteristics, it does not mean that minimal planting areas with low soil volumes can be used to save money.

Finally, an acknowledgement needs to be made that the species best suited for consideration should be Florida Friendly and Florida Native species. Among them, the following considerations should be observed:

- Species best-suited to beachfront exposure and the relentless salt-spray
- Species that have a proven track-record of growing in severe, inhospitable urban environments
- Species that relocate and transplant well
- Species that can tolerate salinity in the groundwater



Drought and Urban Heat Island Tolerance

This measure for drought tolerance is based on the characteristics exhibited by the tree/palm at maturity, as plants generally require less water once established and adapted to their planted location. Additionally, a high degree of an urban heat island effect will exacerbate the evaporation of moisture content within the soil and will create pseudo-drought-like conditions within built-out areas.

- Score of 1 = Not tolerant
- Score of 3 = Somewhat tolerant
- Score of 5 = Highly tolerant



Maintenance Requirements

There is no such thing as a maintenance-free tree or palm; however different species will require different maintenance regimes, either in the form of fruit removal, frond removal, the need to thin out dense canopies or root control. Trees will inevitably require higher levels of maintenance when younger until they are trained and established to meet the needs/design criteria of their unique placement.

- Score of 1 = Requires high maintenance
- Score of 3 = Requires some maintenance
- Score of 5 = Requires low maintenance



Leaf or Fruit Litter

There is no such thing as a litter-free tree or palms. They will either shed leaves/fronds, fruit or flowers depending on its seasonal growth cycle. Large fleshy flowers or fruits that are numerous, excessively woody or which had thick flesh can particularly be concerning if planted over designated pedestrian areas.

- Score of 1 = Produces litter of considerable concern
- Score of 3 = Produces litter that is manageable
- Score of 5 = Produces litter in minimal quantities.



Overall Longevity and Life-span

Continuity of the urban canopy and a maximization of the potential benefits that trees provide are best manifested in mature and established trees. This metric measures the life-span of the specie’s when planted in an urban context, assuming appropriate standards of care are administered including watering, fertilization, corrective pruning, etc.

- Score of 1 = Short lived, less than 30 years.
- Score of 2 = Moderate life span, 31 to 80 years.
- Score of 3 = Somewhat long-lived, 81 to 150 years
- Score of 5 = Long-lived species, greater than 151 years



Resilience to Relocation

Given a sandy substrate or urban over-compacted soils, some species will relocate better than others. This is due to the rapid percolation of water in the existing substrate or the inability for specific root systems to re-anchor in a reasonable amount of time where they don't become a target liability of concern. For the most part, small trees and palms will relocate better than shade and large canopy trees

- Score of 1 = Does not relocate well
- Score of 3 = Generally relocates satisfactorily
- Score of 5 = Relocates well



Root System Characteristics

This is a measure of how problematic the specie's root can be, assuming adequate planting standards are met with a reasonable soil volume for growth. Of great consideration is the impact roots have on adjacent hardscape investments, be they pedestrian walkways, pedestrian-use areas, roadways, underground utilities, building foundations, and grey drainage infrastructure.

- Score of 1 = Strong expansive roots, very problematic
- Score of 3 = Somewhat problematic
- Score of 5 = Not problematic



Storm and High-Wind Tolerance

High wind events are a standard in South Florida. Assuming a satisfactory root growth is established, this metric rates each specie's susceptibility to being toppled-over by wind gusts or to branch and limb breakage. Trees with a lower rating may be best-suited for park areas and open space areas, whereas species with a high rating are best-suited for highly trafficked or transited areas, or areas near critical infrastructure.

- Score of 1 = Low tolerance to high winds
- Score of 3 = Moderate tolerance to high winds
- Score of 5 = High tolerance to high winds



Salt Tolerance

Because of Miami Beach's unobstructed exposure to salt-spray, particularly on the seaward-side of the barrier island, each specie's ability to tolerate exposure to salt is a critical metric for consideration. As climate change increases the salinity of Biscayne Bay, areas on the western sides of the island that today experience reduced amounts of salinity exposure are expected to see an increase in salt exposure.

- Score of 1 = Low salt tolerance
- Score of 3 = Some salt tolerance
- Score of 5 = High salt tolerance



Shade Casted

The ability for any given specie to curtail against the heat island effect or to promote pedestrian walkability is directly related to how densely shaded its canopy can be. While palms will cast more shade the lower the canopy is to the ground, as they grow the shade that they cast can be rather negligible (unless they're clustered in groups). As such, palms are all rated with the score of 1.

- Score of 1 = Low shade casted
- Score of 3 = Moderate shade casted
- Score of 5 = Heavy shade casted



Tolerance to Crown-Raising

Because Miami Beach is predominantly an urbanized, built-out context and because the majority of the publicly-owned urban forest will inhabit public right of ways, it is important to consider how well a tree can be pruned to meet clearance requirements for pedestrians, vehicles, visibility, or for CPTED. This metric rates the specie's ability to achieve the necessary clear trunk to meet these urban considerations.

- Score of 1 = Low tolerance to crown-raising
- Score of 3 = Moderate tolerance to crown-raising
- Score of 5 = High tolerance to crown-raising



SPATIAL DESIGN CRITERIA AFFECTING TREES IN URBAN CONDITIONS

While the Likelihood of Adaptability and Resilience Index categories help to identify an overall list of appropriate species for the Miami Beach context, further design considerations need to be taken into account at the time of selecting a specific specie for any given location. These are design considerations that any given hired design professional would factor in when making decisions about specie election. These are expanded as follows:

Canopy Growth Area Clearances

When building setbacks are minimal and when buildings exceed 2 stories in height, considerations need to be made as to what specie would be less impacted by the limitation of clear space for the canopy to spread in a balanced and even form. When the canopy of trees grows in an unbalanced form, they are more likely to be structurally unsound and increase their chances of falling over in a high wind or prolonged over saturated event.

Dimensional Planting Root Area

Providing adequate area for healthy root growth to occur is vital, not only to the long-term survivability of the tree or palms, but also to ensure its structural soundness to combat the adverse conditions of a high-wind event. This does not preclude that a large tree cannot be planted in a small space, provided that the space is amended with the correct type of green infrastructure that will sustain its survival. As such, a determination needs to be made on a case-by-case basis as to what the specific needs are for each selected tree for the specifics of each location.

More often than not, because of its densely urban quality, the use of soil cells and/or pavement suspension systems will need to be employed and should be accounted for early on in the process of budget and use determination. According the University of Florida, the following are derived standards for uncompacted soil needs capable of promoting good root growth. They developed these while assessing post-hurricane conditions for adequate soil volumes per tree that increases the chances of the trees’ survivability.

- Small Trees (heights shorter than 30 feet at maturity) require a minimum of 9.3 cubic yards of root growth area per tree
- Medium Trees (heights between 31 to 50 feet at maturity) require a minimum of 37 cubic yards of root growth area per tree
- Large Trees (heights above 51 feet at maturity) require a minimum of 83 cubic yards of root growth area per tree

It should be noted that where trees are planted in a cluster or in a continuous planting strip, the recommended soil volume can be shared between trees at a rate of 50 percent, provided that the soil is uncompacted and is properly amended.

It is also critical to note that typical organic soil depths in Miami Beach tend to be shallow, generally not exceeding a depth of 24 to 30 inches. As such excavating tree pits to a minimum of 36 inches and requiring an average planting soil depth of 30 inches should be the targeted norm.

Growth Habit and Form

Trees that can naturally grow with a single trunk (also known as a ‘Standard’ growth pattern) are preferred in urban contexts, particularly where trees need to share constrained spaces with pedestrians, commercial uses, and the need to accommodate sight clearance triangles for sightlines. Smaller trees that typically grow with a multi-trunk form can sometimes be formed to provide the necessary clearances as well. Additionally, trees that have a horizontal spreading quality to their canopy will provide the most ample shade and will be the best suited for minimizing the heat island effects of asphalt and sidewalk areas overly exposed to solar radiation.

Habitat-Supporting Species

One of the goals of the City of Miami Beach is to provide ample canopy specie diversity to sustain the local habitats of birds and other species of the area. This is of vital importance, because as the effects of sea level rise occur, a potential loss of low-lying areas may be seen. As a result, the remaining canopy areas in the adapted portions of the city will become vitally significant to the survivability of those species.

Overhead Utilities

Beyond soils being overly-compacted, the second most significant challenge in Miami Beach to a robust urban tree canopy is the presence of overhead utility lines. These are not limited to powerlines alone, but also feed services such as telephone, cable and internet to the various homes and buildings throughout the City. The predominant consideration is the election of tree species that will not conflict with the overhead wires. First, the entanglement of tree branches and powerlines make those powerlines more susceptible to rupture if a tree branch, in a high wind event, snaps the wires. For this reason and under the rationale of preventing security concerns, Florida Power

and Light (FPL) has carte blanche permissions to “storm-prune” trees. This “preparedness strategy” results in the severe pruning of the tree’s canopy into what is commonly known as V-notching the canopy. While this may prevent the immediate conflict between branches and powerlines, the pruning methods puts into severe question the ability of the tree to survive storms all-together, because they are generally left unbalanced and structurally weaker.

In the spirit of prevention, FPL has published its “Right Tree, Right Place” list, that categorizes tree species according to the minimum proximity it may have to overhead wires. Designers, Engineers and Home Owners are encouraged to refer to the latest edition of this list as a design election tool when specifying a particular tree or palm specie when overhead wires are present.

Shade Tolerance

As development occurs and more and more properties maximize the development potentials of any given site, increasingly trees may be planted in areas where they are obscured from direct sunlight by the shadows that are being casted by the buildings. Because most tree species require full sun exposure, areas that are densely shaded by edifications may not be suitable for all species. The selection of the appropriate specie to tolerate either full shade, partial shade or full sun conditions needs to be taken into account. This is particularly true to landscape buffer areas between properties or in alleyways and service corridors. For street trees connecting north to south, partial shade conditions can be observed in areas flanked on both sides by buildings in excess of 4 stories, such as segments of Collins and Washington Avenues. For streets connecting east to west, shade patterns are seasonal, with the south side of the streets being in complete shade for the entirety of the day. Similarly, these conditions are most visible in areas where buildings 4 stories or more are present, such as on 41st Street and the streets with more densely developed areas of multistory buildings stretching between Washington Ave and Collins Ave in South Beach, Indian Creek Drive and Collins Avenue in Mid Beach, and along 71st Street in North Beach.

Soil Saturation and Temporary Inundation Tolerance

King tides, torrential rain events and temporary flooding due to storm surges are all considerations that need to be taken into account when selecting the correct tree for any given location. Luckily, trees typical of the Maritime Hammock are well-suited and adapted to these temporal, momentary conditions. Trees with a rampant, interconnected network of roots will structurally be able to stay upright when soils get overly saturated and its cohesion is compromised. Optimally, trees that can sustain short periods of over-saturation in the soil will also have a tendency to sustain areas of higher soil compaction. When utilizing soil cell systems to provide ample root growing areas, designers and engineers need to incorporate embedded infrastructure that will aide the release of excess fluids so the system doesn’t become a waterlogged container.





TREE MATRICES



LARGE TREES

		Criteria														Summary		Benefits				Criteria														Summary		Benefits			
		Drought and Urban Heat Island Tolerance	Leaf or Fruit Litter	Maintenance Requirements	Overall Longevity and Life-span	Resilience to Relocation	Root System Characteristics	Salt Tolerance	Shade Casted	Storm and High-Wind Tolerance	Tolerance to Crown-Raising	Tolerance to Flooding	Overall Score	Percentage of Likelihood of Adaptability and Resilience	Benefits Wildlife	Native	Urban-Tree Friendly			Drought and Urban Heat Island Tolerance	Leaf or Fruit Litter	Maintenance Requirements	Overall Longevity and Life-span	Resilience to Relocation	Root System Characteristics	Salt Tolerance	Shade Casted	Storm and High-Wind Tolerance	Tolerance to Crown-Raising	Tolerance to Flooding	Overall Score	Percentage of Likelihood of Adaptability and Resilience	Benefits Wildlife	Native	Urban-Tree Friendly						
1	Acer rubrum Red Maple	1	3	5	2	3	3	1	3	3	5	5	34	62%	Y	Y	N	24	Kigelia pinnata Sausage Tree	1	1	1	3	3	1	1	5	1	5	3	25	45%	N	N	Y						
2	Bucida buceras Black Olive	5	1	1	5	5	1	5	5	1	5	1	35	64%	N	N	N	25	Lagetroemia speciosa Queen's Crape Myrtle	3	3	3	3	3	5	1	3	3	3	3	33	60%	N	N	Y						
3	Bulnesia arborea Verawood	5	3	3	2	3	5	1	3	1	3	3	32	58%	Y	N	Y	26	Lysiloma latisiliquum Wild Tamarind	5	5	5	5	3	3	5	5	3	5	3	47	85%	Y	Y	Y						
4	Bursera simaruba Gumbo Limbo	5	5	5	3	5	3	5	5	5	3	3	47	85%	Y	Y	Y	27	Magnolia grandiflora 'Blanchard' Blanchard Magnolia	3	1	5	3	1	3	5	3	5	5	5	39	71%	Y	Y	Y						
5	Calopyllum brasiliense Brazilian Beautyleaf	3	3	5	3	3	3	5	5	5	5	3	43	78%	N	N	Y	28	Magnolia virginiana Sweetbay Magnolia	1	3	1	2	1	3	1	3	3	3	5	26	47%	N	Y	N						
6	Cassia fistula Golden Shower	3	1	3	5	3	3	3	5	1	5	1	33	60%	Y	N	Y	29	Mangifera indica Mango	3	1	1	3	3	3	3	5	1	5	3	31	56%	Y	N	N						
7	Cassia grandis Pink Shower	5	3	3	2	3	3	3	3	1	3	3	32	58%	N	N	Y	30	Manilkara zapoto Sapodilla	5	1	3	3	3	3	5	5	3	5	3	39	71%	N	N	Y						
8	Cassia javanica Apple Blossom Shower	5	3	3	2	3	3	3	3	1	3	3	32	58%	Y	N	Y	31	Pachira aquatica Guiana Chestnut Tree	5	3	3	3	3	3	3	3	1	3	3	33	60%	N	N	Y						
9	Ceiba pentandra Kapok Tree	5	3	5	5	1	1	3	5	1	5	3	37	67%	N	N	N	32	Peltophorum Pterocarpum Copperpod Tree	5	1	3	3	3	1	3	3	1	5	1	29	53%	N	N	N						
10	Ceiba speciosa Silk Floss Tree	5	1	5	2	3	3	1	3	1	3	5	32	58%	N	N	N	33	Persia borbonia Red Bay	5	5	5	3	3	3	5	3	5	5	5	47	85%	Y	Y	Y						
11	Chrysophyllum cainito Star Apple	3	3	3	3	3	5	3	5	3	5	3	39	71%	N	N	N	34	Pinus elliotii 'var densa' South Florida Slash Pine	5	3	5	5	1	1	5	3	3	5	1	37	67%	Y	Y	N						
12	Coccoloba pubescens Big Leaf Seagrape	5	3	3	5	1	3	5	3	3	1	3	35	64%	Y	N	Y	35	Podocarpus gracilior Weeping Podocarpus	3	5	3	5	1	3	3	3	5	3	3	37	67%	N	N	Y						
13	Coccoloba uvifera Seagrape	5	3	5	5	1	3	5	3	5	1	3	39	71%	Y	Y	Y	36	Polyalthia longifolia Mast Tree	5	5	5	3	3	3	3	1	3	1	3	35	64%	N	N	Y						
14	Conocarpus erectus Green Buttonwood	5	5	5	5	3	5	5	3	5	3	3	47	85%	Y	Y	Y	37	Quercus virginiana Live Oak	5	3	5	5	3	3	5	5	5	5	5	49	89%	Y	Y	Y						
15	Delonix regia Royal Poinciana	5	1	3	3	3	1	5	5	1	5	3	35	64%	N	N	N	38	Quercus virginiana 'High Rise' High Rise Live Oak	5	3	5	5	3	3	5	5	5	5	5	49	89%	Y	Y	Y						
16	Diospyros digyna Black Sapote	3	1	1	2	3	3	1	5	3	5	3	30	55%	N	N	N	39	Sapindus saponaria Florida Soapberry	5	3	5	3	3	3	5	3	1	3	3	37	67%	N	Y	N						
17	Diospyros virginiana Persimmon	3	1	1	3	3	3	1	5	3	5	3	31	56%	N	Y	N	40	Sideroxylon foetidissimum False Mastic	5	3	5	5	3	3	5	5	5	5	3	47	85%	N	Y	Y						
18	Elaeocarpus decipiens Japanese Blueberry	5	5	5	3	3	3	3	3	3	3	3	39	71%	Y	N	Y	41	Simarouba glauca Paradise Tree	5	5	3	5	3	1	5	3	5	3	3	41	75%	Y	Y	Y						
19	Erythrina crista-galli Cockspur Coral Tree	5	3	3	3	3	1	3	3	3	3	3	33	60%	N	N	N	42	Spathodea campanulata African Tulip Tree	5	3	5	3	3	3	3	3	1	3	3	35	64%	N	N	N						
20	Exothea paniculata Inkwood	3	5	5	3	3	3	3	3	5	3	3	39	71%	N	Y	N	43	Swietenia mahagoni Mahogany	5	1	3	5	3	3	5	5	3	5	5	43	78%	Y	Y	Y						
21	Ficus aurea Strangler Fig	5	3	3	5	5	1	3	5	3	5	3	41	75%	Y	Y	Y	44	Tamarindus indica Indian Tamarind Tree	5	1	3	5	3	3	3	5	5	5	3	41	75%	N	Y	Y						
22	Ficus citrifolia Short-leaf Fig	5	3	5	5	5	1	3	5	3	5	3	43	78%	Y	Y	Y	45	Taxodium ascendens Pond Cypress	5	5	3	5	1	1	3	3	5	3	5	39	71%	Y	Y	Y						
23	Jacaranda mimosifolia Jacaranda	5	1	3	2	3	3	1	3	1	5	3	30	55%	N	N	N	46	Taxodium distichum Bald Cypress	5	5	3	5	1	1	3	3	5	3	5	39	71%	Y	Y	Y						

MEDIUM TREES

		Drought and Urban Heat Island Tolerance	Leaf or Fruit Litter	Maintenance Requirements	Overall Longevity and Life-span	Resilience to Relocation	Root System Characteristics	Salt Tolerance	Shade Casted	Storm and High-Wind Tolerance	Tolerance to Crown-Raising	Tolerance to Flooding	Overall Score	Percentage of Likelihood of Adaptability and Resilience	Benefits Wildlife	Native	Urban-Tree Friendly
1	<i>Avicennia germinans</i> Black mangrove	1	5	5	5	1	1	5	3	5	1	5	37	67%	N	Y	N
2	<i>Bucidia buceras</i> 'Shady Lady' Shady Lady Black Olive	5	3	3	3	5	3	5	3	3	5	1	39	71%	N	N	Y
3	<i>Caesalpinia granadillo</i> Bridalveil Tree	3	3	3	3	3	3	3	3	3	3	3	33	60%	N	N	Y
4	<i>Chrysophyllum oliviforme</i> Satin Leaf Tree	5	3	3	3	3	3	5	3	5	3	5	41	75%	Y	Y	Y
5	<i>Citharexylum fruticosum</i> Fiddlewood	5	5	5	3	3	5	5	3	3	1	3	41	75%	Y	Y	Y
6	<i>Clusia rosea</i> Pitch Apple	5	5	5	5	3	1	5	3	5	3	3	43	78%	N	Y	Y
7	<i>Coccoloba diversifolia</i> Pigeon Plum	5	5	5	3	3	3	5	3	5	3	3	43	78%	Y	Y	Y
8	<i>Crescentia cujete</i> Calabash Tree	3	3	3	3	3	5	3	3	3	1	3	33	60%	N	N	N
9	<i>Drypetes laterifolia</i> Guiana Plum	5	3	5	3	3	5	3	3	5	3	3	41	75%	N	Y	Y
10	<i>Drypetes diversifolia</i> Milkbark	5	3	5	3	3	5	3	3	5	3	3	41	75%	N	Y	Y
11	<i>Ficus rubiginosa</i> Rusty Leaf Fig	3	5	3	5	3	3	3	3	5	3	3	39	71%	N	N	Y
12	<i>Filicium decipiens</i> Japanese Fern Tree	5	5	5	3	3	3	3	5	1	3	3	39	71%	N	N	Y
13	<i>Frangipani</i> Plumeria sp.	5	3	5	3	5	5	5	1	1	1	1	35	64%	N	N	N
14	<i>Guapira discolor</i> Blolly	5	5	5	5	3	5	5	3	3	3	3	45	82%	N	Y	Y
15	<i>Guapira longifolia</i> Long-leaf Blolly	5	5	5	5	3	5	5	3	3	3	3	45	82%	N	Y	Y
16	<i>Ilex cassine</i> Dahoon Holly	5	3	5	3	3	5	5	3	5	3	5	45	82%	Y	Y	Y
17	<i>Ilex krugiana</i> Krug's Holly	5	5	3	5	3	5	5	3	3	3	3	43	78%	N	Y	Y
18	<i>Krugiodendron fereum</i> Black Ironwood	5	5	5	3	3	5	5	3	5	3	3	45	82%	Y	Y	Y
19	<i>Laguncularia racemosa</i> White Mangrove	1	5	5	5	1	1	5	3	5	1	5	37	67%	N	Y	N
20	<i>Lysiloma sabicu</i> Sabicu	5	5	3	3	5	5	5	1	3	1	5	41	75%	N	Y	Y
21	<i>Morus rubra</i> Red Mulberry	5	1	1	3	3	3	1	3	3	1	5	29	53%	Y	Y	N
22	<i>Noronhia emarginata</i> Madagascar Olive	5	5	5	3	3	3	5	3	5	3	3	43	78%	N	N	Y

		Drought and Urban Heat Island Tolerance	Leaf or Fruit Litter	Maintenance Requirements	Overall Longevity and Life-span	Resilience to Relocation	Root System Characteristics	Salt Tolerance	Shade Casted	Storm and High-Wind Tolerance	Tolerance to Crown-Raising	Tolerance to Flooding	Overall Score	Percentage of Likelihood of Adaptability and Resilience	Benefits Wildlife	Native	Urban-Tree Friendly
	<i>Pandanus utilis</i> Screw Pine	5	3	5	5	1	1	5	1	3	1	3	33	60%	N	N	Y
	<i>Piscidia piscipula</i> Jamaica Dogwood	5	3	5	5	3	3	5	3	3	3	5	43	78%	Y	Y	Y
	<i>Podocarpus macrophyllus</i> Yew Podocarpus	3	5	3	5	3	3	3	1	5	1	3	35	64%	Y	N	Y
	<i>Rhizophora mangle</i> Red Mangrove	3	5	5	5	1	1	5	3	5	1	5	39	71%	Y	Y	N
	<i>Sideroxylon salicifolium</i> Willow Bustic	5	5	5	3	3	3	3	3	3	3	3	39	71%	N	Y	Y
	<i>Tabebuia chrysotricha</i> Golden Trumpet Tree	5	1	1	2	3	5	3	3	1	3	1	28	51%	N	N	Y
	<i>Tabebuia heterophylla</i> Pink Trumpet Tree	5	1	3	3	5	3	5	3	1	3	3	35	64%	N	N	Y

SMALL TREES

		Drought and Urban Heat Island Tolerance	Leaf or Fruit Litter	Maintenance Requirements	Overall Longevity and Life-span	Resilience to Relocation	Root System Characteristics	Salt Tolerance	Shade Casted	Storm and High-Wind Tolerance	Tolerance to Crown-Raising	Tolerance to Flooding	Overall Score	Percentage of Likelihood of Adaptability and Resilience	Benefits Wildlife	Native	Urban-Tree Friendly	
1	<i>Acacia choriophylla</i> Cinnecord	5	3	5	3	3	3	5	1	3	1	3	35	64%	N	Y	Y	24
2	<i>Annona glabra</i> Pond Apple	1	1	3	3	1	3	3	1	5	1	5	27	49%	Y	Y	N	25
3	<i>Ardisia escallonioides</i> Marlberry	3	3	5	3	3	3	5	1	3	1	3	33	60%	Y	Y	Y	26
4	<i>Bucida spinosa</i> Spiny Black Olive	5	3	3	3	5	3	3	1	5	3	1	35	64%	N	N	Y	27
5	<i>Byra ebenus</i> Jamaican Rain Tree	5	3	5	3	3	3	3	1	3	1	3	33	60%	N	N	Y	28
6	<i>Byrsonima lucida</i> Locust Berry	5	3	3	3	3	3	3	1	3	1	1	29	53%	Y	Y	Y	29
7	<i>Calliandra haematocephala</i> Powderpuff Tree	5	3	3	3	3	3	1	1	5	1	3	31	56%	Y	N	N	30
8	<i>Calyptranthes pallens</i> Spicewood	5	5	3	3	3	3	3	1	3	1	3	33	60%	Y	Y	Y	31
9	<i>Calyptranthes zuzygium</i> Myrtle of the River	1	5	5	3	3	3	3	3	5	1	5	37	67%	Y	Y	Y	32
10	<i>Canella winterana</i> Wild Cinnamon	5	3	5	3	3	5	3	1	5	1	3	37	67%	N	Y	Y	33
11	<i>Capparis cynophallophora</i> Jamaica Caper	5	5	5	3	3	3	5	1	3	1	3	37	67%	Y	Y	Y	34
12	<i>Cassia surattensis</i> Glaucous Cassia	3	1	3	1	5	5	1	1	1	1	1	23	42%	Y	N	N	35
13	<i>Citharexylum fruticosum</i> Fiddlewood	1	3	3	3	3	3	1	1	3	1	5	27	49%	Y	Y	Y	36
14	<i>Cephalanthus occidentalis</i> Button Bush	1	3	3	3	3	3	1	1	3	1	5	27	49%	Y	Y	Y	37
15	<i>Cochlospermum vitifolium</i> Buttercup Tree	5	1	1	2	1	3	3	3	5	1	5	30	55%	N	N	N	38
16	<i>Conocarpus erectus</i> var. <i>sericeus</i> Silver Buttonwood	5	5	5	3	3	5	5	1	3	1	1	37	67%	N	Y	Y	39
17	<i>Cordia boissieri</i> White Geiger Tree	5	3	5	3	3	5	3	1	3	1	1	33	60%	N	N	Y	40
18	<i>Cordia sebestena</i> Geiger Tree	5	3	5	3	3	5	5	1	3	1	1	35	64%	N	Y	Y	41
19	<i>Eriobotrya japonica</i> Loquat	5	1	3	3	3	3	3	1	1	1	3	27	49%	N	N	Y	42
20	<i>Eugenia axillaris</i> White Stopper	5	3	5	5	5	5	5	1	5	1	3	43	78%	Y	Y	Y	43
21	<i>Eugenia rhombea</i> Red Stopper	5	3	5	5	5	5	5	1	5	1	3	43	78%	Y	Y	Y	44
22	<i>Eugenia foetida</i> Spanish Stopper	5	3	5	5	5	5	5	1	5	1	3	43	78%	Y	Y	Y	
23	<i>Genipa clusiifolia</i> Seven Year Apple	5	5	5	3	3	3	5	1	3	1	1	35	64%	N	Y	Y	

	Drought and Urban Heat Island Tolerance	Leaf or Fruit Litter	Maintenance Requirements	Overall Longevity and Life-span	Resilience to Relocation	Root System Characteristics	Salt Tolerance	Shade Casted	Storm and High-Wind Tolerance	Tolerance to Crown-Raising	Tolerance to Flooding	Overall Score	Percentage of Likelihood of Adaptability and Resilience	Benefits Wildlife	Native	Urban-Tree Friendly
<i>Guaiacum officinale</i> Lignum Vitae	5	5	5	5	1	5	5	1	5	1	1	39	71%	N	Y	Y
<i>Gymnanthes lucida</i> Crabwood	5	5	5	5	5	5	3	1	5	1	1	41	75%	Y	Y	Y
<i>Lagerstroemia indica</i> Crape Myrtle	5	1	1	3	3	5	1	1	5	1	3	29	53%	Y	N	Y
<i>Ligustrum japonicum</i> Japanese or Wax Privet	5	5	5	3	3	5	3	1	5	1	3	39	71%	N	N	Y
<i>Ligustrum lucidum</i> Glossy Privet	3	5	5	3	3	5	1	1	5	1	3	35	64%	N	N	Y
<i>Myrica cerifera</i> Wax Myrtle	5	5	3	5	3	3	5	1	3	1	1	35	64%	Y	Y	Y
<i>Myrcianthes fragrans</i> Simpson's Stopper	5	5	5	5	3	5	5	1	5	1	1	41	75%	Y	Y	Y
<i>Myrsine guianensis</i> Myrsine	5	5	5	5	3	5	5	1	5	1	3	43	78%	Y	Y	Y
<i>Parkinsonia aculeata</i> Jerusalem Thron	5	3	3	3	3	3	5	1	1	3	1	31	56%	N	N	N
<i>Pimenta dioica</i> All-Spice Tree	5	5	5	3	3	5	1	1	3	1	3	35	64%	Y	N	Y
<i>Plimia cauliflora</i> Jaboticaba	3	3	3	3	3	3	1	1	3	1	1	25	45%	N	N	Y
<i>Pithecellobium keyensi</i> Blackhead	5	3	3	3	3	3	5	1	3	1	3	33	60%	N	Y	N
<i>Quercus geminata</i> Sand Live Oak	5	5	5	5	3	5	5	1	5	1	1	41	75%	Y	Y	N
<i>Randia aculeata</i> White Indigo Berry	5	5	5	5	3	3	5	1	3	1	3	39	71%	Y	Y	N
<i>Reynosia septentrionalis</i> Darling Plum	5	3	3	3	3	3	5	1	3	1	3	33	60%	N	Y	N
<i>Spondias dulcis</i> Golden Apple / Ambarella	3	1	3	2	3	3	1	1	1	1	1	20	36%	Y	N	N
<i>Tabebuia caraiba</i> Yellow Tabebuia Tree	5	1	1	2	5	5	3	1	1	3	1	28	51%	N	N	Y
<i>Tabebuia impetiginosa</i> Purple Tabebuia	5	1	3	3	3	5	3	1	1	1	1	27	49%	N	N	Y
<i>Tecoma stans</i> Yellow Elder	5	3	5	3	3	5	3	1	3	1	3	35	64%	Y	N	Y
<i>Ximenia americana</i> Tallow Wood Plum	5	3	3	3	3	3	5	1	3	1	3	33	60%	N	Y	N
<i>Zanthoxylum fagara</i> Wild Lime	5	3	1	3	3	3	5	1	3	1	3	31	56%	N	Y	N





LARGE PALMS

		Drought and Urban Heat Island Tolerance	Leaf or Fruit Litter	Maintenance Requirements	Overall Longevity and Life-span	Resilience to Relocation	Root System Characteristics	Salt Tolerance	Shade Casted	Storm and High-Wind Tolerance	Tolerance to Crown-Raising	Tolerance to Flooding	Overall Score	Percentage of Likelihood of Adaptability and Resilience	Benefits Wildlife	Native	Urban-Tree Friendly
1	<i>Bismarckia nobilis</i> Bismarck Palm	5	3	3	3	5	5	3	1	5	1	1	35	64%	Y	Y	Y
2	<i>Butia capitata</i> Pindo Palm	5	1	1	3	5	5	3	1	5	1	3	33	60%	Y	Y	Y
3	<i>Coccothrinax argentata</i> Florida Silver Palm	5	5	5	3	3	5	5	1	5	1	1	39	71%	Y	Y	Y
4	<i>Cocos nucifera</i> Coconut Palm	5	1	1	5	3	5	5	3	5	1	3	37	67%	N	N	N
5	<i>Copernicia baileyana</i> Bailey Palm	3	5	3	5	3	5	3	1	5	1	1	35	64%	N	N	Y
5	<i>Dictyosperma album</i> Hurrican Palm	1	5	3	2	3	5	5	1	5	1	1	32	58%	N	N	Y
6	<i>Elaeis guineensis</i> African Oil Palm	3	3	3	3	3	5	3	3	5	3	5	39	71%	N	N	Y
7	<i>Hyophorbe lagenicaulis</i> Bottle Palm	5	5	3	3	3	5	5	1	5	1	3	39	71%	N	N	N
8	<i>Latania loddigesii</i> Latan Palm (Blue/Red)	3	5	3	3	3	5	3	1	5	1	5	37	67%	N	N	N
8	<i>Leucothrinax morrisii</i> Key Thatch Palm	5	5	5	5	3	5	5	1	5	1	1	41	75%	Y	Y	Y
9	<i>Leucothrinax spp.</i> Broom Thatch Palm	5	5	5	5	3	5	5	1	5	1	1	41	75%	N	N	Y
8	<i>Neodypsis decaryi</i> Triangle Palm	5	5	3	3	3	5	1	1	5	1	1	33	60%	N	N	Y
9	<i>Phoenix canariensis</i> Canary Island Date Palm	5	3	3	5	1	5	3	3	5	3	1	37	67%	N	N	Y
10	<i>Phoenix dactylifera</i> 'Medjool' Medjool Date Palm	5	3	3	5	1	5	3	3	5	3	3	39	71%	N	N	Y
11	<i>Phoenix sylvestris</i> Sylvester Date Palm	5	3	3	5	1	5	3	1	5	3	1	35	64%	N	N	Y
12	<i>Phoenix reclinata</i> Wild Date Palm	5	1	1	3	3	5	3	3	5	5	3	37	67%	N	N	N
13	<i>Pseudophoenix sargentii</i> Buccaneer Palm	5	5	3	3	3	5	5	1	5	1	1	37	67%	N	Y	Y
13	<i>Roystonea regia</i> Cuban Royal Palm	5	1	1	5	3	3	3	3	5	1	5	35	64%	N	N	N
14	<i>Roystonea spp. regia</i> Florida Royal Palm	3	1	1	5	3	3	3	3	5	3	5	35	64%	N	Y	N
15	<i>Sabal palmetto</i> Cabbage Palm	5	5	5	5	5	5	5	1	5	1	5	47	85%	Y	Y	Y
16	<i>Thrinax radiata</i> Florida Thatch Palm	5	5	5	5	3	5	5	1	5	1	1	41	75%	Y	Y	Y
17	<i>Trachycarpus fortunei</i> Windmill Palm	1	5	3	3	3	5	3	1	5	1	3	33	60%	Y	N	Y

SPECIES PROFILES



LARGE TREES

OVERALL MAXIMUM HEIGHTS
IN EXCESS OF 25 FEET



Acer rubrum
Red Maple

This deciduous tree displays red coloring during different seasons of the year. Good for wet sites.

Height Range: 50’ - 60’
Spread: 15’ - 25’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Oval, Round Upright
Drought tolerance: Low
Fertilization Requirements: Low



Bucida buceras
Black Olive

This evergreen tree is messy which can stain sidewalks, cars or anything else they drop on. Good for open green areas.

Height Range: 40’ - 50’
Spread: 35’ - 50’
Tree Type: Shade
Growth Rate: Slow
Growth Habit: Oval, Rounded Shape
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring / Summer



Bulnesia arborea
Verawood

Having even-pinnate leaves, butter-yellow, radially symmetrical flowers, and winged hollow pods.

Height Range: 40’
Spread: 20’ - 30’
Tree Size: Large
Tree Type: Flowering
Growth Rate: Moderate
Blooming Season: Spring / Summer / Fall



Bursera simaruba
Gumbo Limbo

Shiny red and peeling bark. Wind tolerant.

Height Range: 25’ - 40’
Spread: 25’ - 30’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Round
Drought tolerance: High
Fertilization Requirements: Low



Calopyllum brasiliense
Brazilian Beautyleaf

Evergreen tree that has a good salt tolerance.

Height Range: 30’ - 40’
Spread: 30’ - 50’
Tree Type: Shade
Growth Habit: Upright, pyramidal
Growth Rate: Moderate
Growth Habit: Oval, Round, Pyramidal
Drought tolerance: High
Fertilization Requirements: Low



Cassia fistula
Golden Shower

Dry deciduous or semi-deciduous tree great as ornamental tree, grows in full sun.

Height Range: 30’ - 50’
Spread: 25’ - 50’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Oval, Upright, Vase Shape
Drought tolerance: Moderate
Fertilization Requirements: Low to Moderate
Blooming Season: Spring / Summer



Cassia grandis
Pink Shower

Ornamental tree that grows in full sun.

Height Range: 30’ - 50’
Spread: 25’ - 50’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Dense, Umbrella-Shaped Canopy
Drought tolerance: High
Blooming Season: Spring



Cassia javanica
Apple Blossom Shower

Makes a durable street tree throughout its range and is quite drought-tolerant once it becomes well-established.

Height Range: 30’ - 40’
Spread: 20’ - 30’
Tree Type: Flowering
Growth Rate: Moderate
Drought tolerance: Moderate
Blooming Season: Spring



Ceiba pentandra
Kapok Tree

Huge tree with spiny trunk, very large specimen tree. Deciduous in dry conditions.

Height Range: 75’ - 100’
Spread: 60’ - 100’
Tree Type: Exotic
Growth Rate: Fast
Growth Habit: Irregular
Drought tolerance: High
Blooming Season: Winter



Ceiba speciosa
Silk Floss Tree

A great exotic looking tree for quickly creating tropical effects.

Height Range: 35’ - 50’
Spread: 40’ - 55’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Round, pyramidal
Drought tolerance: High
Blooming Season: Winter
Fertilization Requirements: Low



Chrysophyllum cainito
Star Apple

Tropical fruit tree, slow-growing evergreen tree.

Height Range: 25’ - 80’
Spread: N/A
Tree Type: Fruit Tree
Growth Rate: Moderate
Growth Habit: Round to oval canopy
Drought tolerance: Moderate
Fertilization Requirements: Three times per year
Blooming Season: Summer / Fall



Coccoloba pubescens
Grand-leaf Seagrape

Can be used as an ornamental tree. Excellent for seaside locations.

Height Range: 15’
Spread: 10’ - 20’
Tree Type: Fruit Tree
Growth Rate: Slow
Growth Habit: Vase-like
Drought tolerance: High
Fertilization Requirements: Moist, well-drained fertile soils
Blooming Season: Spring / Summer / Fall



Coccoloba uvifera
Sea Grape

Salt tolerant. Good seaside plant. Broad spreading.

Height Range: 25’ - 35’
Spread: 20’ - 30’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Vase-like
Drought tolerance: High
Fertilization Requirements: Low



Conocarpus erectus
Green Buttonwood

Evergreen tree that prefers full sun. Salt and wind tolerant. Good for residences, parks and common areas

Height Range: 30’ - 45’
Spread: 20’ - 30’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Vase-like, Spreading
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring / Fall



Delonix regia
Royal Poinciana

Fast growing tree. Produces showy reddish, orange flowers in summer. Long seed pods can be a nuisance. Subject to wind damage. Needs space to develop root system to reduce likelihood of toppling.

Height Range: 35’ - 45’
Spread: 40’ - 60’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Vase-like, Spreading
Blooming Season: Summer



Diospyros digyna
Black Sapote

Tree with novel edible fruits.

Height Range: 60’ - 80’
Spread: 30’
Tree Type: Fruit Tree
Growth Rate: Slow
Growth Habit: Elliptic-Oblong
Drought tolerance: Moderate
Fertilization Requirements: Low
Blooming Season: Fall / Winter



Diospyros virginiana
Common Persimmon

Irregularly-shaped native tree, for possible naturalizing in yards or parks.

Height Range: 40’ - 60’
Spread: 20’ - 35’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Oval, Pyramidal
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring / Summer



Elaeocarpus decipiens
Japanese Blueberry

Evergreen tree that prefers full to partial sun.

Height Range: 30’ - 40’
Spread: 30’ - 40’
Tree Type: Shade
Growth Rate: Slow
Growth Habit: Pyramidal
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring



Erythrina crista-galli
Cockspur Coral Tree

Widely planted as a street or garden tree. The flowers produce a light fragrance.

Height Range: 15’ - 25’
Spread: 15’ - 25’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Umbrella-Shaped
Drought tolerance: High
Blooming Season: Summer



Exothea paniculata
Inkwood Tree

Tree with dense foliage maintained close to the ground.

Height Range: 25’ - 35’
Spread: 25’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Oblong to lanceolate
Drought tolerance: Moderate
Fertilization Requirements: 6 months
Blooming Season: Winter / Summer / Spring



Ficus aurea
Strangler Fig

The native strangler fig is vine-like while young, later strangling its host with heavy roots and eventually becoming a self-supporting tree.

Height Range: 50’ - 60’
Spread: 50’ - 70’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Irregular
Drought tolerance: High
Blooming Season: Spring / Summer



Ficus citrifolia
Short-Leaf Fig

Naturally found in tropical hammocks throughout south Florida and requires full sun for optimal growth

Height Range: 30’ - 40’ (70’)
Spread: 50’ - 80’
Tree Type: Native
Growth Rate: Moderate to fast
Growth Habit: Oval, Rounded with flowers inside
Drought tolerance: High
Blooming Season: Winter / Spring / Fall



Jacaranda mimosifolia
Jacaranda

Good choice for large open areas.

Height Range: 25’ - 50’
Spread: 15’ - 30’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Umbrella-Shaped
Drought tolerance: Low
Fertilization Requirements: Moderate
Blooming Season: Summer / Spring



Kigelia pinnata
Sausage Tree

Full sun tree. Mainly used as an ornamental tree.

Height Range: 40’ - 50’
Spread: 15’ - 30’
Tree Type: Native, Shade
Growth Rate: Fast
Growth Habit: Umbrella-Shaped
Drought tolerance: Low
Blooming Season: Summer



Lagetroemia speciosa
Queen’s Crape Myrtle

Moderate-growing with leaves that turn red before falling in winter, large showy pink/purplish flowers during the summer.

Height Range: 30’ - 45’
Spread: 25’ - 30’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Umbrella-Shaped
Drought tolerance: High
Fertilization Requirements: Moderate
Blooming Season: Summer



Lysiloma latisiliquum
Wild Tamarind

Short trunk topped with long, somewhat arching branches. Good for parks, boulevards, and open areas.

Height Range: 40’ - 60’
Spread: 30’ - 40’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Umbrella-Shaped
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring



Magnolia grandiflora ‘Blanchard’
Blanchard Magnolia

Has large, leathery leaves and showy flowers.

Height Range: 50’ - 70’
Spread: 20’ - 35’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Oval
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring / Summer



Magnolia virginiana
Sweetbay Magnolia

Ornamental tree with fragrant flowers.

Height Range: 30’ - 60’
Spread: 10’ - 35’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Wide, Columnar tree
Drought tolerance: Low
Blooming Season: Spring / Summer



Mangifera indica
Mango Tree

Popular fruit tree, the flowers are used to repel mosquitos. This tree is good for public open space or residential use.

Height Range: 80’ - 100’
Spread: 35’ - 45’
Tree Type: Fruit Tree
Growth Rate: Moderate
Growth Habit: Umbrella-Shape
Drought tolerance: Moderate
Blooming Season: Spring / Summer / Fall



Manilkara zapota
Sapodilla Tree

This evergreen tree is resistant to winds.

Height Range: 70’ - 90’
Spread: 30’ - 45’
Tree Type: Fruit Tree
Growth Rate: Slow
Growth Habit: Pyramidal when Young
Drought tolerance: High
Blooming Season: Winter / Summer



Pachira aquatica
Guiana Chestnut Tree

The pachira needs plenty of sunlight, Deciduous tree with showy fragrant flowers.

Height Range: 50’ - 60’
Spread: 20’ - 30’
Tree Type: Shade
Growth Rate: Slow
Growth Habit: Columnar
Drought tolerance: High
Blooming Season: Spring / Summer



Peltophorum pterocarpum
Copperpod Tree

When bloomed, the entire tree’s canopy is smothered with a yellow blanket of flowers with pods that ripen to a coppery red.

Height Range: 40’ - 50’
Spread: 30’ - 40’
Tree Type: Flowering, Shade
Growth Rate: Fast
Growth Habit: Vase-like, densely foliated
Drought tolerance: High
Blooming Season: Summer



Persea borbonia
Red Bay

Tree with a reddish brown bark with irregular furrows that separate flat-topped ridges.

Height Range: 30’ - 50’
Spread: 30’ - 50’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Dense, Well Rounded
Drought tolerance: High
Blooming Season: Spring



Pinus elliotii ‘var densa’
South Florida Slash Pine

Evergreen conifer that has relatively long needles. Needles grow in clusters of 2 - 3 and measure approximately (12 inches) in length. It doesn’t do well in grade changes and traffic above root system.

Height Range: 80’ - 100’
Spread: 35’ - 50’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Oval
Drought tolerance: High



Podocarpus gracilior
Weeping Podocarpus

Evergreen tree growing in full sun or partial shade, it will tolerate a wide range of well-drained soils and should be protected from frost.

Height Range: 30’ - 50’
Spread: 25’ - 35’
Tree Type: Shade
Growth Rate: Slow
Growth Habit: Oval, weeping
Drought tolerance: High



Polyalthia longifolia
Mast Tree

A gloriously columnar tree with an extremely weeping nature. The Mast Tree is considered an evergreen in its native habitat and prefers direct sun.

Height Range: 30’ - 65’
Spread: 6’ - 8’
Tree Type: Architectural accent
Growth Rate: Fast
Growth Habit: Columnar
Drought tolerance: High



Quercus virginiana
Live Oak

Highly salt tolerant and wind resistant, long-lived evergreen shade tree.

Height Range: 40’ - 50’
Spread: 25’ - 35’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Spreading
Drought tolerance: High



Quercus virginiana ‘High Rise’
High Rise Live Oak

Highly salt tolerant and wind resistant, long-lived evergreen shade tree.

Height Range: 50’ - 80’
Spread: 80’ - 100’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Pyramidal
Drought tolerance: High



Sapindus saponaria
Florida Soapberry

Evergreen Tree should be grown in full sun and will tolerate almost any soil. It is highly drought- and salt-tolerant.

Height Range: 30’ - 40’HT
Spread: 25’ - 35’
Tree Type: Native
Growth rate: Moderate
Growth Habit: Oval, Round
Drought tolerance: High
Fertilization Requirements: Low
Blooming season: Winter / Spring



Sideroxylon foetidissimum
False Mastic

Evergreen tree that needs full sun.

Height Range: 30’ - 60’
Spread: 30’ - 50’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Dense, Irregular Crown
Drought tolerance: High
Blooming Season: Spring / Summer / Fall



Simarouba glauca
Paradise Tree

Attractive reddish color on new foliage. Fast growing. Female plant bears black berries that attract birds. Does well in exposed locations.

Height Range: 40’ - 50’
Spread: 25’ - 30’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Oval
Drought tolerance: High



Spathodea campanulata
African Tuliptree

The African Tulip tree is known throughout the world as one of the most beautiful of all flowering trees.

Height Range: 50’ - 60’
Spread: 35’ - 50’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Upright/erect, round, spreading
Drought tolerance: Moderate
Blooming Season: Winter / Spring



Swietenia mahogany
Mahogany Tree

Low wind tolerance; needs space to develop adequate root system to reduce the likelihood of toppling; Large seed pods can be a nuisance. High salt tolerance.

Height Range: 35’ - 60’
Spread: 40’ - 60’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Round
Drought tolerance: High



Tamarindus indica
Indian Tamarind Tree

Evergreen shade tree with small feathery leaves. Wind tolerant. Seed pods can be a nuisance.

Height Range: 50’ - 65’
Spread: 40’ - 50’
Tree Type: Shade
Growth Rate: Moderate
Growth Habit: Vase, Round
Drought tolerance: High
Blooming season: Spring / Summer



Taxodium ascendens
Pond Cypress

Provides a good vertical accent to the landscape and should be used more in urban areas.

Height Range: 50’ - 60’
Spread: 10’ - 15’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Columnar, Upright
Drought tolerance: High
Fertilization Requirements: High
Blooming Season: Spring / Summer / Fall



Taxodium distichum
Bald Cypress

Thrives in wet sites. Deciduous tree, loses all its leaves in winter. Wind tolerant.

Height Range: 30’ - 60’
Spread: 25’ - 35’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Pyramidal, Oval
Drought tolerance: High





Avicennia germinans
Black Mangrove

The Black Mangrove have roots that poke up out of the sediment instead of growing into it, allowing the tree to get air.

Height Range: 15’ - 40’
Spread: 10’ - 30’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Clusters
Drought tolerance: Low
Fertilization Requirements: Low
Blooming Season: Spring / Summer



Bucida buceras
Shady Lady Black Olive

This tree is one of the most beautiful in South Florida trees, with its lush layers of tiny leaves on zigzagged stems.

Height Range: 40’ - 50’
Spread: 35’ - 50’
Tree Type: Native, Shade
Growth Rate: Slow
Growth Habit: Oval to Round Shape
Drought tolerance: High
Fertilization Requirements: 3 times a year
Blooming Season: Spring / Summer



Caesalpinia granadillo
Bridalveil Tree

A large evergreen tree. Decorated with showy yellow blossoms. The bark peels off in thin strips showing an unusual green and grey mottling. Should be grown in full sun on well-drained soil.

Height Range: 30’ - 35’
Spread: 25’ - 35’
Tree Type: Shade
Growth Rate: Moderate
Growth Habit: Vase-like
Blooming Season: Summer / Fall



Chrysophyllum oliviforme
Satin Leaf Tree

Evergreen. Wet and/or shady areas, Wind tolerant.

Height Range: 20’ - 30’
Spread: 20’ - 25’
Tree Size: Medium
Tree Type: Native
Growth Rate: Slow
Growth Habit: Oval
Drought tolerance: High
Blooming Season: Year Round

MEDIUM TREES

**OVERALL HEIGHTS
BETWEEN 15 AND 25 FEET**



Citharexylum fruticosum
Fiddlewood

Well suited as a tall hedge, nice for patio tree that can be grown in the shade of taller trees, has a high drought tolerance.

Height Range: 20’ - 30’
Spread: 8’ - 15’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Oval
Drought tolerance: High
Blooming Season: Summer



Clusia rosea
Pitch Apple

Extremely slow-growing broadleaf evergreen. Grows in part shade/part sun.

Height Range: 20’ - 30’
Spread: 15’ - 25’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Vase-like, Round
Drought tolerance: High
Blooming Season: Summer



Coccoloba diversifolia
Pigeon Plum

Young trees appear pyramidal until the multiple trunks begin spreading.

Height Range: 15’ - 25’
Spread: 20’ - 35’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Single or Multi-trunk with diverse foliage
Drought tolerance: High
Blooming Season: Spring



Crescentia cujete
Calabash Tree

Due to the irregular spreading shape and fruit can be used as an ornamental tree.

Height Range: 25’ - 30’
Spread: 20’ - 25’
Tree Type: Fruit Tree
Growth Rate: Moderate
Growth Habit: Spreading, Round
Drought tolerance: Moderate
Blooming Season: Year Round



Drypetes lateriflora
Guiana Plum

Full Sun to Partial Shade Tree/Shrub. Primarily recommended for natural landscapes and habitat restorations.

Height Range: 20’ - 30’
Spread: N/A
Tree Type: Native
Growth Rate: Slow to Moderate
Growth Habit: Thin, firm leaf structure
Drought tolerance: Moderate
Blooming Season: Spring / Summer



Drypetes diversifolia
Milkbark

Full Sun to Partial Shade.

Height Range: 25’ - 30’
Spread: 20’ - 30’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Shrub
Drought tolerance: High
Blooming Season: Spring / Summer / Fall



Ficus rubiginosa
Rusty Leaf Fig

Excellent evergreen tree that tolerates salt spray conditions. Drought tolerant once established and thrives in full sun or partial shade environments.

Height Range: 35’ - 50’
Spread: 35’ - 60’
Tree Type: Shade
Growth Rate: Fast
Growth Habit: Round



Filicium decipiens
Japanese Fern Tree

Broad canopy. Decorative leaves

Height Range: 20’ - 25’
Spread: 20’ - 25’
Tree Type: Shade
Growth Rate: Moderate
Growth Habit: Round
Drought tolerance: High



Frangipani
Plumeria sp.

More commonly known for its uses in tree pits, deck/patios, and parking lot islands.

Height Range: 20’ - 25’
Spread: 20’ - 25’
Tree Type: Fruit Tree
Growth Rate: Slow
Growth Habit: Symmetrical
Drought tolerance: Moderate



Guapira discolor
Blolly

Can be used as an accent tree or shrub. It takes well to pruning and can be formed into a small accent or specimen tree.

Height Range: 10’ - 25’
Spread: 10’ - 15’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Dense, Rounded Crown
Drought tolerance: Moderate
Fertilization Requirements: Moderate
Blooming Season: Year Round



Guapira longifolia
Long-leaf Blolly

Accent tree or shrub. Buffer plantings.

Height Range: 10’ - 25’
Spread: 10’ - 15’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Dense, Rounded Crown
Drought tolerance: Moderate
Fertilization Requirements: Moderate
Blooming Season: Year Round



Ilex cassine
Dahoon Holly

Growing well in full sun to partial shade, it does best in moist soils. Tree grows in part shade/part sun. High Drought tolerance.

Height Range: 20’ - 40’
Spread: 8’ - 12’
Tree Size: Medium
Tree Type: Native
Growth rate: Moderate
Growth Habit: Pyramidal, Oval
Blooming season: Spring



Ilex krugiana
Krug's Holly

Could be use as an accent or specimen tree in residential or commercial landscapes.

Height Range: 20’ - 30’
Spread: 8’ - 10’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Pyramidal, Irregular Crown
Drought tolerance: High
Fertilization Requirements: Moderate
Blooming Season: Spring



Krugiodendron fereum
Black Ironwood

Evergreen, low-growing dense-wooded tree. Drought tolerant and wind tolerant.

Height Range: 20’ - 30’
Spread: 25’ - 30’
Tree Size: Medium
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round
Drought tolerance: High



Laguncularia racemosa
White Mangrove

One out of four Mangrove species. Grows in lagoons and areas where tides may be high.

Height Range: 65’
Spread: 2’ - 3’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Narrow, rounded crown
Drought tolerance: Low
Blooming Season: Spring / Summer



Lysiloma sabicu
Sabicu

Slender tree with long, straight branches that hold feathery leaves with red tips. Ideal for parks because of their striking new foliage.

Height Range: 25’ - 30’
Spread: 20’
Tree Type: Flowering Tree
Growth Rate: Slow
Growth Habit: Shrub-Umbrella
Drought tolerance: Moderate



Morus rubra
Red Mulberry

Deciduous tree, best in full sun. The fruit is messy and its considered undesirable to urban areas.

Height Range: 35’ - 50’
Spread: 35’ - 40’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Round
Drought tolerance: Low
Blooming Season: Spring



Noronhia emarginata
Madagascar Olive

It can become a good screen subject planted in a row or clusters of three.

Height Range: 20’ - 25’
Spread: 15’ - 20’
Tree Type: Broadleaf evergreen
Growth Rate: Slow
Growth Habit: Upright, wide cylinder
Fertilization Requirements: Twice in growing season
Drought tolerance: High



Pandanus utilis
Screw Pine

Palm-like evergreen tree.

Height Range: 20’ - 30’
Spread: 12’ - 20’
Tree Type: Fruit Tree
Growth Rate: Slow to Moderate
Growth Habit: Pyramidal, Umbrella-Shaped
Drought tolerance: Moderate
Fertilization Requirements: 3 times a year
Blooming Season: Winter



Piscidia piscipula
Jamaica Dogwood

Deciduous tropical tree and one of the most outstanding for woodworking. Higly salt tolerant.

Height Range: 35’ - 50’
Spread: 35’ - 60’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Spreading
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring



Podocarpus Macrophyllus
Yew Podocarpus

The evergreen dense canopy works well as a screen or hedge.

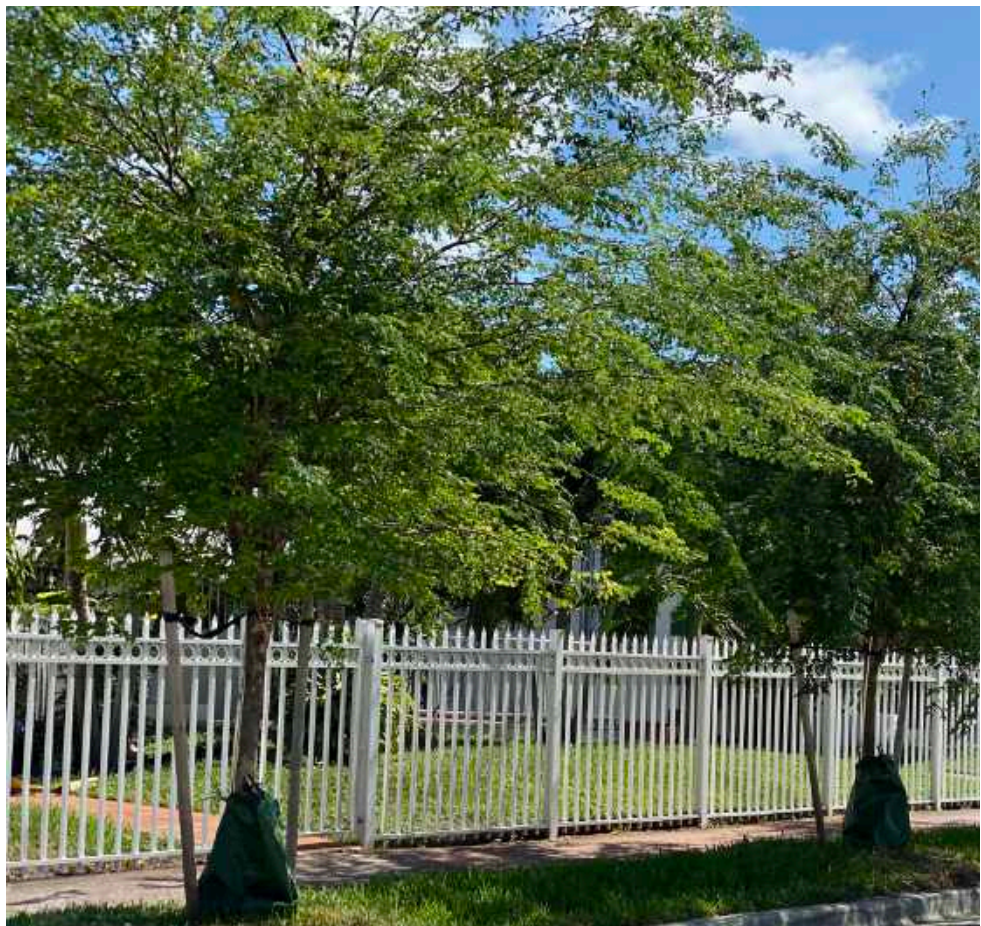
Height Range: 20’ - 40’
Spread: 10’ - 20’
Tree Type: Needled Evergreen
Growth Rate: Slow
Growth Habit: Narrow, Conical tree
Drought tolerance: Moderate
Blooming Season: Spring / Summer / Fall



Rhizophora mangle
Red Mangrove

The Red Mangrove grows along the coast, sometimes directly in the ocean near the coast and the tidal swamps.

Height Range: 65’
Spread: 2’ - 3’
Tree Type: Native
Growth Rate: Fast
Drought tolerance: Medium
Blooming Season: Year Round



Dipholis salicifolia
Willow Bustic

A small tree suitable for street trees or to shade a small property.

Height Range: 25’ - 30’
Spread: 20’ - 25’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Open-growing
Drought tolerance: Medium
Fertilization Requirements: Low
Blooming Season: Spring



Tabebuia chrysotricha
Golden Trumpet

Great accent tree for medians, requires full sun.

Height Range: 25’ - 35’
Spread: 25’ - 35’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Round, Irregular Shape
Drought tolerance: High
Fertilization Requirements: Not required
Blooming Season: Spring



Tabebuia heterophylla
Pink Trumpet Tree

Pink Trumpet Tree is well suited for use as a street tree or for other areas such as in parking lot islands and buffer strips where temperatures are high & soil space limited.

Height Range: 20’ - 30’
Spread: 15’ - 25’
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Irregular outline, Oval shape
Drought tolerance: High
Blooming Season: Spring / Summer



SMALL TREES

OVERALL HEIGHTS
UP TO 15 FEET



Acacia choriophylla
Cinnecord

Can serve as an accent or specimen tree and is ideal for a native plant garden. It’s an endangered specie in Florida.

Height Range: 15’ - 20’
Spread: 5’ - 8’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Open, Irregular Crown
Drought tolerance: High
Blooming Season: Summer



Annona glabra
Pond Apple

Pond Apple is best planted as a large shrub or small tree in wet areas where little else would thrive.

Height Range: 15’ - 20’
Spread: 15’ - 20’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Dense and irregular
Drought tolerance: Moderate
Blooming Season: Spring



Ardisia escallonioides
Marlberry

Used as an evergreen shrub or small tree, makes for good screening for shady sites.

Height Range: 12’ - 15’
Spread: 6’ - 12’
Tree Type: Native Flowering
Growth Rate: Moderate
Growth Habit: Shrub, Oblonged shape
Drought tolerance: Moderate
Blooming Season: Spring



Bucida spinosa
Spiny Black Olive

Unusual bonsai looking tree.

Height Range: 15’ - 20’
Spread: 15’ - 20’
Tree Type: Shrub
Growth Rate: Slow
Growth Habit: Bonsai Shape
Drought tolerance: Moderate
Fertilization Requirements: Frequent
Blooming Season: Winter



Brya ebenus
Jamaican Rain Tree

Works great as an accent tree and flowers throughout the year, creating a fountain of gold.

Height Range: 20’ - 30’
Spread: 10’ - 15’
Tree Type: Flowering
Growth Rate: Slow
Growth Habit: Drooping branches
Drought tolerance: High
Blooming Season: Year Round



Byrsonima lucida
Locustberry

Full sun small tree.

Height Range: 5’ - 15’
Spread: 15’ - 20’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Round
Drought tolerance: High
Blooming Season: Spring / Summer



Calliandra haematocephala
Powderpuff Tree

Powderpuffs are actually large, fast-growing, wide shrubs. Buy one already trained to grow like a tree on a single trunk to keep maintenance to a minimum.

Height Range: 12’ - 15’
Spread: 10’ - 15’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Vase-like, Round
Blooming Season: Year Round



Calypttranthes pallens
Spicewood

Spicewood is an upright shrub or small tree with a unique spicy fragrance.

Height Range: 10’ - 15’
Spread: 8’ - 10’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Oval
Blooming Season: Spring / Summer / Fall



Calypttranthes zuzygium
Myrtle-of-the-River

Small specimen tree.

Height Range: 15’ - 20’
Spread: 10’ - 15’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Rounded Crown
Drought tolerance: Low
Fertilization Requirements: Moderate
Blooming Season: Spring / Summer



Canella winterana
Wild Cinnamon

Red showy flowers cover the tree in summer and fall. Best growth and flowering occur in the full sun and well-drained site.

Height Range: 15’ - 45’
Spread: 15’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Columnar
Drought tolerance: High
Blooming Season: Spring / Summer



Capparis cynophallophora
Jamaica Caper

Jamaica Capper can be utilized as an understory tree in the partial shade.

Height Range: 10’ - 15’
Spread: 15’ - 25’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Oval, Vase-like growth
Drought tolerance: High
Blooming Season: Summer



Cassia surattensis
Glaucous Cassia

Known for its weaker root structure, this tree, it is most commonly known for its small yet, bold-colored stature to compliment landscapes.

Height Range: 12’ - 18’
Spread: 10’ - 25’
Tree Type: Flowering, Shrub
Growth Rate: Fast
Growth Habit: Oval, Vase-link growth
Drought tolerance: Moderate
Blooming Season: Summer



Citharexylum spinosum
Fiddlewood

Moderate salt tolerance allows planting near the beach.

Height Range: 15’ - 35’
Spread: 8’ - 25’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Oval
Drought tolerance: High
Blooming Season: Summer



Cephalanthus occidentalis
Button Bush

This tree can grows well in wet soils, including flood conditions and shallow standing water.

Height Range: 6’ - 12’
Spread: 4’ - 8’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round
Drought tolerance: Low
Blooming Season: Spring / Summer



Cochlospermum vitifolium
Buttercup Tree

Small deciduous tree with large bright yellow flowers. The yellow flowers sometimes cover the entire tree with vivid results.

Height Range: 20’ - 25’
Spread: 15’ - 20’
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Oval, Pyramidal
Drought tolerance: High
Blooming Season: Spring / Summer



Conocarpus erectus var. Sericeus
Silver Buttonwood

Extremely slow-growing broadleaf evergreen. Grows in part shade/part sun; tree grows in full sun.

Height Range: 15’ - 20’
Spread: 15’ - 20’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Vase-like, Spreading



Cordia sebestena
White Geiger

Geiger-Tree is salt tolerant, making it ideal for use in coastal landscapes.

Height Range: 25’ - 30’
Spread: 20’ - 25’
Tree Type: Flowering
Growth Rate: Slow
Growth Habit: Round / Vase Shape
Drought tolerance: High
Blooming Season: Year Round



Cordia sebestena
Geiger Tree

Appearing especially in spring and summer are dark orange flowers which appear in clusters at branch tips.

Height Range: 20’ - 25’
Spread: 25’ - 30’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round, Vase-like
Drought tolerance: High
Blooming Season: Summer / Spring



Eriobotrya japonica
Loquat

Specimen tree that can be used as a street tree or median strip tree in areas where overhead space is limited.

Height Range: 10’ - 25’
Spread: 10’ - 25’
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Round
Drought tolerance: High
Blooming Season: Fall



Eugenia axillaris
White Stopper

The White Stopper has an interesting, earthy fragrance.

Height Range: 15’ - 25’
Spread: 8’ - 15’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Oval
Drought tolerance: High
Blooming Season: Summer



Eugenia rhombea
Red Stopper

Can be trained as a standard tree. Great for small areas.

Height Range: 15’ - 20’
Spread: 10’ - 15’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Oval
Drought tolerance: High
Blooming Season: Year Round



Eugenia foetida
Spanish Stopper

Evergreen tree; small leaves in tight formation; flowers; High salt tolerance and drought tolerance. Can be planted adjacent to power lines.

Height Range: 15’ - 20’
Spred: 10’ - 15’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Columnar, Oval
Blooming Season: Spring / Summer.



Genipa clusiifolia
Seven Year Apple

Florida native salt-tolerant plant making it ideal for use in coastal landscapes.

Height Range: 10’ - 12’
Spread: 5’ - 8’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round
Drought tolerance: High
Blooming Season: Spring / Summer



Guaiacum officinale
Lignum Vitae

Extremely slow-growing broadleaf evergreen. Grows in part shade/part sun.

Height Range: 20’ - 30’
Spread: 8’ - 12’
Tree Size: Medium
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round
Drought tolerance: High
Blooming Season: Year Round



Gymnanthes lucida
Crabwood

Accent tree with full canopy that can act as a buffer.

Height Range: 10’ - 25’
Spread: 10’ - 15’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round
Drought tolerance: High
Fertilization Requirements: Moderate
Blooming Season: Year Round



Lagerstroemia indica
Crape Myrtle

Can be grown as either a shrub or small tree. Produces wide, showy flowers. Has thin, gray/red bark that exfoliates.

Height Range: 15’ - 30’
Spread: 15’ - 25’
Tree Size: Medium
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Vase-like
Drought tolerance: High
Blooming Season: Spring / Summer



Ligustrum japonicum
Japanese or Wax Privet

An attractive & tough multi-trunked plant. Requires little maintenance. Extremely fast growing, can add green to new landscapes quickly.

Height Range: 8’ - 12’
Spread: 15’ - 25’
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Vase-like, Round, Spreading
Blooming Season: Spring



Ligustrum lucidum
Glossy Privet

An attractive and tough plant that requires little maintenance. Extremely fast growing and can add green to new landscapes quickly.

Height Range: 20’ - 30’
Spread: 20’ - 35’
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Round, Vase-like
Blooming Season: Spring



Myrica cerifera
Wax Myrtle

Adaptable to many habitats, growing naturally in wetlands.

Height Range: 10’ - 15’
Spread: 8’ - 10’
Tree Type: Native
Growth Rate: Fast
Growth Habit: Round
Drought tolerance: High
Blooming Season: Spring / Winter



Myrcianthes fragrans
Simpson’s Stopper

Hardy native; can be planted adjacent to power lines. Small fragrant flowers , small berries attractive to birds.

Height Range: 20’ - 30’
Spread: 15’ - 25’
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round
Drought tolerance: High
Blooming Season: Spring / Summer



Myrsine guianensis
Myrsine

Large shrub or small tree with an erect trunk and an irregular narrow crown. Full sun to light shade.

Height Range: 10’ - 15’
Spread: 8’ - 12’
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Upright
Drought tolerance: High
Blooming Season: Year Round



Parkinsonia aculeata
Jerusalem Thorn

Small picturesque tree with open foliage.

Height Range: 15’ - 20’
Spread: 20’ - 25’
Tree Type: Flowering
Growth Rate: Fast
Growth Habit: Umbrella, Vase-like
Drought tolerance: High
Blooming Season: Spring / Summer



Pimenta dioica
All-Spice Tree

Adapts to moist conditions easily and does well in dappled shade or sun.

Height Range: 15’ - 20’
Spread: 15’ - 20’
Tree Type: Flowering
Growth Rate: Slow to Moderate
Growth Habit: Irregular, oval
Drought tolerance: High
Blooming Season: Spring



Plinia cauliflora
Jaboticaba

A tropical, medium-sized cultivated fruit tree native to South Brazil that produces an abundant fruit high in Vitamin C.

Height Range: 15’ -40’
Spread: 18’ - 30’
Growth Rate: Slow
Growth Habit: Multi-trunk, Oval
Blooming Season: Several times a year



Pithecellobium keyense
Blackhead

Accent or specimen shrub or small tree along the coast. Buffer plantings.

Height Range: 10' - 18'
Spread: 8' - 15'
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Irregular crown with short trunk
Drought tolerance: High
Blooming Season: Year Round



Quercus geminata
Sand Live Oak

Sand Live Oak tree can grow in sandy, scrub habitat and does not reach the dimensions of the live oak

Height Range: 15' - 30'
Spread: 10' - 15'
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round, Irregular Shape
Drought tolerance: High
Fertilization Requirements: Low
Blooming Season: Spring



Randia aculeata
White Indigo Berry

Shrub border or foundation plant that often produces spines at the base of leaves. Provides significant food and moderate amounts of cover for wildlife.

Height Range: 6' - 8'
Spread: 3' - 6'
Tree Type: Native Shrub
Growth Rate: Slow to Moderate
Growth Habit: Erect trunk & narrow crown
Drought tolerance: High
Blooming Season: Year Round



Reynosa septentrionalis
Darling Plum

Salt-tolerant tree making it ideal for use in coastal landscapes.

Height Range: 8' - 20'
Spread: N/A
Tree Type: Native
Growth Rate: Slow
Growth Habit: Round, Irregular Shape
Drought tolerance: High
Blooming Season: Spring / Summer



Spondias dulcis
Golden Apple/Ambarella

The tree is often cultivated in the tropics, both for its edible fruit and as an ornamental tree.

Height Range: 30' - 40'
Spread: 40' - 50'
Tree Type: Fruit Tree
Growth Rate: Fast
Growth Habit: Round, Irregular Shape
Drought tolerance: Moderate
Blooming Season: Spring / Summer / Fall



Tabebuia aurea
Yellow Tabebuia

Colorful accent tree during flowering season.

Height Range: 15' - 25'
Spread: 10' - 15'
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Round, Irregular Shape
Drought tolerance: High
Blooming Season: Winter / Spring



Tabebuia impetiginosa
Purple Tabebuia

Colorfull accent tree during flowering season.

Height Range: 15' - 25'
Spread: 10' - 15'
Tree Type: Flowering
Growth Rate: Moderate
Growth Habit: Round, Irregular Shape
Drought tolerance: High
Blooming Season: Winter / Spring



Tecoma stans
Yellow Elder

This tree is noted for its brilliant, bell-shaped, fragrant yellow flowers. The somewhat weedy growth requires pruning to control shape.

Height Range: 12' - 30'
Spread: 20' - 30'
Tree Type: Flowering
Growth Rate: Moderate to Fast
Growth Habit: Irregular Shape, Oval
Drought tolerance: High
Blooming Season: Year Round



Ximenia americana
Tallow Wood Plum

Great for natural landscapes and habitat restoration. Thorny branches.

Height Range: 10' - 25'
Spread: 10' - 20'
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Irregular Shape
Drought tolerance: High
Blooming Season: Spring / Summer / Fall



Zanthoxylum fagara
Wild-lime

Foliage is aromatic. Good as screen plant where its thorns will be an asset.

Height Range: 15' - 20'
Spread: 15' - 20'
Tree Type: Native
Growth Rate: Moderate
Growth Habit: Round
Drought tolerance: High
Blooming Season: Spring / Summer / Fall



LARGE PALMS

OVERALL HEIGHTS
EXCEEDING 15 FEET
OF CLEAR WOOD TRUNK



Bismarckia nobilis
Bismarck Palm

Excellent focal point in large garden; single stem.

Size: 30’ - 50’ HT
Spread: 15’ - 25’
Growth Rate: Slow
Type: Specimen
Drought Tolerance: High
Light Requirements: Full sun, partial sun, or partial shade
Maintenance Need: Moderate
Frond: Fan Leaf



Butia capitata
Pindo Palm

Excellent focal point in large garden; single stem.

Size: 15’ - 25’ HT
Spread: 10’ - 15’
Growth Rate: Slow
Type: Evergreen
Drought Tolerance: High
Light Requirements: Full sun, partial sun, or partial shade
Maintenance Need: Moderate
Frond: Linear / Silver, Blue-green



Coccothrinax argentata
Florida Silver Palm

Nice accent in a shrub border, and can be massed together for color impact.

Size: 6’ - 15’ HT
Spread: 6’ - 7’
Growth Rate: Slow
Type: Native
Drought Tolerance: High
Light Requirements: Full sun, partial sun or partial shade, shade
Maintenance Need: Low
Frond: Star-shaped / Green, Silver



Cocos nucifera
Coconut Palm

Single trunk, large nuts. High salt tolerance.

Size: 50’ - 80’ HT
Spread: 20’ -25’
Growth Rate: Moderate
Type: Single Trunk
Drought Tolerance: High
Light Requirements: Full sun, partial sun or partial shade, shade
Maintenance Need: Low
Frond: Feather Leaf



Copernicia baileyana
Bailey Palm

Single stem, spiny petiole.

Size: 30’ - 50’ HT
Spread: 15’
Type: Specimen
Drought Tolerance: Medium
Light Requirements: Sun to partial shade
Maintenance Need: High
Frond: Fan Leaf



Dictyosperma
Hurricane palm

Known for its ability to withstand hurricane winds.

Size: 12’ - 25’ HT
Spread: 10’ - 15’
Growth Rate: Slow
Type: Evergreen
Drought Tolerance: Low
Light Requirements: Sun to partial shade
Maintenance Need: Low
Frond: Feather leaf



Elaeis guineensis
African Oil Palm

Single Trunk; spiny petiole.

Size: 30’-50’ HT
Spread: 15’ - 20’
Growth Rate: Moderate
Type: Specimen
Drought Tolerance: Moderate
Light Requirements: Full sun, partial sun, or partial shade
Maintenance Need: High
Frond: Feather Leaf



Hyophorbe lagenicaulis
Bottle Palm

Thrives on heat and is very salt tolerant. Sculpted crownshaft resembles a bottle.

Size: 12’ HT
Spread: 6’ - 10’
Growth Rate: Slow
Type: Specimen
Drought Tolerance: Moderate
Light Requirements: Full sun to partial shade
Maintenance Need: Low
Frond: Feather Leaf



Latania loddigesii
Latan Palm

Surface of each leaf is covered with a waxy down, providing a silvery appearance.

Size: 20’ - 30’ HT
Spread: 10’ - 12’
Growth Rate: Slow
Type: Evergreen
Drought Tolerance: High
Light Requirements: Full sun to partial shade
Maintenance Need: Low
Frond: Star-shaped / Silver, green



Coccothrinax crinita
Thatch Palm

Known for long shag of hair that clothes the stem.

Size: 10’ - 15’ HT
Spread: 6’ - 10’
Growth Rate: Slow
Type: Specimen
Drought Tolerance: Moderate
Light Requirements: Partial shade
Maintenance Need: Moderate
Frond: Star-shaped, fan / Dark green top, silver underneath



Thrinax parviflora
Broom Thatch Palm

Surface of each leaf is covered with a waxy down, providing a silvery appearance.

Size: 8’ - 20’ HT
Spread: 10’ - 12’
Growth Rate: Slow
Type: Evergreen
Drought Tolerance: Moderate
Light Requirements: Full sun to partial shade
Maintenance Need: Low
Frond: Fan Leaf



Dypsis decaryi
Triangle Palm

Three-planed arrangement of leaves give great use for accent planting.

Size: 25’ - 35’ HT
Spread: 15’
Growth Rate: Slow
Type: Evergreen
Drought Tolerance: Moderate
Light Requirements: Full sun to partial shade
Maintenance Need: Low
Frond: Grow in three rows forming triangle



Phoenix canariensis
Canary Island Date Palm

Single Trunk; spiny petiole.

Size: 30’ - 40’ HT
Spread: 20’ -25’
Growth Rate: Slow
Type: Specimen
Drought Tolerance: High
Light Requirements: Full sun to partial shade
Maintenance Need: Moderate
Frond: Feather Leaf



Phoenix dactylifera ‘Medjool’
Medjool Date Palm

Single Trunk; spiny petiole.

Size: 30’ - 40’ HT
Spread: 10’ - 15’
Growth Rate: Slow
Type: Specimen
Drought Tolerance: High
Light Requirements: Full sun to partial shade
Maintenance Need: Moderate
Frond: Feather Leaf



Phoenix sylvestris
Sylvester Date Palm

Single Trunk; spiny petiole.

Size: 30’ - 40’ HT
Spread: 20’ - 25’
Growth Rate: Slow
Type: Specimen
Drought Tolerance: High
Light Requirements: Full sun to partial shade
Maintenance Need: Moderate
Frond: Feather Leaf



Phoenix reclinata
Wild Date Palm

Clumping multi-trunk, weedy and has spiny petiole.

Size: 25’ - 50’ HT
Spread: 10’ - 15’
Growth Rate: Moderate
Type: Specimen
Drought Tolerance: High
Light Requirements: High
Maintenance Need: Moderate
Frond: Feather Leaf



Pseudophoenix sargentii
Buccaneer Palm

Most durable for seaside planting.

Size: 10’ - 15’ HT
Spread: 8’ - 12’
Growth Rate: Slow
Type: Native
Drought Tolerance: High
Light Requirements: Full sun to partial shade
Maintenance Need: Low
Frond: Linear, Fan Leaf



Roystonea regia
Cuban Royal Palm

Distinctive height makes for an ideal promenade statement.

Size: 50’ - 100’ HT
Spread: 15’ - 30’
Growth Rate: Slow
Type: Native / Specimen
Drought Tolerance: Moderate
Light Requirements: Full sun to partial shade
Maintenance Need: Low
Frond: Linear, Feather Leaf



Roystonea spp.
Royal Palm

Single Trunk.

Size: 50’ - 70’ HT
Spread: 15’ - 25’
Growth Rate: Moderate
Type: Native
Drought Tolerance: Moderate
Light Requirements: Full sun to partial shade
Maintenance Need: Moderate
Frond: Feather Leaf



Sabal Palmetto
Cabbage Palm

Cabbage Palm is topped with a very dense, round crown of deeply cut leaves.

Size: 40’ - 50’ HT
Spread: 10’ - 15’
Growth Rate: Slow
Type: Native
Drought Tolerance: High
Light Requirements: Full sun to partial or full shade
Maintenance Need: Moderate
Frond: Star-shaped / Orbiculate



Thrinax radiata
Florida Thatch Palm

Accent or specimen tree in the landscape.

Size: 15’ - 20’ HT
Spread: 6’ - 10’
Growth Rate: Slow
Type: Native
Drought Tolerance: High
Light Requirements: Full sun to partial shade
Maintenance Need: Moderate
Frond: Star-shaped



Trachycarpus fortunei
Windmill Palm

Compact crown with large, fan-like, green foliage and distinctive hairy black fibers.

Size: 10’ - 20’ HT
Spread: 6’ - 10’
Growth Rate: Slow
Type: Broadleaf evergreen
Drought Tolerance: Moderate
Light Requirements: Full sun to partial shade
Maintenance Need: Moderate
Frond: Star-shaped





URBAN PLANTING

TREE PLANTING - AN URBAN STRATEGY

INTRODUCTION

Deciding how to roll-out the planting of trees and the integration of a specie diversification strategy can be quite daunting, particularly if there isn’t a direction to that roll-out. While an overall diversification of the entire city’s inventory of specie is critical and important, so is the need to ensure that there is a design mechanism that supports the creation of ‘place’, supports notions of neighborhoods, communicates a hierarchy of roadway and streetscapes, and operates as a city-wide wayfinding system. The latter two of these are the most important from a design standpoint, because a significant number of individuals traversing through the street of Miami Beach are tourists, each seeking visual cues to affirm that they are moving through the city on their chosen paths towards a given destination. The ability for the urban forest to service those needs, while leveraging itself to assist in the definition of distinct areas and communities, can be a very powerful planning tool.

This ‘toolkit’ establishes the first attempt at consolidating a city-wide strategy. We deem it as a “first attempt” because planning decisions are never final, and this ‘toolkit’ must be deemed as a ‘working document’. As the City engages new area-specific master plans, the priorities of those recommendations’ impacts on aesthetic, as derived by the use of trees, palms and landscape material, must be then incorporated into and reflected in this tree master plan.

Additionally, it is important to note that this is not a street tree master plan nor a streetscape master plan. Those types of documents require a greater degree of involvement and detail that far exceeds the scope of work outlined for this ‘toolkit’. Both a street tree master plan and a streetscape master plan, among other things, would specifically identify unique species to be located at exact locations throughout their selected corridor. The recommendations put forth

in these would also be based on site-specific information, such as topographical surveys, that would refine the level of detail to a degree that this ‘toolkit’ does not account for.

Instead, this document needs to be understood as a Predominant Species Plan that seeks to identify critical street and corridors, as well as makes an attempt to create some level of distinction between the larger character-areas of the City. Upon determining what species to plant in what location, it is encouraged that the user refers to this Predominant Species Plan to assess the palette of options recommended. Additionally, the user should further investigate the selected corridor to verify if a special area or corridor-specific plan has been developed that more specifically identifies what are the unique species that are being required as a part of that vision. The more specific plan should override any recommendation put forward herein. As such, the recommendations put forward in this plan should serve as a set of guidelines, more so than regulations.

In identifying corridors and areas, several considerations have been made, including:

- Reinforcing the established hierarchy of roadways to enhance their operational quality
- Recognizing overall topographic circumstances that may impact large swaths of the urban forest
- Supporting general, perceptive qualities of large areas and corridors

The Predominant Species Plan seeks to identify palettes of preferred predominant tree/palm species for different types of roadways and areas, categorized by their performative quality in the physical make-up of the city. These include:

- Highly visible and high-profile corridors

- Commercial corridors
- Hospitality corridors
- Gateways
- Cultural corridors & areas
- City-connector corridors
- Neighborhood-connector corridors
- Urban residential areas
- Suburban residential areas

HIGHLY VISIBLE AND HIGH-PROFILE CORRIDORS describe corridors and areas that are of unique iconographic significance. These include corridors such as:

- Lincoln Road Mall,
- Ocean Drive (from 5th to 15th Street),
- Arthur Godfrey Road (41st Street), and
- 71st Street (from Dickens Avenue to Collins Avenue).

COMMERCIAL CORRIDORS describe corridors that support the commercial needs of the residents and visitors to Miami Beach. These include corridors such as:

- Alton Road (from 5th Street to Dade Boulevard),
- Washington Avenue (from 5th to 17th Street),
- 71st Street (from Rue Notre Dame to Rue Vendome)
- Normandy Drive (from Rue Vendome to Rue Notre Dame)
- Collins Avenue (from 63rd to 76th Street).

HOSPITALITY CORRIDORS describe corridors that support a predominant of hotel uses. These typically are characterized by having intense pedestrian use and are fronted by buildings with distinctively architectural facades. These include corridors such as:

- Ocean Drive (From South Pointe Drive to 5th Street)
- Collins Avenue (from South Pointe Drive to 44th Street)

GATEWAYS describe corridors and areas that are of significance in defining a high-quality, unique arrival experience for tourists to the City. These include:

- 5th Street (from Alton Road to Ocean Drive),
- Harding Avenue (from 87th Terrace to 86th Street), and
- Julia Tuttle Causeway (from the City boundary to Alton Road)

CULTURAL CORRIDORS & AREAS describes roadways and areas that are of important significance to the cultural realm and experience of the City. These include:

- 71st Street and Normandy Drive, surrounding the plaza at Rue Vendome
- 21st and 22nd Streets, surrounding Collins Park
- Convention Center Drive
- 72nd and 73rd Streets, surrounding the North Shore Park

- CITY-CONNECTOR CORRIDORS describe corridors that are critical to intra-city connectivity. These include corridors such as:
- Harding Avenue
- 71st Street (from Bay Drive to Rue Notre Dame)
- Normandy Drive (From Rue Notre Dame to Bay Drive)
- Indian Creek Drive
- Alton Road (north of Dade Boulevard)
- 63rd Street,
- Meridian Avenue (From Dade Boulevard to 5th Street),
- Pine Tree Drive, and
- Venetian Causeway

NEIGHBORHOOD-CONNECTOR CORRIDORS describe corridors that are important for intra- and inter-neighborhood connectivity. These include corridors such as:

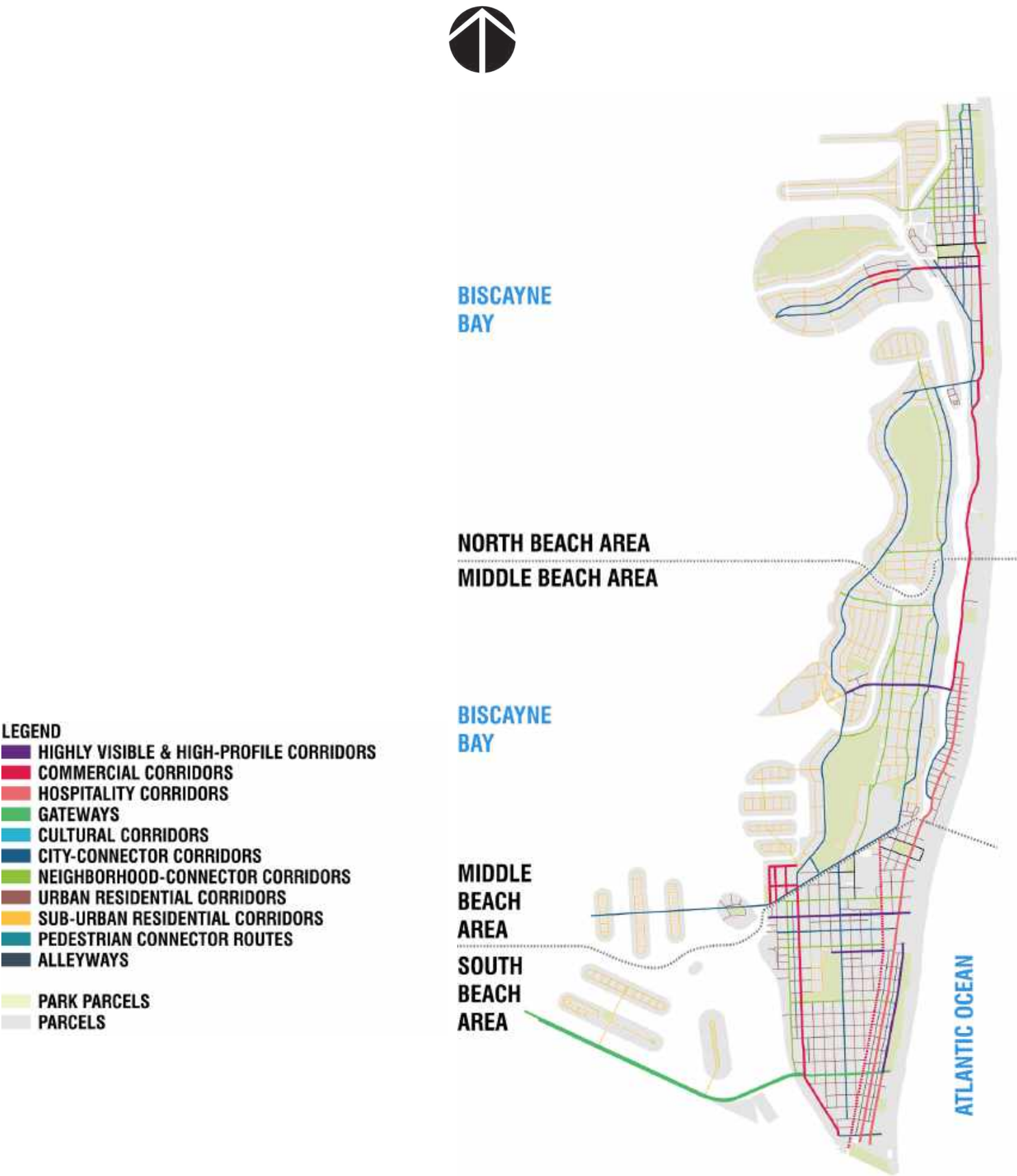
- 11th Street
- 15th Street
- 17th Street
- Chase Avenue
- Prairie Ave
- Sheridan Avenue
- 47th Street
- 77th Street
- Tatum Waterway
- Dickens Avenue, and
- West Avenue

URBAN RESIDENTIAL AREAS describe areas with predominantly multi-family residential dwellings. These areas include:

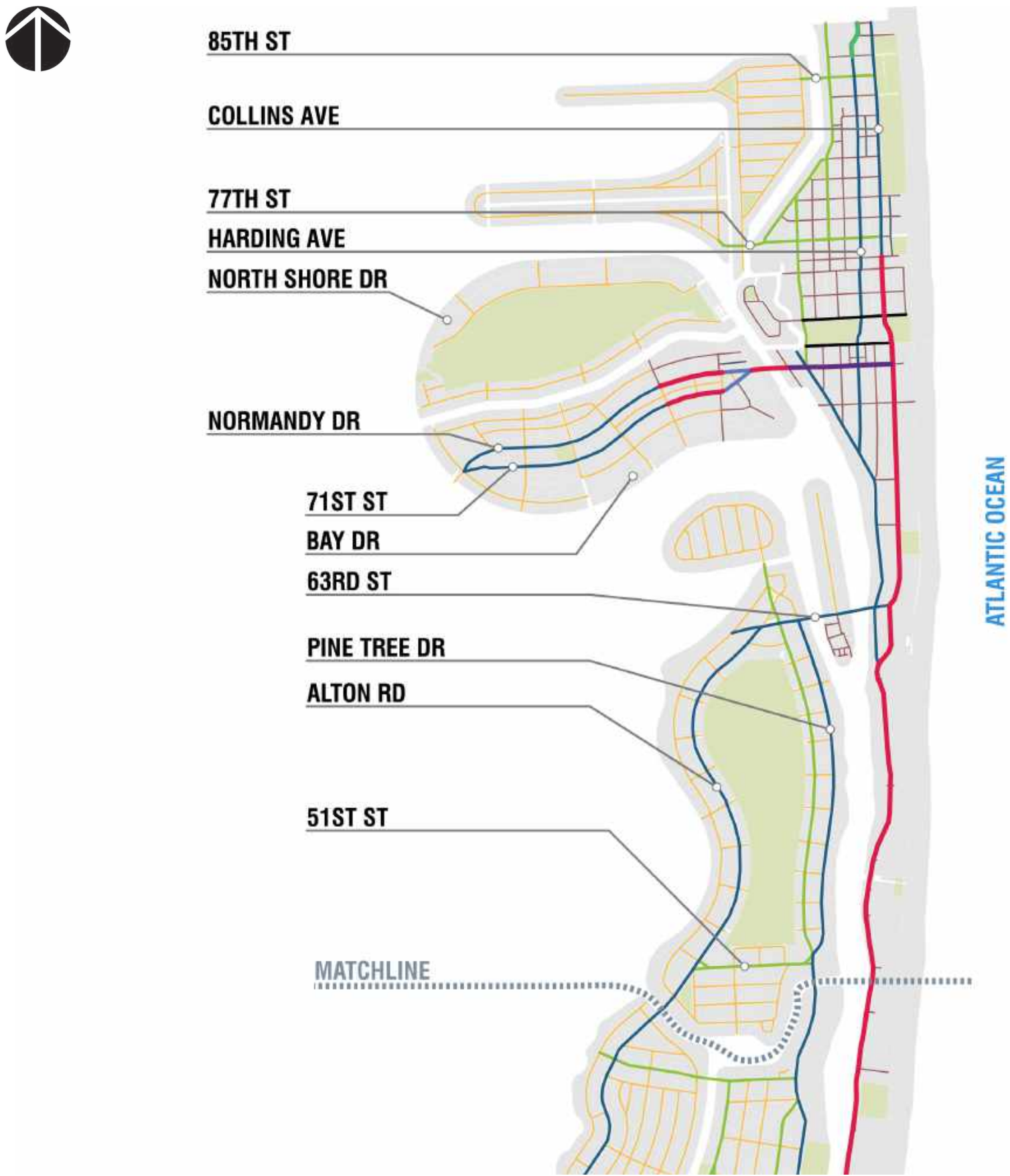
- Areas generally south of 17th Street and west of Washington Avenue
- Areas generally east of the convention center and west of Collins Avenue
- Areas generally between Indian Creek Drive and Collins Avenue
- Areas along Collins Avenue from Indian Beach Park to Alison Park and west to the Indian Creek Drive
- Areas north of 73rd Street between Tatum Waterway and Dickens Avenue to the ocean

SUBURBAN RESIDENTIAL AREAS describe areas with predominantly single-family homes fronting the streets. These areas feel mostly like a traditional, suburban neighborhood.

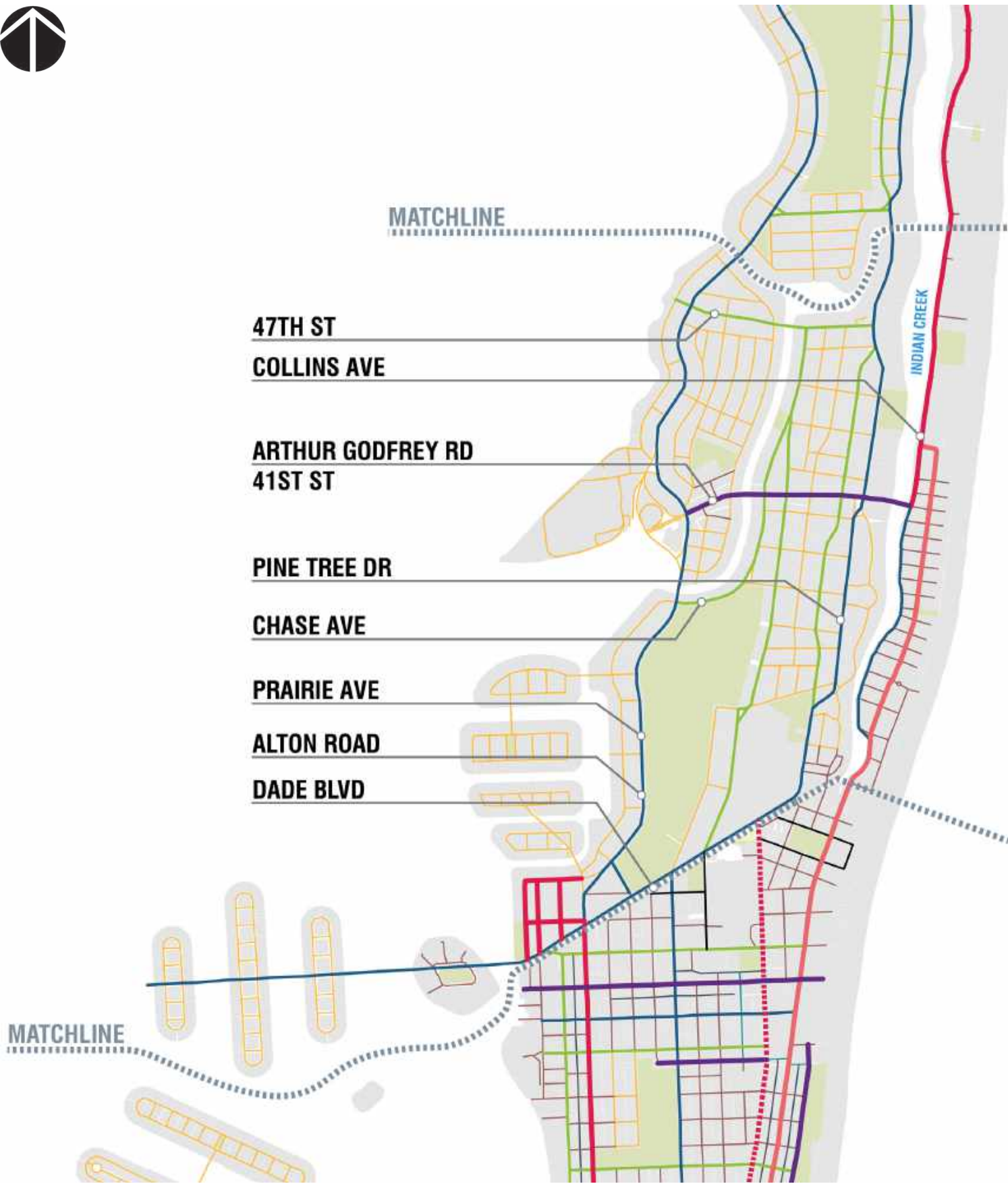
STREET-TREE PREDOMINANT SPECIES PLAN
CITY-WIDE VIEW



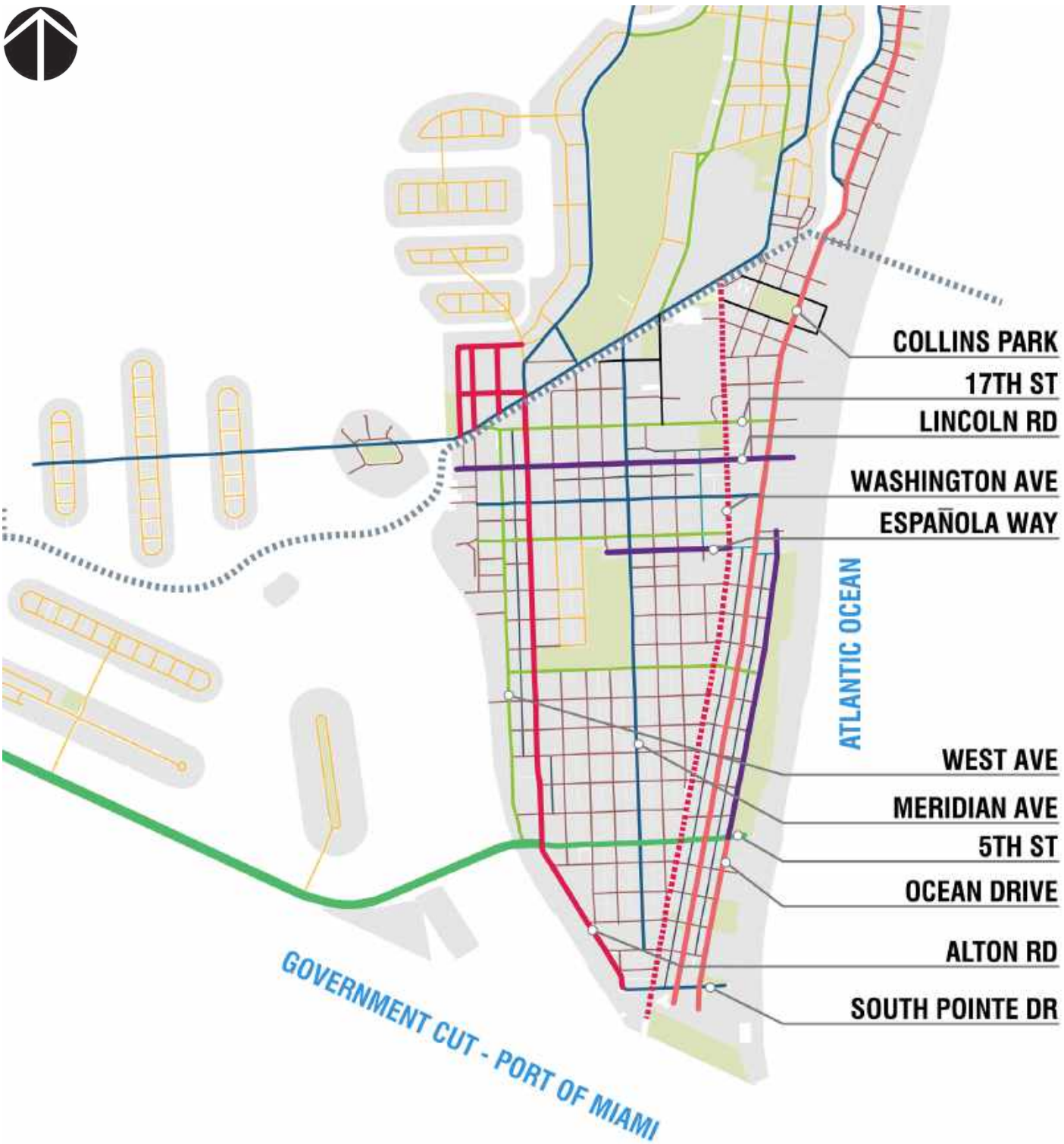
STREET-TREE PREDOMINANT SPECIES PLAN - ENLARGEMENT
FOCUS AREA: NORTH BEACH AREA



STREET-TREE PREDOMINANT SPECIES PLAN - ENLARGEMENT
FOCUS AREA: MIDDLE BEACH AREA



STREET-TREE PREDOMINANT SPECIES PLAN - ENLARGEMENT
FOCUS AREA: SOUTH BEACH AREA





HIGHLY VISIBLE AND HIGH-PROFILE CORRIDORS

TYPICAL CONDITIONS

- Large expanses of continuous hardscape needed to accommodate large numbers of pedestrians
- When accessible, they are highly transited by vehicles and tour buses, requiring tall clearances from any street landscape canopy
- Generally, the sidewalks have a high intensity of varied uses: walkable areas, sidewalk cafes with large shade umbrellas, furnishings
- Aesthetics are generally driven by marketing cues promoting Miami Beach as a beach resort destination; as a result, there is an overuse of palms

RELEVANT CORRIDORS

- Lincoln Road Mall,
- Ocean Drive (from 5th to 15th Street),
- Arthur Godfrey Road (41st Street), and
- 71st Street (from Dickens Avenue to Collins Avenue)
- Española Way

URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- Require the extensive use of green infrastructure to provide soil volume for proper root growth
- Consider visibility, safety and building protrusions; select species that can provide clearances of a minimum of 14 feet when mature
- Consider reduced spacing between selected specie to provide greater shade
- Consider reducing loading zone areas and repurposing them for bulb-out and with street trees
- Consider diversifying street tree palette to include species regarded as 'expensive' or 'luxury'
- Do not use self-cleaning palms or trees with a high index of littering

Recommended predominant species:

- Trees: Cathedral Oak, High Rise Oak
- Palms: Medjool Date Palm, Bismarck Palm



COMMERCIAL CORRIDORS

TYPICAL CONDITIONS

- Large expanses of continuous hardscape needed to accommodate large numbers of pedestrians
- Large numbers of small businesses that depend on frontage visibility to gain opportunistic business
- High concentration of restaurant uses with some outdoor seating
- Building facades generally have awnings that protrude over the sidewalk and may conflict with tree canopies
- Typically lined by extensive curbside parking
- Utilized by large commuter buses and large delivery trucks

URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- Require the extensive use of green infrastructure to provide soil volume for proper root growth
- Consider visibility, safety and building protrusions; select species that can provide clearances of a minimum of 14 feet when mature
- Plant trees at a minimum overall height of 15 feet
- Consider using standard spacing of 20-feet between selected species
- Consider selecting species with a thin, dappled canopy that allows for some visibility through the leaves so business signage can be legible
- Do not use self-cleaning palms or trees with a high index of littering

Recommended predominant species:

- Trees: Live Oak, Royal Poinciana, Bridalveil
- Palms: Medjool Date Palm, Bismarck Palm

RELEVANT CORRIDORS

- Alton Road (from 5th Street to Dade Boulevard),
- Washington Avenue (from 5th to 17th Street),
- 71st Street (from Rue Notre Dame to Rue Vendome)
- Normandy Drive (from Rue Vendome to Rue Notre Dame)
- Collins Avenue (from 63rd to 76th Street)



HOSPITALITY CORRIDORS

TYPICAL CONDITIONS

- Large expanses of continuous hardscape areas
- Hotels typically have circular driveways to accommodate drop-off and valet services; this severely limits the ability to provide street trees either because driveways limit access to planting areas, especially at the shared property lines between hotels, or because of sight clearances required at the exit point of the driveway onto the street
- Right-of-ways tend to be built-out and buildings have tall facades on shallow setbacks, resulting in an overuse of palms as street trees

URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- Require the extensive use of green infrastructure to provide soil volume for proper root growth
- Consider visibility, safety and building protrusions; select species that can provide clearances of a minimum of 14 feet when mature
- Plant trees at a minimum overall height of 20 feet
- Consider planting palms in-line with shared property lines and large shade tree species along the properties' mid-frontage
- Consider selecting species with a dense, wide-spreading canopy
- Consider selecting tree species that flower and have distinctive character

Recommended predominant species:

- Trees: Mahagony, Pond Cypress
- Palms: Medjool Date Palm, Coconut Palm

RELEVANT CORRIDORS

- Ocean Drive (from South Pointe Drive to 5th Street)
- Collins Avenue (from South Pointe Drive to 44th Street)



CASE STUDY

PINE TREE DRIVE ADAPTING MEANING

The preservation of elements that contribute to Miami Beach’s rich history has been deemed by the residents as an important consideration that should be taken into account on every project, with the goal to preserve as much as reasonably possible, those contributing elements. Pine Tree Drive is such a condition. As early as 1910, John Collins planted a double hedgerow of Australian Pines (Casuarina equisetifolia) on the eastern edge of his mango and avocado groves to protect his crops from the wind and salt spray originating from the nearby beach. These Australian Pines have remained in place for over 80 years and since have become iconic to that segment of roadway, serving as the namesake for the corridor.

Unlike objects and edifices, trees are faced with a challenge when trying to preserve them for historical reasons. First, they are living, dynamic elements susceptible to disease, infestations, and damage from storms. Secondly, and more poignantly in the case of Pine Tree Drive, these specific trees have a lifespan of approximately 50 years, and we are long past their age of natural attrition. An evaluation of the existing Australian Pine Trees has recommended that severe pruning be conducted to eliminate any dead and decayed branching and to eliminate their overall heights so they don’t topple over in a high-wind event. As these trees naturally die or are removed because of precarious conditions, new and younger Australian Pine Trees cannot be planted in their place, because both Miami-Dade County and the City of Miami Beach have deemed them as an invasive specie. As a result, this corridor serves as a perfect example for a case study to explore strategies to slowly transition aged and mature canopy to newer plantings for greater resilience. The strategy put forth in this plan establishes a sequence and phasing strategy to achieve these modifications over a period of several years.

Each phase should consist of the same scope of work items, as follows:

- Locate the areas to be affected for replacement planting;
- Perform an arborist report to determine the metrics for tree replacement and mitigation, consistent with the City’s Landscape Ordinance;
- Remove the existing Australian Pine Tree and dispose of them consistent with the law, and rake and remove all remaining pine needle litter, without exception;
- Remove any branches of abutting Australian Pine that may be spanning over the new area to plant, as well as any growth that may have the propensity to span over it;
- Determine the locations where new trees will be placed. Auger and excavate tree planting pits a minimum of 3-times the size of the root ball of the incoming tree to a minimum depth of 30 inches.
- Excavate the top-most layer of soil to a minimum depth of 18 inches and replace it with new, amended soils; and
- Install the new vegetation at an elevation slightly higher than the remaining, abutting Australian Pine to prevent irrigation, rainwater and litter from draining onto the newly graded, soiled and planted areas.



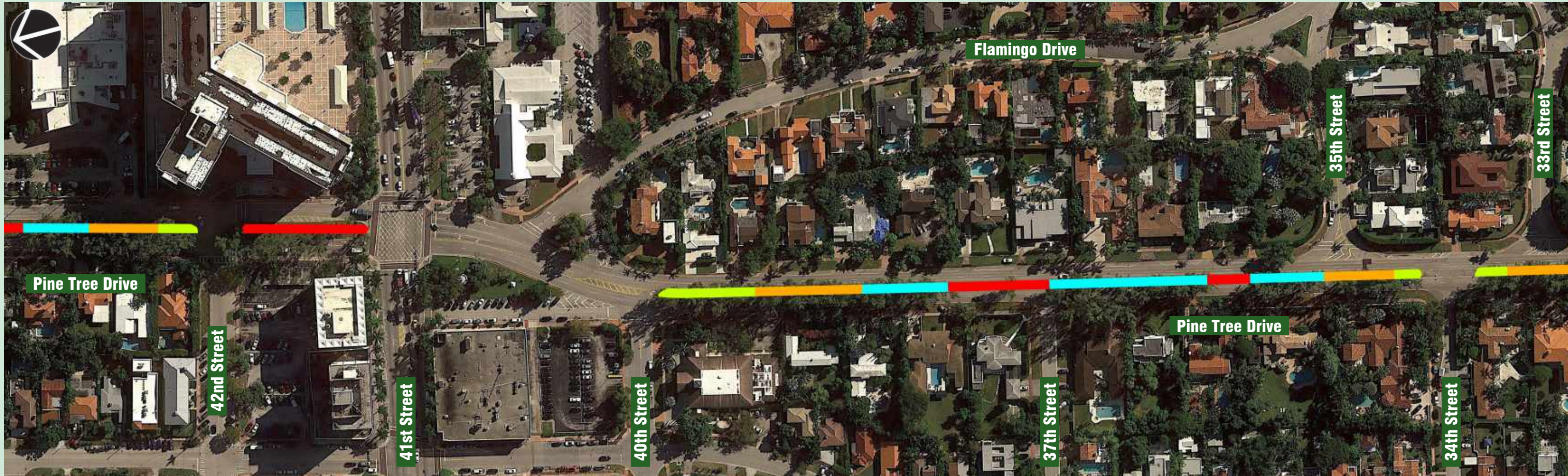
RECOMMENDED REPLACEMENT TREE SPECIES:

Replacement tree species are herein being recommended as viable, alternate plantings for succession throughout the corridor. These species include:

- For the Medians - all new plantings to be a mixture of the following ranked species:
 - Pinus elliottii – Slash Pine
 - Pinus clausa – Sand Pine
 - Pinus taeda – Loblolly Pine, and
 - Juniperus silicicola – Southern Red Cedar
- For the Swale areas - because the swales are sizeable, larger canopy trees can be accommodated, such as:
 - Quercus virginiana - Live Oak,
 - Ficus citrifolia - Short-leaf Ficus, and
 - Ficus aurea - Strangler Fig.

This objective makes every attempt to remain true to the existing character of the Drive by installing a predominant amount of native pine trees in the medians. Additional canopy species in the swale areas will lend species diversity to ensure that the planting mix is resilient to potential pests or disease.







TRANSITIONAL PLANTING STRATEGIC PLAN

The transitional planting strategic plan included focuses on the medians and seeks to establish a method for slowly transitioning the existing planting to its envisioned mixed of Florida-native pine trees. The phases have been formulated to provide the necessary changes in a manner that provides the best-designed approach, in a manner that slowly transitions the perception of visitors through that experience so as to not have an immediate drastic change.

- PHASE 1 PLANTING RECOMMENDATIONS – YEAR 1**
Identify locations of bare planting, where large gaps exist, or can be created with the minimal removal of existing trees, to plant with a mix of the recommended species. Phase 1 planting should consist entirely of pine species.
- PHASE 2 PLANTING RECOMMENDATIONS - YEAR 4**
Clear rhythmic gaps in the existing hedgerow of Australian Pines and plant them with a 70/30 mix, as recommended, to establish a pattern of alternating plantings.
- PHASE 3 PLANTING RECOMMENDATIONS – YEAR 7**
Clear and plant the end-caps of the medians entirely with a mix of pine species.
- PHASE 4 PLANTING RECOMMENDATIONS – YEAR 10**
Remove all remaining Australian Pines and plant those areas with a 70/30 mix, as recommended, to complete the planting corridor.



INTERMEDIATE PHASE - PERSPECTIVE



FINAL PHASE - PERSPECTIVE



INTERMEDIATE PHASE - ELEVATION



FINAL PHASE - ELEVATION

GATEWAYS

TYPICAL CONDITIONS

- Emblematic and signature locations
- Generally surrounded by ample landscape areas
- Similar to corridors appealing to the tourist experience, the selection of canopy landscape material is predominantly palms.
- Generally, on major access corridors, making them prime candidates for beatification grant funding.

RELEVANT CORRIDORS

- 5th Street (from Altn Road to Ocean Drive),
- Harding Avenue (from 87th Terrace to 86th Street), and
- Julia Tuttle Causeway (from the City boundary to Alton Road)



URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- While green infrastructure may not be needed because of large pervious areas, encourage the amendment of soils to sustain through drought periods
- Select species that can be seen and identified at a long distance away, preferably ones that are a larger scale
- Consider species that have seasonal character
- Select species that can tolerate temporary flooding

Recommended predominant species:

- Trees: African Tuliptree, Kapok Tree, Short-leaf Fig
- Palms: Canary Date Palm, Bailey Palm



CULTURAL CORRIDORS AND AREAS

TYPICAL CONDITIONS

- Corridors associated with and fronted by large expanses of open space.
- Open spaces tend to be used for important and culturally-significant events, such as performances, outdoor exhibits, gatherings, etc
- Highly-dynamic programming and need to be unencumbered in order to accommodate varying events results in large expanses of open spaces left unplanted; when canopy is provided, it is mostly done through palms in order to maintain pedestrian level clearances and visibility for security reasons.

URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- While green infrastructure may not be needed because of large pervious areas, encourage the amendment of soils to sustain through drought periods
- Consider species that have seasonal character
- Consider species that have a columnar growth habit
- Canopy species mix should be equal trees:palms

Recommended predominant species:

- Trees: Silk Floss Tree, Common Persimmon
- Palms: Medjool Date Palm, Lantana Palm, Royal Palm

RELEVANT CORRIDORS

- 71st Street and Normandy Drive, surrounding the plaza at Rue Vendome
- 21st and 22nd Streets, surrounding Collins Park
- Convention Center Drive
- 72nd and 73rd Streets, surrounding the North Shore Park





CASE STUDY

LA GORCE ISLAND

ADAPTING FOR INCREASED SALINE-TOLERANCES

One of the more challenging aspects of landscape adaptation is the process of facilitating for adaptive change, while preserving a clear established identity, particularly when that identity has its foundation based on a specie that will not survive well as the on-coming climate change ramps up. Such is the case of La Gorce Island, a gated residential island-community located on the Biscayne Bay side of the City. Currently, the street tree selection that predominates throughout the island is the Royal Palm. The palm’s scale, dimension and austere columnar character, together with its relentlessly, repetitive use as the only, singular street tree species creates a look that is majestic, monumental and very estate-like. This is particularly a good match to the large and elegant villa-inspired homes that populate the island. But beyond that stunning, colonnade estate experience lies weaknesses and vulnerabilities that reside just beneath the surface that will inevitably cause a die-off of these Royal Palms.

The first of these is the fact that it is a streetscape that is solely reliant on a single species. As discussed elsewhere in this report, a strong resilience in urban canopy is highly dependent on the complexity and diversity of the mix of species that exist. Having an entire community solely reliant on one specie to establish its identity and look makes it incredibly vulnerable to being easily wiped out with an onslaught of a single epidemic that targets and affects that specie. The City has already seen this happen with the presence of Lethal Bronzing and Ganoderma Butt Rot on several of the Royal Palms in that specific location, which infests the rootball and impedes the ability to replant in that same, specific location again in the future. One general, shared characteristic of diseases is that they also impede the continual nourishment of the palm and leads to its eventual death.

The second of these is the relentless changes in global climate and its impact at the local level, particularly the impacts of sea-level rise. Two characteristics that define the Royal Palm specie are its moderate tolerance to salt-spray and its low resistance to salinity in the groundwater. As sea-level rise increases, so will the amount of salinity in the waters of Biscayne Bay which will also increase the overall salinity in the air resulting from the interaction of shorelines with the wind. While the salt spray will be less of an issue for La Gorce, particularly because the streets are all internal to the island and because the palms are

all shielded from any water frontage by the large-scaled homes, protecting the palms from immediate exposure to any salt spray. However, the more poignant and direct impact will come as a result of the rise of salinity in the groundwater; something the root system of the Royal Palms are especially not suited to tolerate. As the roots are touched by groundwater salinity, they go into shock and they cauterize and die back. This eventually leads to a much-reduced root ball spread that affects the palm’s ability to absorb water and conduct nutrients. A symptomatic evidence of this is a diminished canopy size and a greatly reduced spread of its fronded canopy, which manifests itself in a gradual manner.

The more perilous of the impacts is what goes unseen. As the root ball’s spread gets diminished, so does its ability to anchor itself in place. This has significant implications when faced with tropical storms and hurricane events. As these weather events occur, two majorly affecting things happen:

1. consistent, torrential rains saturate the ground, swelling the organic material that is present in the ground’s soil and reducing the cohesion between the various particles that make up the soil mix, and
2. an increase in the unrelenting wind exerts an exponential force on the canopy of the palm that is proportional to the palm’s height (the taller the palm, the stronger the force that is felt at the base to keep it in place - this force exerted is called ‘torque’).

The saturated soils and the increased torque exerted on the base of the palm, coupled with the palm’s reduced root ball and its inability to anchor the palm steadily, makes the large Royal Palms that predominate La Gorce Island especially vulnerable to being toppled over when faced by a storm’s wind. The impact of hundreds of pounds of force from a falling Royal Palm of the height that these specific palms have can pose a serious potential for damage and destruction.

It goes beyond saying that the impacts discussed are not localized; in other words, they are not impacting only one street at a time but rather are impacting the island and the City as a whole. So similar to the situations facing the royal palms on La Gorce Island, all other royal palms similarly situated elsewhere throughout the City could face the same peril. This increases the potential, for example in the case

of La Gorce Island, for the entire community’s street trees to be wiped out in a single storm event, completely changing the character of the neighborhood.

As such, in the face of the inevitable, it’s important for the City to prepare and adapt to increase its opportunities for resiliency in the face of these changes. This case study postulates two general approaches to increasing the overall resiliency of neighborhoods similarly situated as La Gorce Island:

- increase the overall species diversity that makes-up the canopy of the area
- select species that have a greater resistance to groundwater salinity (such as native vegetation to the South Florida waterfront areas or species that are typical to the Maritime Hammock plant communities)
- select species as replacement that facilitate a clear design intent

Specific to La Gorce Island, with its large, majestic and monumental scale, the latter of these steps will be a key driver in facilitating for adaptation while making attempts to transition its look and character to a future experience that is almost similar. In order to achieve this, for example, species with an up-right growth character and which have a high resistance to crown-raising will be the best suited to replicate the monumental character of the ‘place’.

Addressing each of these approaches and implementing some of the recommendations of this overall master plan, the following recommendations are being suggested specifically for the conditions and position of La Gorce Island:

- Diversify the palette away from the single use of palms and tilt the scales towards a predominance of canopy trees, particularly because canopy trees have a stronger root system and are best suited to adapt to increases in ground water salinity.
- Limit the species diversity in street trees to a maximum of three predominant canopy tree species and the use of a single palm specie as an accent, and utilize them in a repetitive, patterned design approach. This limited specie palette will allow for a greater repetitiveness, which is a necessary design component to replicate the estate-like character of the neighborhood.
- Utilize species that are able to withstand crown-raising and that have a robust girth in its branching strategy. They will allow for a greater visibility and spatial exposure of the tree’s architectural structural branching, which is more in line with the majestic trees that are typical of expensive properties.

- Narrow the selection of canopy tree species to ones that culturally carry the perception of stately wealth, such as the Live Oak, Magnolia and Silk Floss Tree. In order to generate the most upright, stately look we would recommend the use of the High-Rise Oak specie, with its more columnar aesthetic.
- As a selection for a palms specie, we would recommend to continue using the Royal Palm to facilitate the transitional character of the neighborhood; however, we would recommend that the existing Royal Palms be replaced 1-to-1 with smaller Royal Palms with a maximum grey wood trunk of approximately 15 feet and continually replacing them when they grow to a height of approximately 30 feet of grey wood. By reducing the excessive heights on the palms and maintaining them within a range, at a minimum, the negative impacts of the torque force exerted on the base of the tree can be greatly diminished and the impact of saltwater can be moderated. This election of using this palm strategy is one that is temporal, as the ground water will inevitably get to a point where the specie will not survive. This strategy can be employed until such time that the increase in groundwater requires a more involved solution.





EXISTING PREDOMINANT ROYAL PALM STRATEGY



PROPOSED ADAPTIVE PLANTING STRATEGY - OPTION 01



PROPOSED ADAPTIVE PLANTING STRATEGY - OPTION 02

CITY-CONNECTOR CORRIDORS

TYPICAL CONDITIONS

- Important roadway connectors that predominantly have planted medians
- With some exceptions, several of these roadways are curved, which increase the impact of sight clearance requirements whenever median cuts and turn lanes are provided
- Medians and sidewalks are mostly planted with canopy trees
- Large numbers of overhead utility wires, negatively impacting the full growth of trees’ canopies
- Many street trees’ roots in limited growth space

RELEVANT CORRIDORS

- Harding Avenue
- 71st Street (from Bay Drive to Rue Notre Dame)
- Normandy Drive (From Rue Notre Dame to Bay Drive)
- Indian Creek Drive
- Alton Road (north of Dade Boulevard)
- 63rd Street,
- Meridian Avenue (From Dade Boulevard to 5th Street),
- Pine Tree Drive,
- Dade Boulevard, and
- Venetian Causeway

URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- Require the extensive use of green infrastructure to provide soil volume for proper root growth
- Consider visibility and safety; select species that can provide clearances of a minimum of 14 feet
- Plant trees at a minimum overall height of 15 feet
- Consider using reduced spacing of 15-feet between selected species
- Consider species that have a single-trunk, standard growth specification
- Select species that have a spreading canopy habit
- Consider flowering trees, especially where existing canopy is predominantly evergreen

Recommended predominant species:

- Trees: Brazilian Beautyleaf, Golden Shower, Sweetbay Magnolia, Strangler Fig
- Palms: Cabbage Palm, Sylvester Palm, Thatch Palm



NEIGHBORHOOD-CONNECTOR CORRIDORS

TYPICAL CONDITIONS

- Highly transited corridors, many without planting medians, of narrow widths
- Large numbers of overhead utility wires, negatively impacting the full growth of trees’ canopies
- High demands for curbside parking
- Generally, the access corridors to property parking lots with minimal landscape buffers and seldomly with street trees
- Preferred corridors for cyclists, because of their high connectivity but reduced vehicular and truck use

RELEVANT CORRIDORS

- | | |
|---|--|
| <ul style="list-style-type: none">• 11th Street• 15th Street• 17th Street• 47th Street• 51st Street• 77th Street• Byron Ave (From 77th Street to 87th Street)• Chase Avenue• La Gorce Drive• Prairie Ave | <ul style="list-style-type: none">• Sheridan Avenue• Tatum Waterway• Dickens Avenue, and• West Avenue |
|---|--|

URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- Require the extensive use of green infrastructure to provide soil volume for proper root growth
- Consider visibility and safety; select species that can provide clearances of a minimum of 10 feet
- Plant trees at a minimum overall height of 12 feet
- Consider clustering trees in available locations
- Consider species that have a single-trunk, standard growth specification
- Select species with a mix of columnar and spreading canopy habits

Recommended predominant species:

- Trees: Live Oak, Mahogany, Pond Cypress
- Palms: Cabbage Palm, Foxtail Palm, Lantan Palm



URBAN RESIDENTIAL AREAS

TYPICAL CONDITIONS

- Inhospitable walking conditions, as rights-of-ways are built-out with narrow sidewalks and no consistent canopy trees or palms
- Excessively high demands for parking reduce opportunities to provide shade trees in bulb-outs
- Buildings have very shallow setbacks fronting the streets, making it very difficult to plant large canopy trees, as their canopy won’t spread evenly and reduces it structural integrity through its growth habit
- Right-of-way corridors are some of the narrowest found throughout the city

RELEVANT AREAS

- Areas generally south of 17th street and west of Washington Avenue
- Areas generally east of the convention center and west of Collins Avenue
- Areas generally between Indian Creek Drive and Collins Avenue
- Areas along Collins Avenue from Indian Beach Park to Alison Park and west to the Indian Creek Drive
- Areas north of 73rd street between Tatum Waterway and Dickens Avenue to the ocean



URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- Require the extensive use of green infrastructure to provide soil volume for proper root growth
- Consider trees that provide compact canopy growth
- Consider trees that grow well in inhospitable environments, such as dune areas and pine rocklands
- Plant trees at a minimum overall height of 15 feet
- Consider using reduced spacing of 15-feet between selected species
- When using palms, consider clustering and grouping them to achieve greater shade

Recommended predominant species:

- Trees: Verawood, Green Buttonwood, Shady Lady, Japanese Blueberry, Wild Tamarind, Queens Crape Myrtle
- Palms: Cabbage Palm, Foxtail Palm, Lantana Palm



SUBURBAN RESIDENTIAL AREAS

TYPICAL CONDITIONS

- Locations with the densest street tree canopy coverage
- Trees tend to grow well and mature
- Large expanses of swale and pervious landscape areas
- Swale parking are compacting soils
- Some sidewalk damage due to surface roots
- Many conflicts with overhead utilities servicing the many homes
- More affluent areas have landscape maintenance contracts with professionals that know how to care for trees; trees tend to be well-tended to

RELEVANT AREAS

Suburban residential areas describe areas with predominantly single-family homes fronting the streets. These areas feel mostly like a traditional, suburban neighborhood.

URBAN FORESTRY CONSIDERATIONS & GUIDELINES

- Recommend the use of green infrastructure to provide soil volumen where needed
- Consider selecting tree and palms species that are less suitable for densely urban areas

Recommended predominant species:

- Trees: Live Oak, Gumbo Limbo, Sausage Tree, Blanchard Magnolia, Paradise Tree
- Palms: African Oil Palm, Pindo Palm, Sylvester Palm, Windmill Palm



CASE STUDY

MERIDIAN AVENUE PRESERVING MATURE CANOPY

One of a major component of the City’s response to climate change is the raising of the street to a minimum elevation of +3.7 feet. The need to raise streets poses several challenges, the most challenging of all being how the new street elevation will interface with an already-existing and built-out environment. Not only do new street elevations need to contend with impacting private properties that remain at the existing elevations, ensuring that drainage is adequately kept from running off onto private property and impacting ADA access between the properties and the right-of-way. Elevated streets, because of their need for harmonization with adjacent properties, can cause havoc on existing urban trees and natural resources. One such example is Meridian Avenue.

A quick look at an aerial view of the City’s South Beach area reveals the uniqueness of Meridian Avenue. Among all the gridded streets, Meridian Avenue stands out as the most dense, vibrant and continuous green spine of mature canopy in the city. The canopy is predominantly made up of *Calophyllum brasiliense* (Brazilian Beautyleaf) trees that have been in place for decades with DBH measurements ranging from 45 inches to over 72 inches. Almost all of the existing trees are considered Heritage Trees of a unique and specimen condition. The trees, beyond providing outstanding annual environmental benefits (1965 gal/yr of storm water filtration and 260 lbs/yr of carbon sequestration – compared to a an average of 649 gal/yr and 133 lbs/yr, respectively, provided by a typical, established tree), they are a great source of pride to the community, emblematic of an intimate, residential scale quality that only exist in that single location within the City. As such, this case study seeks to investigate a method by which the raising of the elevation of Meridian Avenue can be performed without the need to adversely impact the cultural significance of the corridor.



Meridian Avenue’s right of way width is currently 70-feet wide and provides two 11-foot vehicular travel lanes, 2 8-foot wide curbside parking strips, 2-foot curb and gutters, an 8- to 9-foot landscaped swale and a 6-foot sidewalk, all centered within the available space. The existing continuous, 8-ft minimum planting swale has provided the conditions for the canopy trees to strive and grow to their mature extent.

The City’s adopted Transportation Master Plan establishes two standards that underscore the approach to balancing the needs of climate change adaptation for future improvement plans adopted by the City, without sacrificing the uniqueness of Meridian Avenue:

The master plan identifies Meridian Avenue as belonging to a category termed “Bicycle & Pedestrian Priority Corridors”, wherein it proposes two typical sections for right-of-ways of 50 and 60 feet in width. Both typical scenarios identify 11-foot travel lanes and 7-foot parking strips parallel to a 2-foot curb & gutter. The variants between the 50- and 60-foot versions is the provision of protected bike lanes versus bike lanes that are placed between the vehicular travel lane and the parking strip in the narrowest of the two options. This case study seeks to provide a suggestion on how the prioritization of Meridian Avenue as an important bicycle and pedestrian corridor can be achieved consistent with the plan.

The master plan addresses the need for parking as a critical consideration that impacts the design of streets and the transportation infrastructure. Specifically, Meridian Avenue provides a significant number of curbside residential parking spaces, half of which will be negatively impacted by the need to raise the elevation of the corridor. When considering the impact of future improvements on parking and the existing trees, both cannot remain equally unscathed; one has to be impacted. The position of this investigation is that, because transportation and mobility are largely a factor of lifestyle decisions and because increasing numbers of individuals are opting for ride-sharing in lieu of owning a vehicle, the case study will propose that the higher priority be placed on the existing trees, as such parking spaces will be eliminated as a part of the strategy.

Separately, the need to raise Meridian Avenue is directly in conflict with the existing canopy trees that create the corridor’s unique allé experience. Because the roadway and the sidewalks are separated by the tree-planted swale, raising both will inevitably mean that something has to be done about the trees, as the elevation of the tree at its base is essentially statically-set in place. Because these trees are of significant environmental and cultural value, eliminating the trees is simply not an option that should be considered or recommended. As a result, this case study seeks to maintain the trees in place and suggest a solution on how to work around their existing locations and elevations.

The strategy being presented through the case study is based on the following observations:

- The decision on how to approach the conflicts between existing, established mature trees and the need to raise streets and provide for grey infrastructure should not be one that is solely focused on the efficiency of the most optimally-designed drainage system. The solution should be one that recognizes the performative value of large canopy trees to absorb stormwater in the process of evapotranspiration, balanced against what is the acceptable delay before the control of recharge is achieved – the latter of which would be supported by grey infrastructure as a fallback strategy.
- The exposure of tree roots to the potential of saline ground water should be factored to determine the long-term, ultimate survivability of any existing tree in question. The specific unique characteristics of the specie in question should be taken into account. In the specific condition of Meridian Ave, Brazilian Beautyleaf trees’ roots can somewhat withstand exposure to saline groundwater.
- The reduction in parking spaces can be mitigated by the development and construction of new parking garages, as recommended in the Transportation Master Plan, predominantly for the residents immediately impacted by the area. This is a critical recommendation, as reduced on-street parking requirements provide for greater flexibility in designing for adaptation. Additionally, raising streets fronting parcels with shallow front setbacks eliminates the opportunities for properties to adequately accommodate and access the development of off-street parking on their lots.







The following assumptions were made:

- It assumes that Meridian Ave will need to be raised a total of 4 feet as part of its adaptation strategy. Because the predictions of the ultimate impact of sea level rise and climate change are dynamically changing, the case study assumes a worst-case scenario situation. While this scenario may be more than what is currently being contemplated, it serves the purpose of forcing the need for innovation in design to meet the challenges in a manner that can be adapted to many different situations along the corridor.
- It assumes that the cultural and environmental value of the existing mature tree stock is such that it will remain in place.
- It assumes that a one-size-fits-all strategy is incompatible with the needs to innovate and to engineer a custom solution for this unique condition. Readily-available typical sections in both the Transportation Master Plan (adopted 2016) and the Street Design Guidelines (adopted 2016) were analyzed and found to be insufficient for their application in climate change adaptation.
- It assumes that while the need to adapt to climate change is a dynamically, complex one, the opportunities to engineer solutions to meet the future design criteria can be most implementable if they employ or modify acceptable standard construction methods already in-place and adopted by various agencies, such as the Florida Department of Transportation. This facilitates the use of a readily-acceptable standards that are trusted by agencies and professionals whose recommendations are subject to liabilities, and it provides a basis upon which to prognosticate the cost impact of such complex engineering strategies.

LEGEND

1. Retaining wall
2. Modified FDOT Index 520 gravity wall
3. Modify gravity wall top to ensure 5-foot ADA access
4. Pervious concrete slab
5. Pervious asphalt or concrete drainage layers
6. 2-inch diameter PVC drain
7. Pervious asphalt
8. FDOT Type D 2-foot Curb and Gutter
9. Custom tree grate, measured to specifics of each tree
10. Concrete slab
11. Bioswale
12. Access sidewalk connector to parking spaces
13. Landscape planting area
14. Curbside parking strip
15. 4-foot wide bike lane
16. 2 qty, 11-foot travel lanes
17. Crown-raise low branches (not shown)



BIO-SWALE DETAIL, LEADS STORM WATER TO TREE PIT



PROVIDE SEATING AND HARMONIZATION FACING FLAMINGO PARK



VIEW ALONG CENTERLINE OF RIGHT-OF-WAY

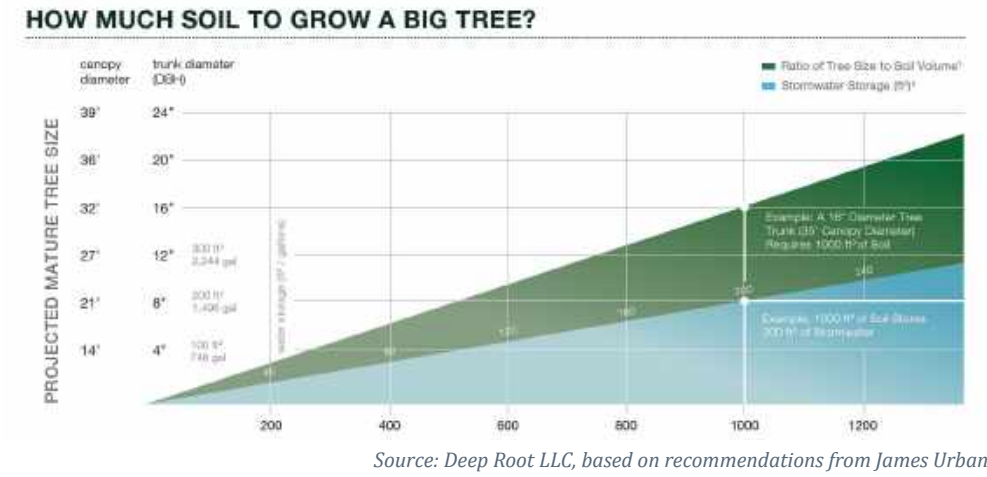
URBAN TACTICS

URBAN TREE ZONE

This toolbox seeks to reinterpret the sidewalk and fronting street infrastructure areas as an Urban Tree Zone, focused on impacting the choices, construction and assembly of these areas to establish conditions that are most favorable for tree growth. Short-term savings can be gained by not implementing any of these recommendations at the time of initial design and construction; however, electing to not implement these recommendations will negatively impact the ultimate, prolonged costs associated with the lifetime of the improvements in the form of increased maintenance costs, repair and unfavorable growing conditions for the trees, which can lead to disease, conditions wrought with liabilities and with diminished opportunities to capitalize on the benefit of trees. As such, this toolbox serves as a design guideline and lays out recommendations at the time of building-out the Urban Tree Zone to facilitate the incorporation of all the competing needs vying for space within the right-of-way, while still providing for optimum conditions for long-term tree growth and survivability. One of the key indicators in the analysis provided earlier in this document demonstrates the low percentage of old, mature trees that exist throughout the City, possibly because the recommendations put forth in this ‘tactics’ section have not been implemented. This has created conditions where trees have been planted in inhospitable areas that do not facilitate for long-term growth.

SOIL VOLUMES

The ultimate goal of defining the articulation of the Urban Tree Zone is the provision of adequate soil volumes to allow trees to grow and mature. James Urban, an authority on conducting research on urban tree growth conditions, states that the typical urban tree needs more than 1000 cubic feet of loam soil in order to grow for prolonged periods of time. It is important to note that having adequate and ample soil volumes that facilitate areas for un-compacted root growth areas is not an ‘encouraged’ or a ‘desired’ condition – it is a critical requirement. Additionally, because a large part of the soil substrate that makes up Miami Beach is fill that was dredged from the local region’s lime rock; these deep pockets of natural soil do not exist. This is coupled with the fact that the natural growth habit of local, native maritime vegetation has a root-growth structure that tends to be shallow. As such, the recommendations provided should not to be considered as a strive for the ‘optimum’ but rather what is ‘essential’ to meet a baseline metric. Alternatives are provided where they are merited, given each unique condition. Lastly, it should be noted on the graphic provided below that the potential for stormwater storage in soil used in soil cell systems can equal as much as 50% of the overall soil volume.



SOIL CELLS AND PAVEMENT SUSPENSION SYSTEMS

These recommendations employ the use of different technologies to create the necessary adaptation within the Urban Tree Zone to foster long-term tree survivability. These are described as follows:



substantial excavation of the existing soils to the desired depth, which is then compacted, and upon which the soil cell units are installed and interlocked, filled with un-compacted soil, and finally topped with the desired hardscape or pavement material. Because of all the excavation needed in order to make room for the assemblage, soil cells are best suited for new construction areas or for areas where existing trees will not be impacted. Soil cells provide the greatest amount of un-compacted soil volume. Examples of soil cells are many, but the most well-known brands are Silva Cells by DeepRoot, StrataVault and RootSpace by GreenBlue. (Average Estimated Cost, Installed (FY2019): \$44.70/CY)



of new or expansion of roadways, walkways and other pavement areas where trees are already existing. Instead of excavating underlying areas to install beds of compaction-suitable material, pilings are driven in a systematic grid format and topped with formwork upon which the desired pavement is installed. The pilings essentially transfer the weight of the topping pavement down into ground, similar to piling foundations in building construction. The benefit of the system lies in that the pilings are driven into the ground with a minimized disruption of the existing root networks of nearby or abutting trees. An example of this system is the Cupolex brand system developed by Pontarolo Engineering. (Average Estimated Cost, Installed (FY2019): \$156.00/SY)

Structural Soil Systems: Structural soils are a specific, usually patented, soil mix that combines planting medium with various sized aggregates. The aggregates allow for compaction of the soils, while creating gaps in between the aggregate material to house organized planting medium and for tree roots to take place. While not the best at facilitating the most optimum condition for the

Soil Cell Systems: Soil cells are engineered assemblies that facilitate the transfer of weight and force onto a compacted base, while creating substantial areas of un-compacted soils for plant growing medium. They look like egg-crates installed in the ground and then filled with planting medium. The different units can be interlocked, and like lego-pieces, the assemblies can be expanded to any area to meet the specific needs of the project. All soil cells are compression elements; therefore it is needed to perform

Pavement Suspension Systems: Pavement suspension systems are best described as methods to suspend hardscape and pavement improvements to be installed on soils that lack the structural cohesion and qualities to support the planned improvements. Initially, it was developed as a method to construct roadways and sidewalks on unsuitable soils, eliminating the need to excavate, remove and replace the soils and reducing construction costs. One adaptive, beneficial use of the system is in the construction

URBAN TACTICS FOR PLANTING TREES

growth of trees (when compared to soil cells), structural soils are best-suited for compacted soils beneath hardscape improvements that are completely surrounded by large amounts of un-compacted soils and pervious areas. An example of a structural soil manufacturer/provider is the patented structural soil mix patented by Cornell University, termed CU-Structural Soil. (Average Estimated Cost, Installed (FY2019): \$27.50/CY)

These different systems do not measure-up equally when it comes to soil volume provisions. According to James Urban, “value engineering recommendations to substitute equal volumes of Structural Soil for [soil cells] should not be accepted. Designers must assure that the products be designed and bid based on the amount of soil within the system, not the overall volume of material being installed. 100 cubic feet of [soil cells] will require 400 to 500 cubic feet of structural soil to provide for equal tree growth. With the typical urban tree needing more than 1,000 cubic feet of loam soil, where space is at a premium, there may not be sufficient room to install enough structural soil to equal the amount of soil provided in the [soil cell] design.”

INDEXED URBAN TREE ZONE BUILD-OUT SCENARIOS

The various scenarios provided are indexed and named so they are easily identified with the various typological conditions they were created for, based on a 4-part naming convention. The following describes the various abbreviations used:

R U	-6	+PRKG
C Commercial Street	Identifies the width of the sidewalk area (defined as the area between the back of curb or gutter and the property line). These are provided with dimensions in ranges.	Identifies if curbside parking is provided or not as a part of the fronting Urban Tree Zone.
R U Residential Street, Urban Quality		
R S Residential Street, Sub-urban Quality		

C | -6 | + PRKG

COMMERCIAL STREET FRONTAGE
WIDTH LESS THAN 6-FEET
WITH CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 20% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees and palms
- **Preferred tree canopy growth habit:** Dense and compact
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 8 feet wide
- **Pervious Concrete Sidewalk:** Recommended
- **Perforated drainage pipe and pervious water capture strip:** Required
- **Irrigation:** Permanent, Required

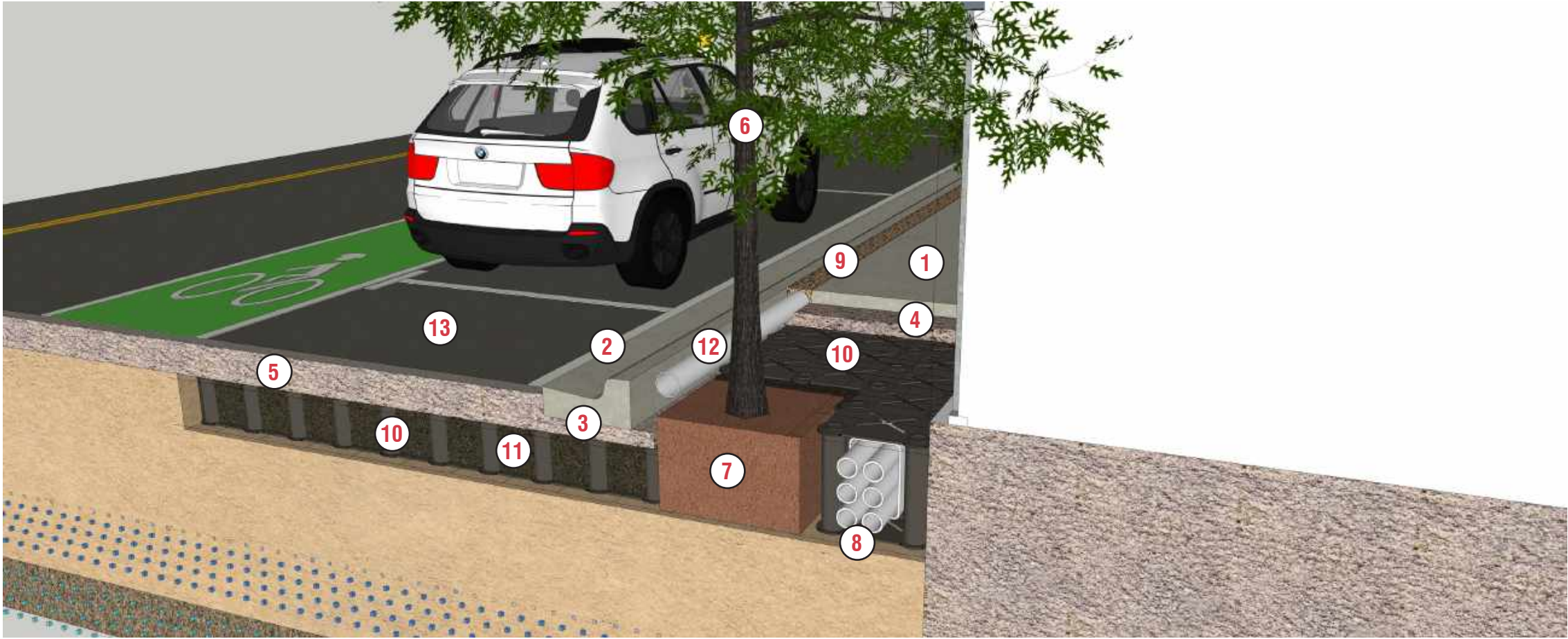
DESIGN ALTERNATIVES:

1. [13] - Parking area may be constructed out of pervious concrete instead of asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [1] - Concrete slab could be replaced with pervious concrete and installed directly onto the soil cell system, eliminating the need for a slab sub-base [4].
4. [8] - Utilities could be installed beneath the parking strip

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All Small-sized Trees that can achieve a minimum clearance of 7 feet and compact, medium-sized trees such as:
 - Green Buttonwood
 - Glaucous Cassia
 - Grape Myrtle
 - Pigeon Plum
 - Spanish Stopper

- Palms:
- Thatch Palm
 - Hurricane Palm
 - Bucaneer Palm
 - Foxtail Palm

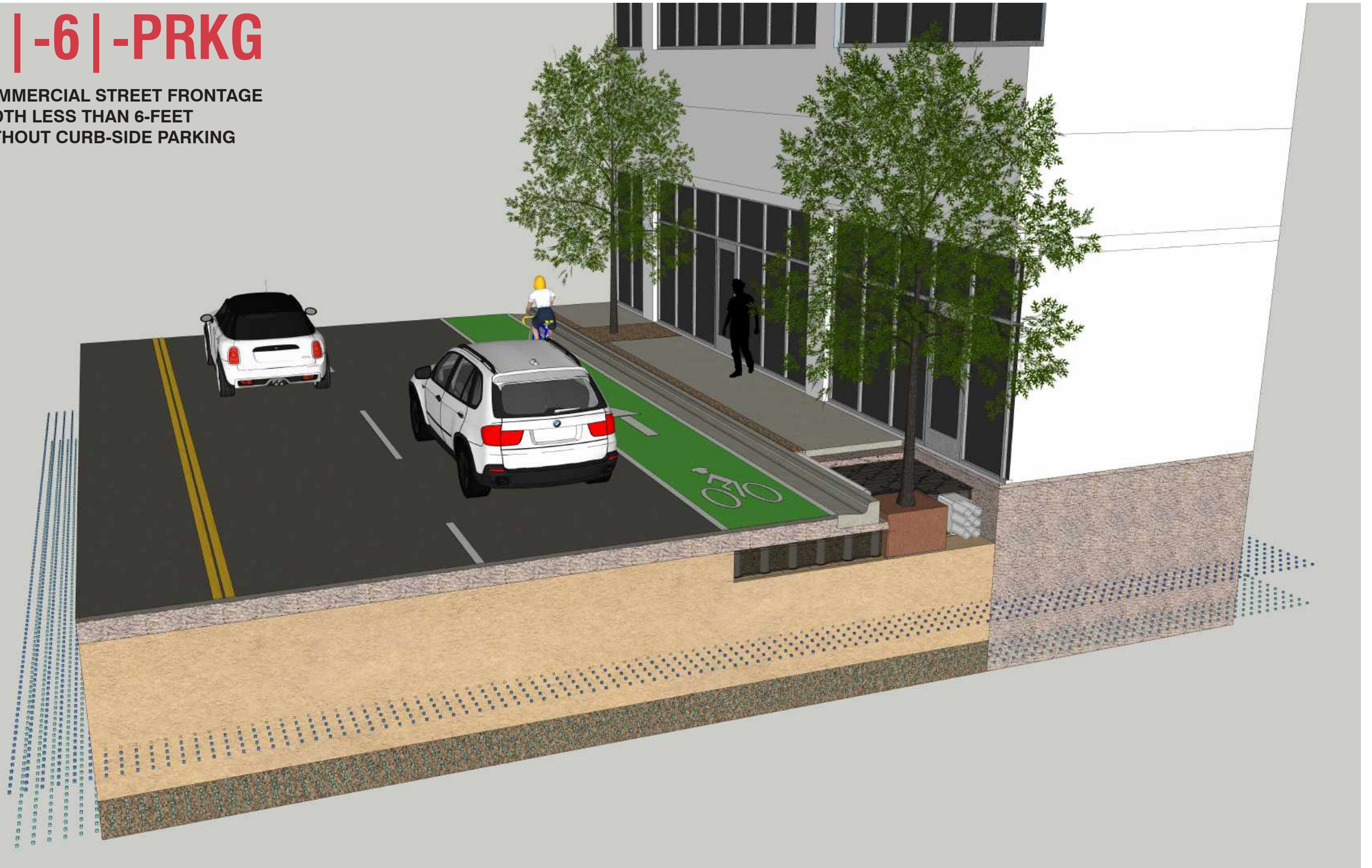


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Perforated Pipe
13. Asphalt Paved Area

C | -6 | -PRKG

COMMERCIAL STREET FRONTAGE
WIDTH LESS THAN 6-FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 10% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees and palms
- **Preferred tree canopy growth habit:** Dense and compact
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 8 feet wide
- **Pervious Concrete Sidewalk:** Recommended
- **Perforated drainage pipe and pervious water capture strip:** Required
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [13] - Bike Lane area may be constructed out of pervious asphalt instead of asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [1] - Concrete slab could be replaced with pervious concrete and installed directly onto the soil cell system, eliminating the need for a slab sub-base [4].
4. [8] - Utilities could be installed beneath the bike lane.

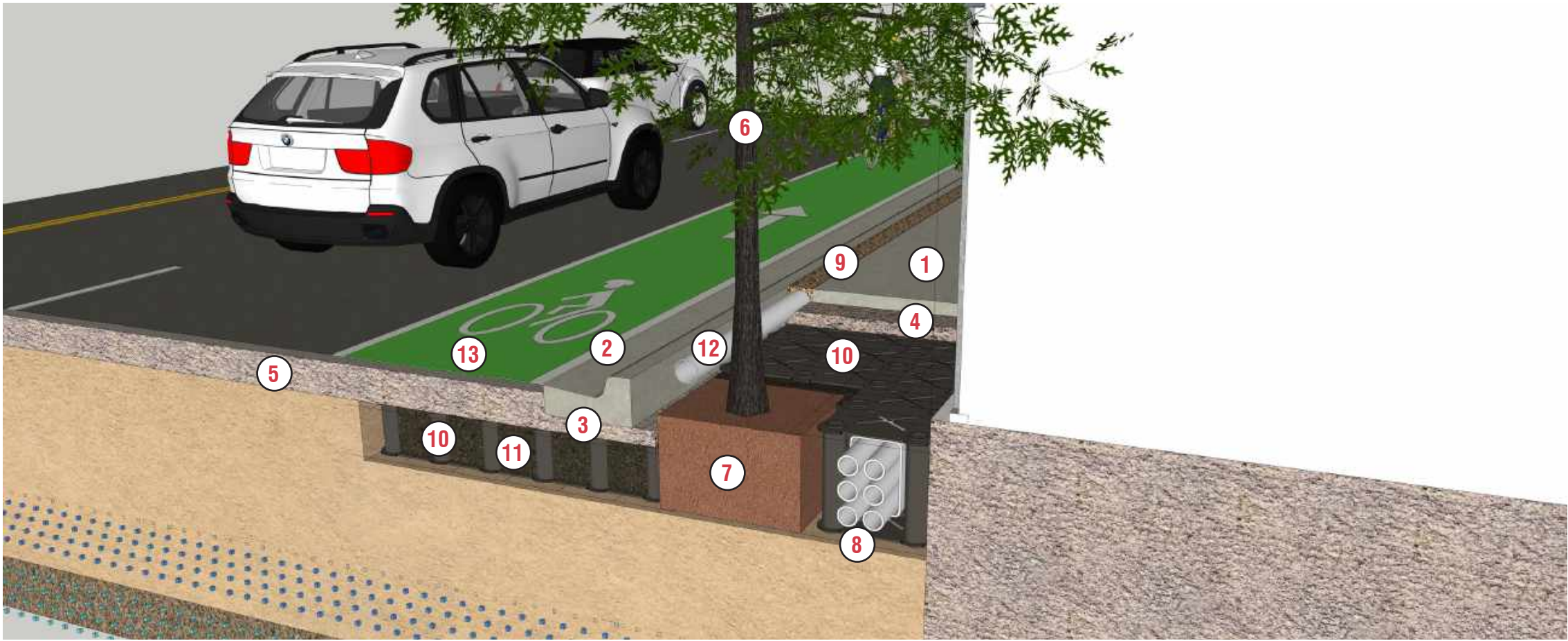
RECOMMENDED SPECIES INCLUDE:

Trees:

- All Small-sized Trees that can achieve a minimum clearance of 7 feet and compact, medium-sized trees such as:
 - Green Buttonwood
 - Glaucous Cassia
 - Crape Myrtle
 - Pigeon Plum
 - Spanish Stopper

Palms:

- Thatch Palm
- Hurricane Palm
- Bucaneer Palm
- Foxtail Palm



LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Perforated Pipe
13. Asphalt Paved Area

C | 6-10 | + PRKG

COMMERCIAL STREET FRONTAGE
WIDTH GREATER THAN 6-FEET BUT LESS THAN 10 FEET
WITH CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

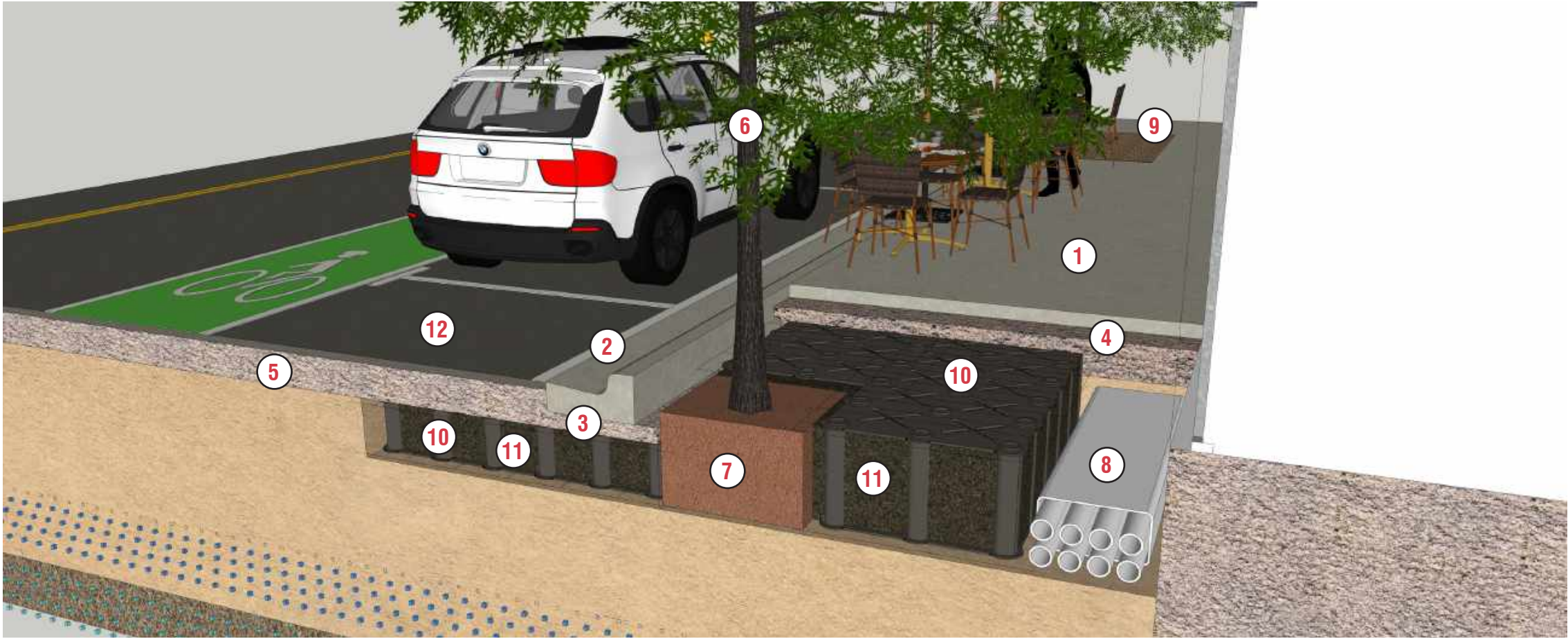
- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 30% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 4 feet wide
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [12] - A portion of the parking area may be constructed out of pervious concrete instead of asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [8] - Utilities could be installed beneath the parking strip

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All medium-sized species, without exception
- Palms:
- Palms with short-length fronds, such as:
 - Lantana Palm
 - Cabbage Palm
 - Foxtail Palm
 - Hurricane Palm
 - Thatch Palm

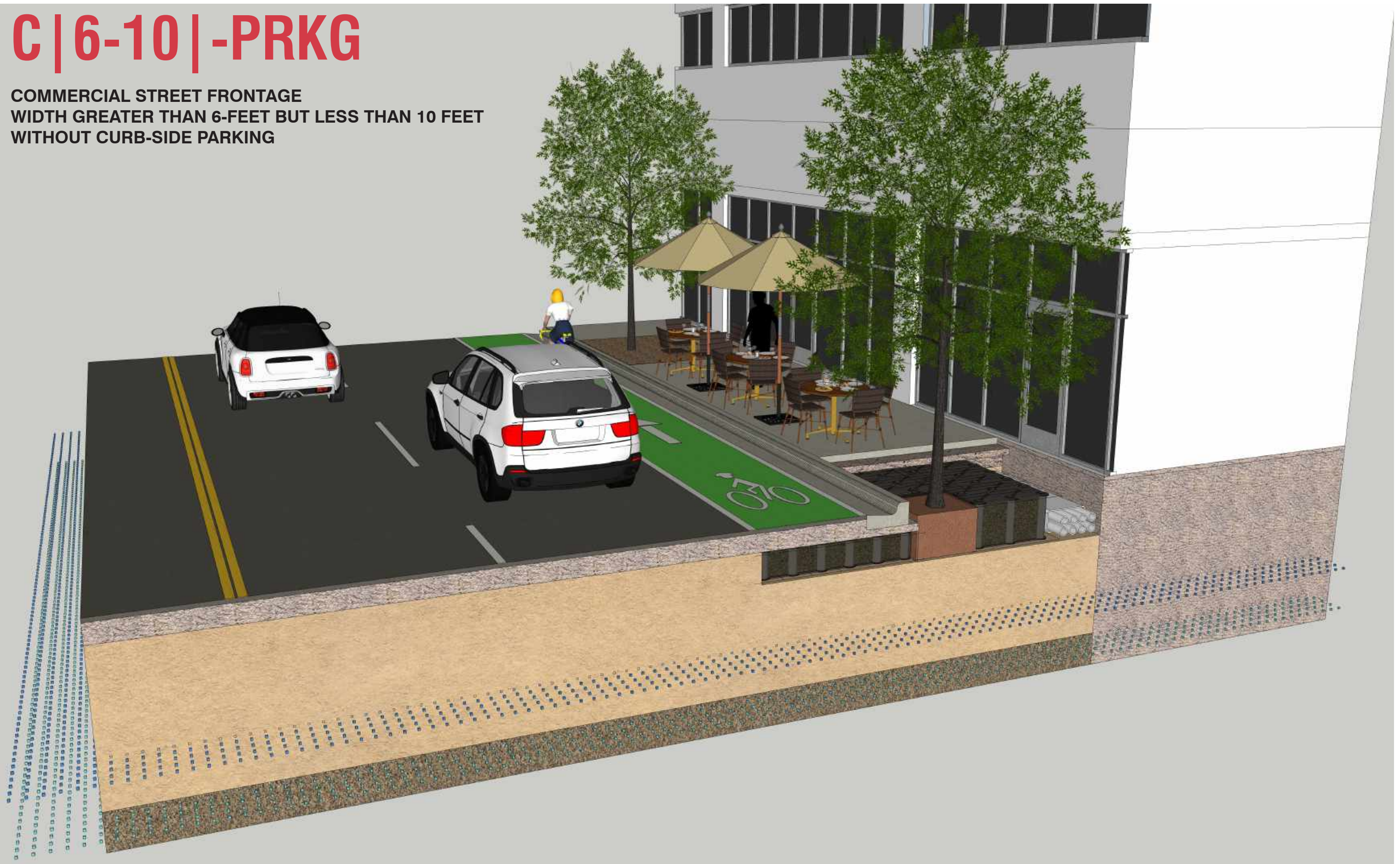


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

C | 6-10 | -PRKG

COMMERCIAL STREET FRONTAGE
WIDTH GREATER THAN 6-FEET BUT LESS THAN 10 FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

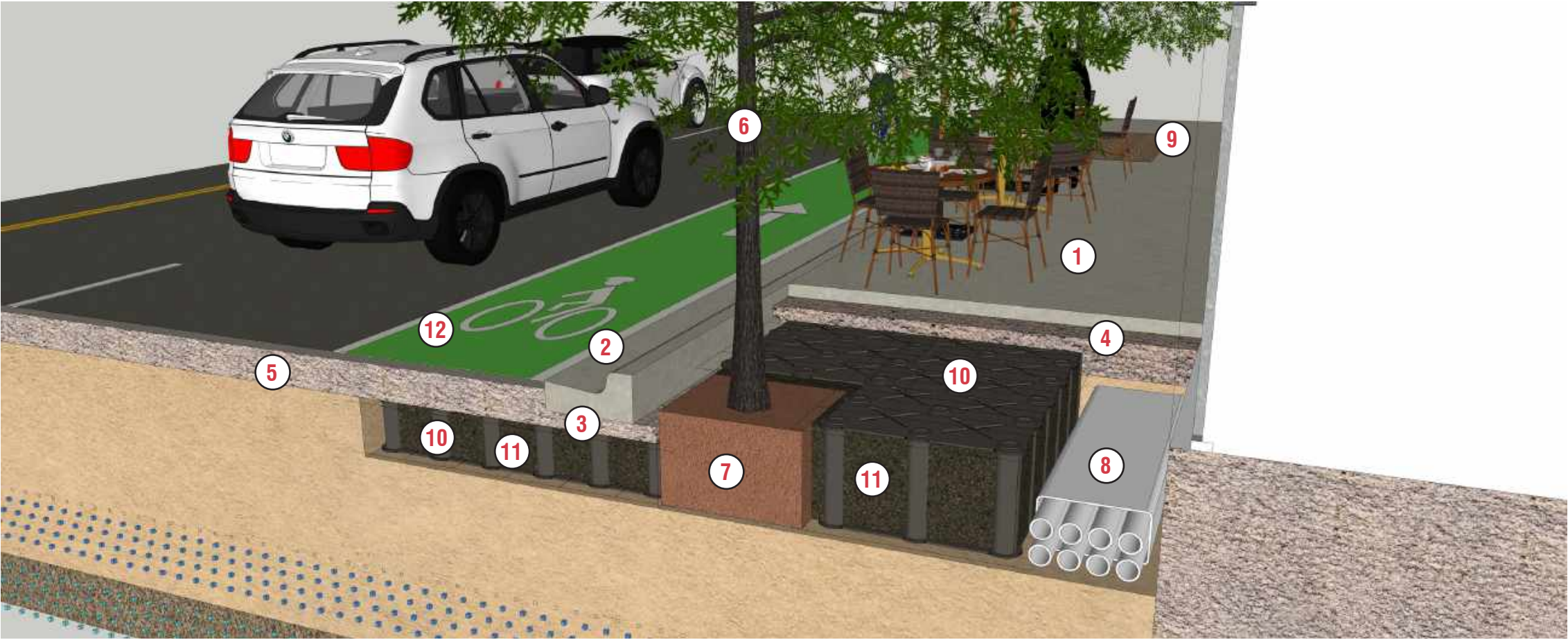
- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 30% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 4 feet wide
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [12] - The bike lane may be constructed out of pervious asphalt instead of regular asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [8] - Utilities could be installed beneath the bike lane

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All medium-sized species, without exception
- Palms:
- All allowable species, without exception

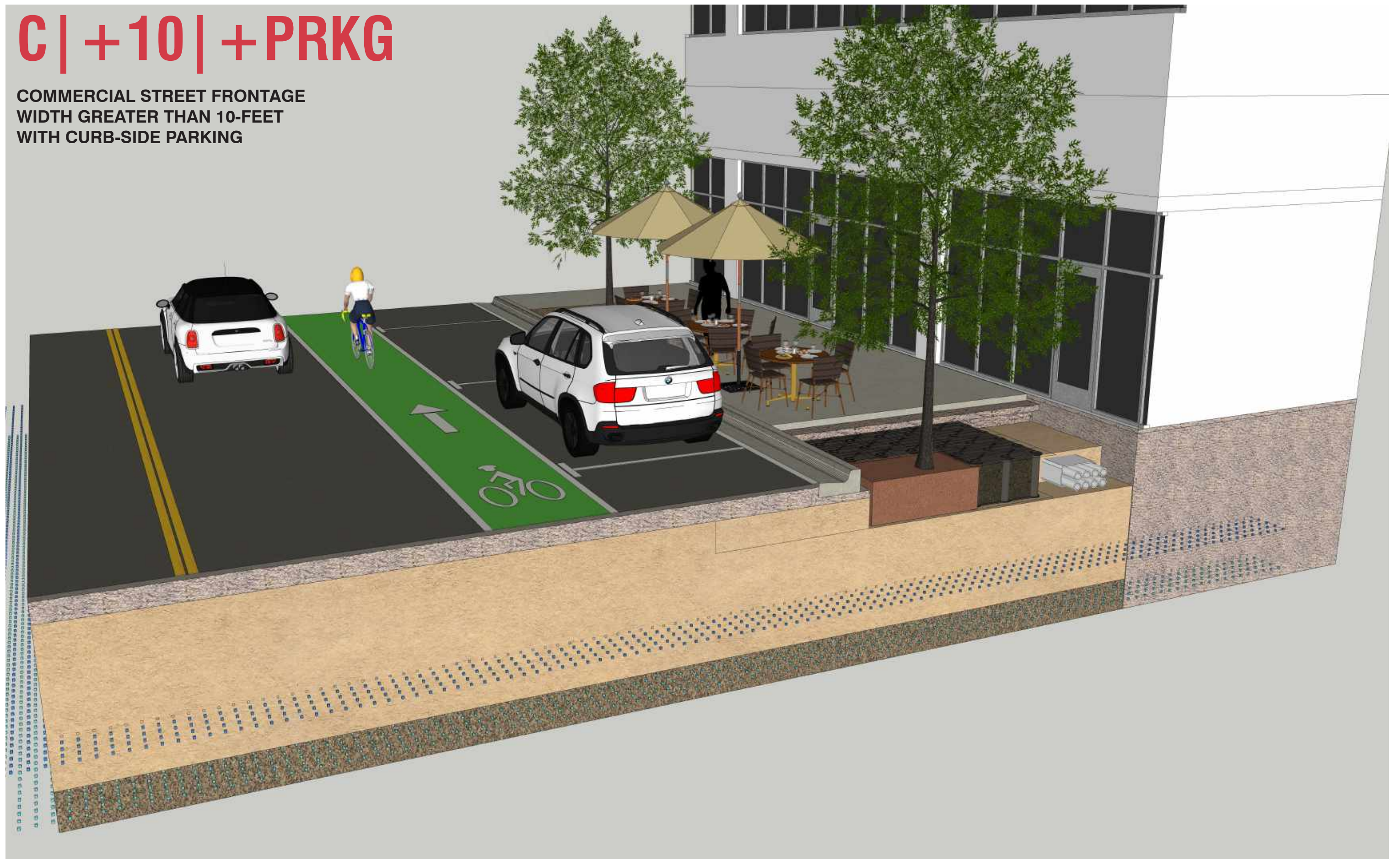


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

C | +10 | +PRKG

COMMERCIAL STREET FRONTAGE
WIDTH GREATER THAN 10-FEET
WITH CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

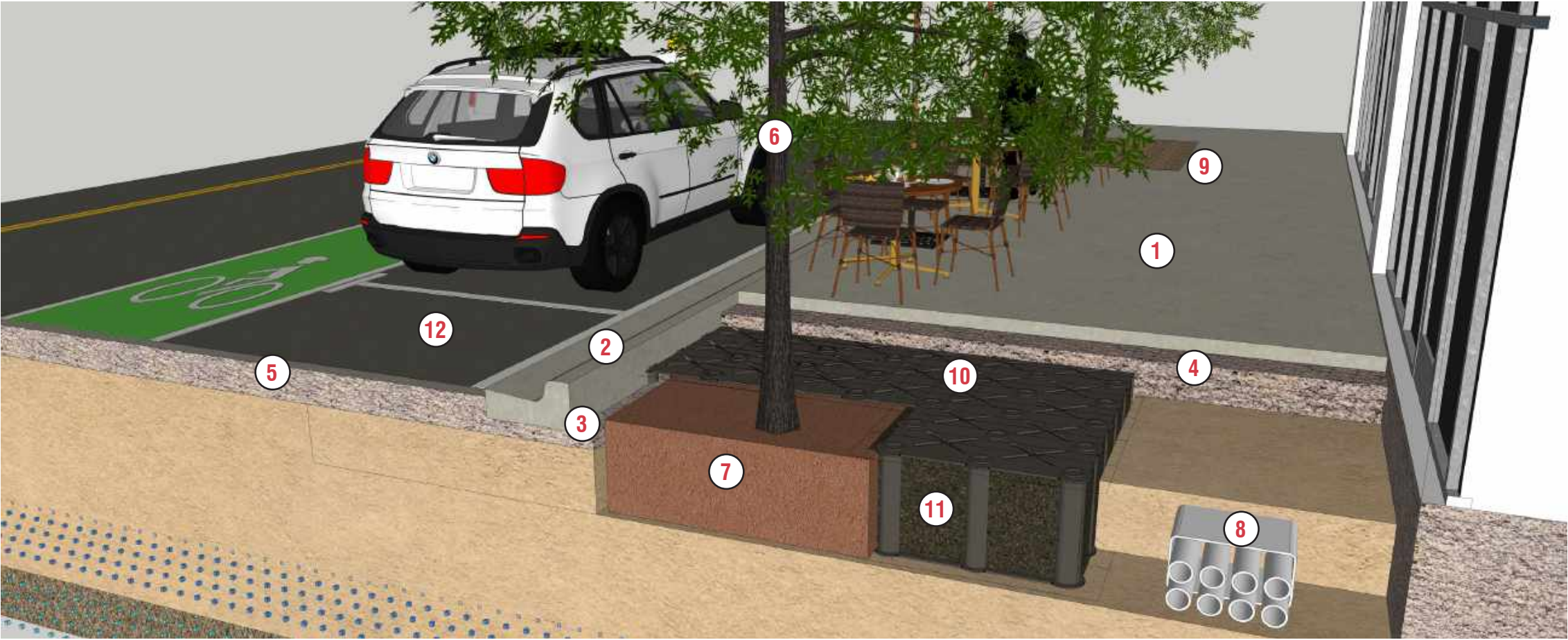
- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 50% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for large shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [11] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided and a minimum of 50% of the concrete sidewalk [1] is constructed out of pervious concrete
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig
- Palms:
- All allowable species, without exception

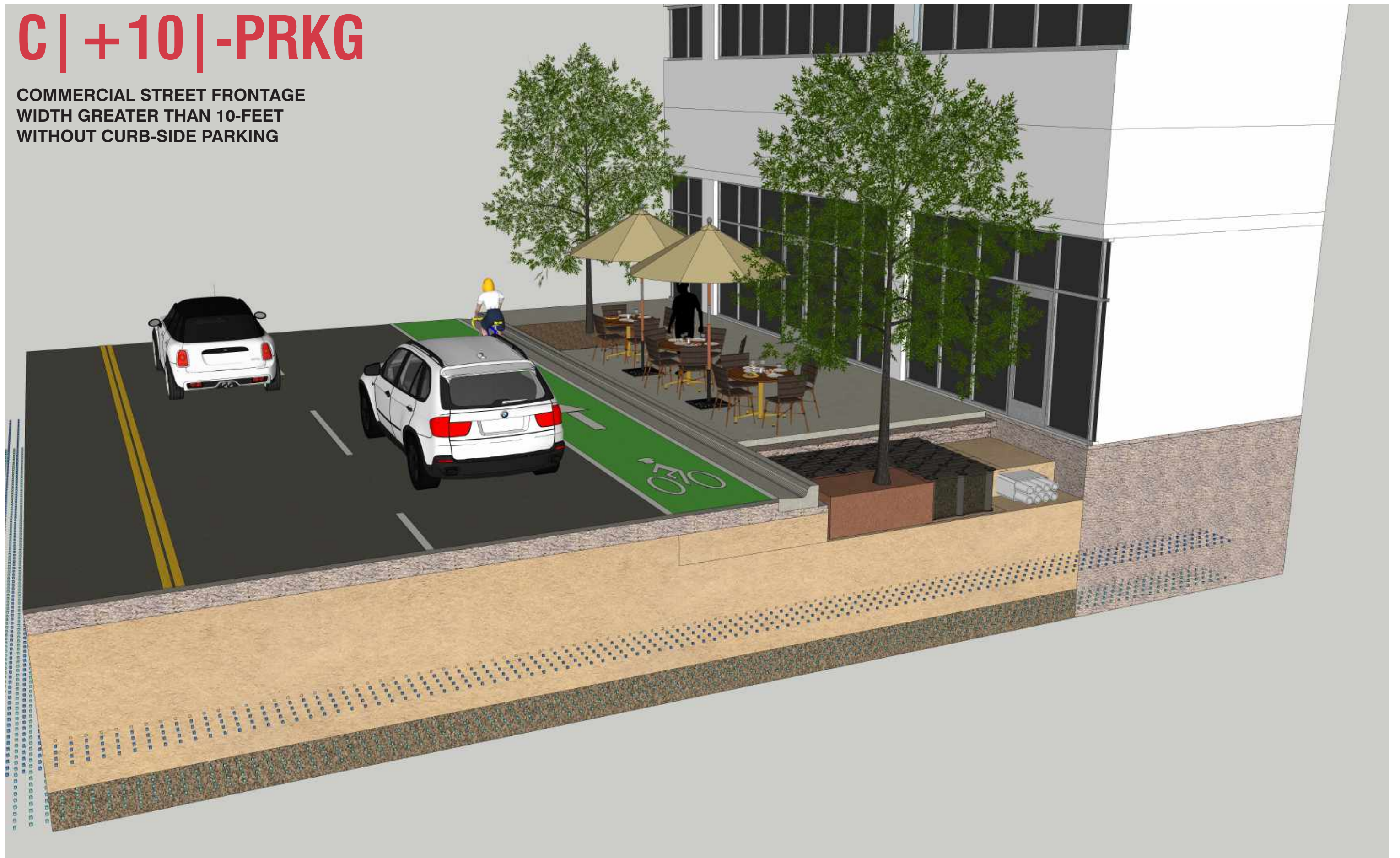


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

C | +10 | -PRKG

COMMERCIAL STREET FRONTAGE
WIDTH GREATER THAN 10-FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

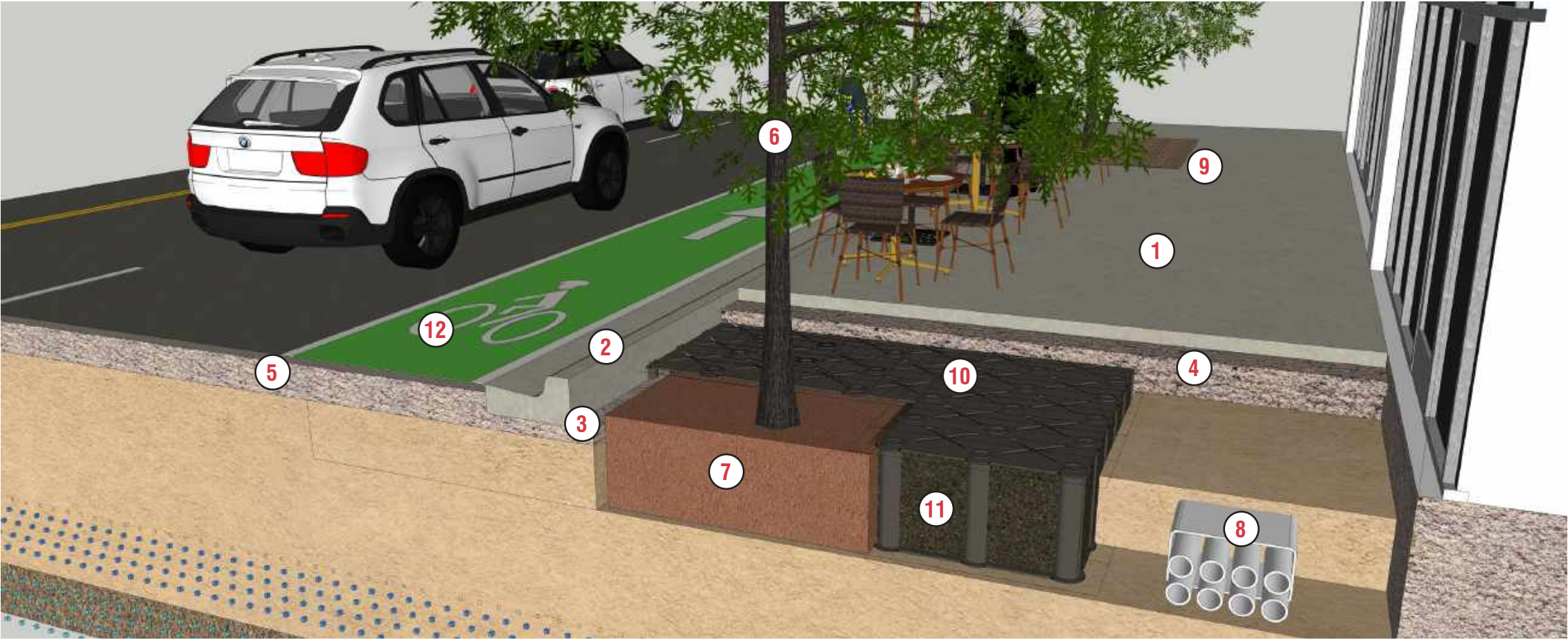
- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 50% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for large shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [11] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided and a minimum of 50% of the concrete sidewalk [1] is constructed out of pervious concrete
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig
- Palms:
- All allowable species, without exception

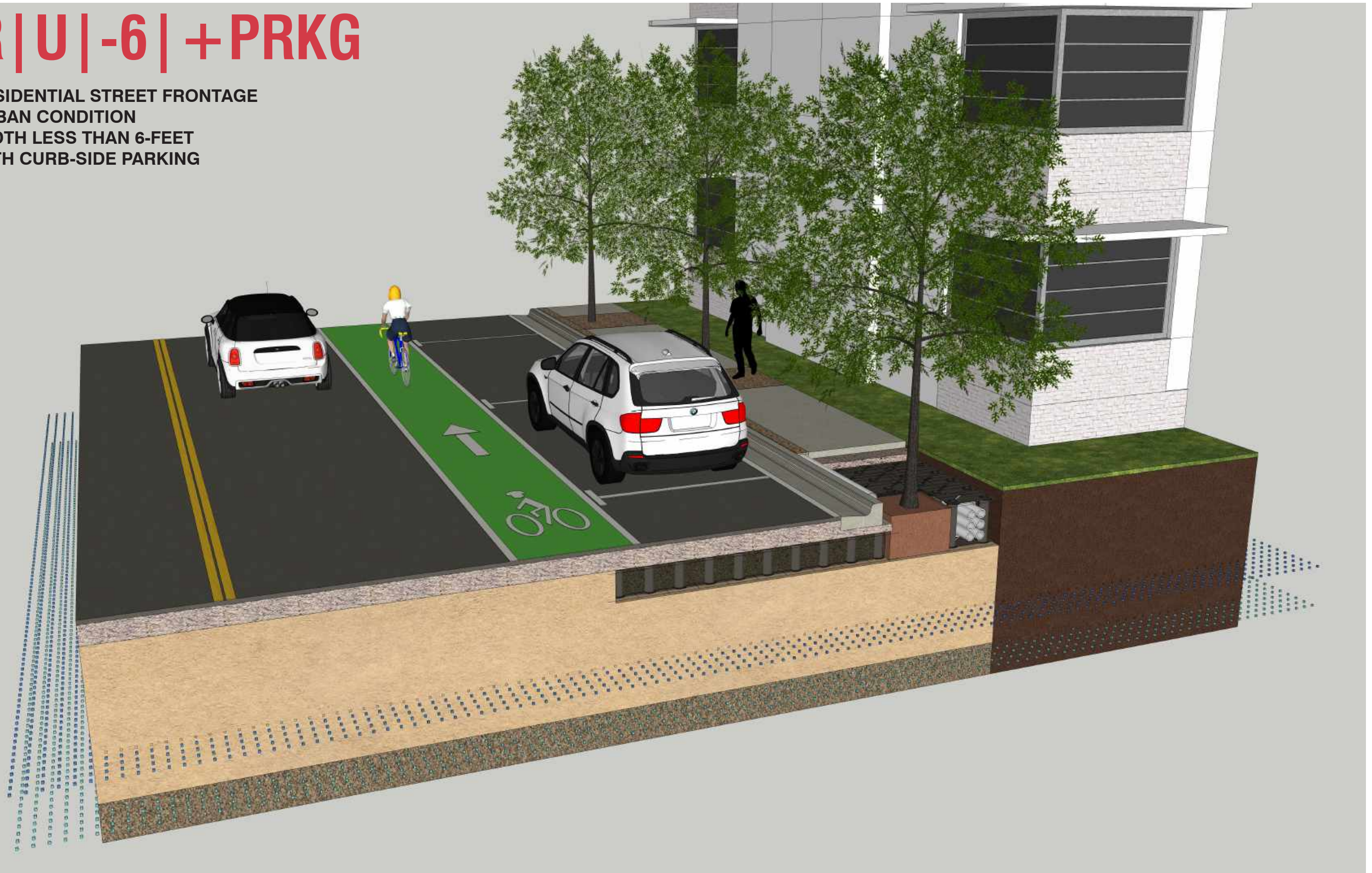


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

R|U|-6| + PRKG

RESIDENTIAL STREET FRONTAGE
URBAN CONDITION
WIDTH LESS THAN 6-FEET
WITH CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

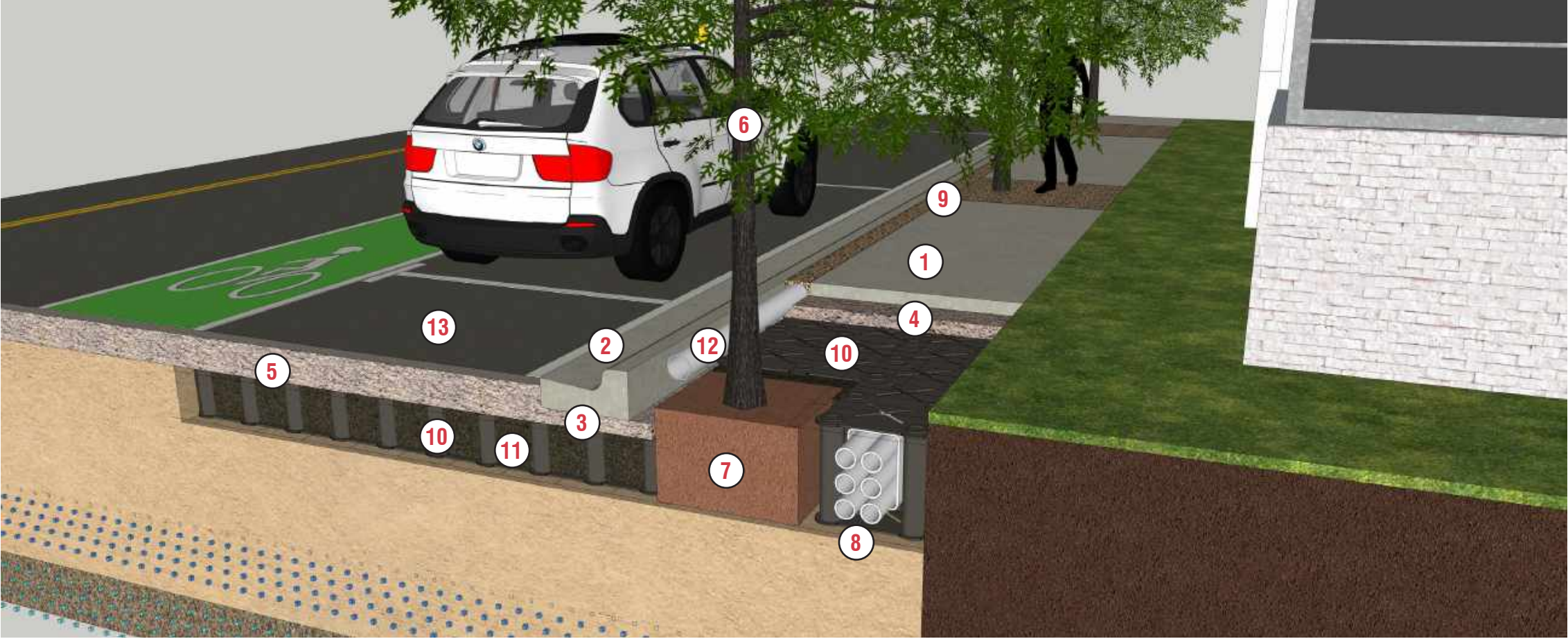
- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 30% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees, depending on the setback of the fronting building
- **Preferred tree canopy growth habit:** Dense and compact
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 8 feet wide
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Required
- **Irrigation:** Temporary Required; Permanent Recommended

DESIGN ALTERNATIVES:

1. [13] - Parking area may be constructed out of pervious concrete instead of asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [1] - Concrete slab could be replaced with pervious concrete and installed directly onto the soil cell system, eliminating the need for a slab sub-base [4].
4. [8] - Utilities could be installed beneath the parking strip
1. [10] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided and a minimum of 50% of the concrete sidewalk [1] is constructed out of pervious concrete

RECOMMENDED SPECIES INCLUDE:

- Trees:
- Medium sized species, such as:
 - Bridal Veil
 - Shady Lady Black Olive
 - Pitch Apple
 - Pigeon Plum
 - Japanese Fern Tree
- Palms:
- All allowable species, except those with fronds that exceed 6 feet in length, such as Date Palms, Coconut Palms, Bismarck Palms, and African Oil Palms

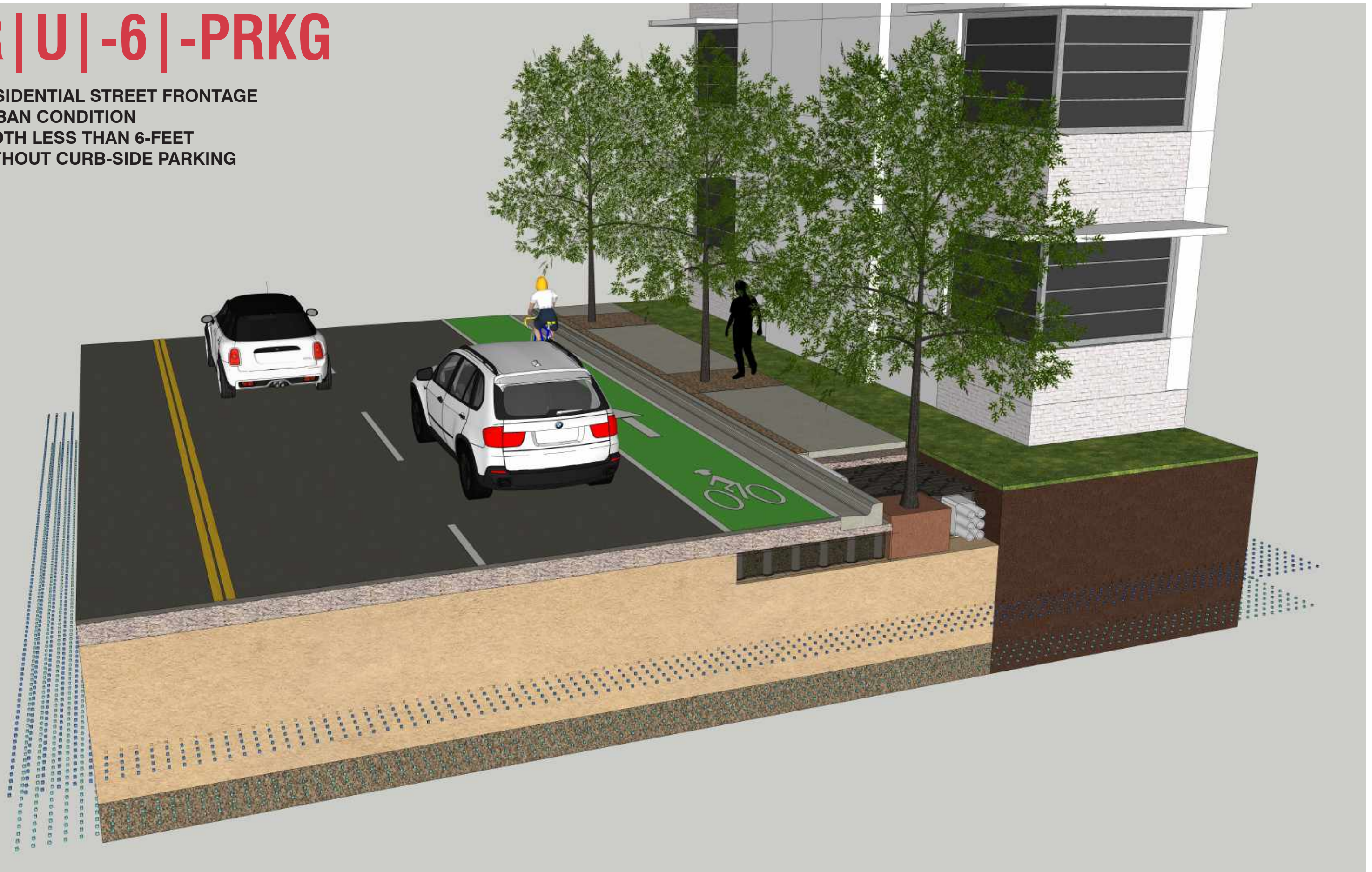


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Perforated Pipe
13. Asphalt Paved Area

R|U|-6|-PRKG

RESIDENTIAL STREET FRONTAGE
URBAN CONDITION
WIDTH LESS THAN 6-FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 30% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees, depending on the setback of the fronting building
- **Preferred tree canopy growth habit:** Dense and compact
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 8 feet wide
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Required
- **Irrigation:** Temporary Required; Permanent Recommended

DESIGN ALTERNATIVES:

1. [13] - Bike Lane area may be constructed out of pervious asphalt instead of regular asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [1] - Concrete slab could be replaced with pervious concrete and installed directly onto the soil cell system, eliminating the need for a slab sub-base [4].
4. [8] - Utilities could be installed beneath the parking strip

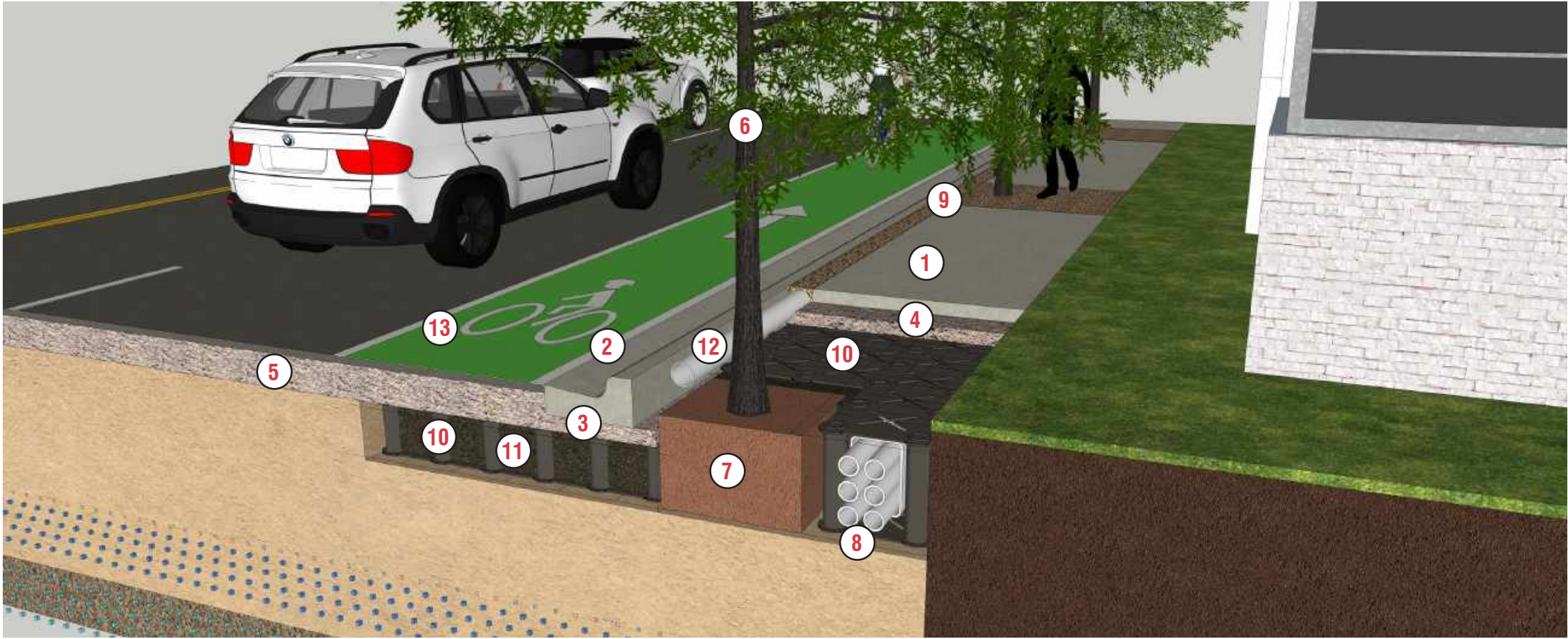
RECOMMENDED SPECIES INCLUDE:

Trees:

- Medium sized species, such as:
 - Bridal Veil
 - Shady Lady Black Olive
 - Pitch Apple
 - Pigeon Plum
 - Japanese Fern Tree

Palms:

- All allowable species, except those with fronds that exceed 6 feet in length, such as Date Palms, Coconut Palms, Bismarck Palms, and African Oil Palms



LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Perforated Pipe
13. Asphalt Paved Area

R|U|6-10| + PRKG

RESIDENTIAL STREET FRONTAGE

URBAN CONDITION

WIDTH GREATER THAN 6-FEET BUT LESS THAN 10 FEET

WITH CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

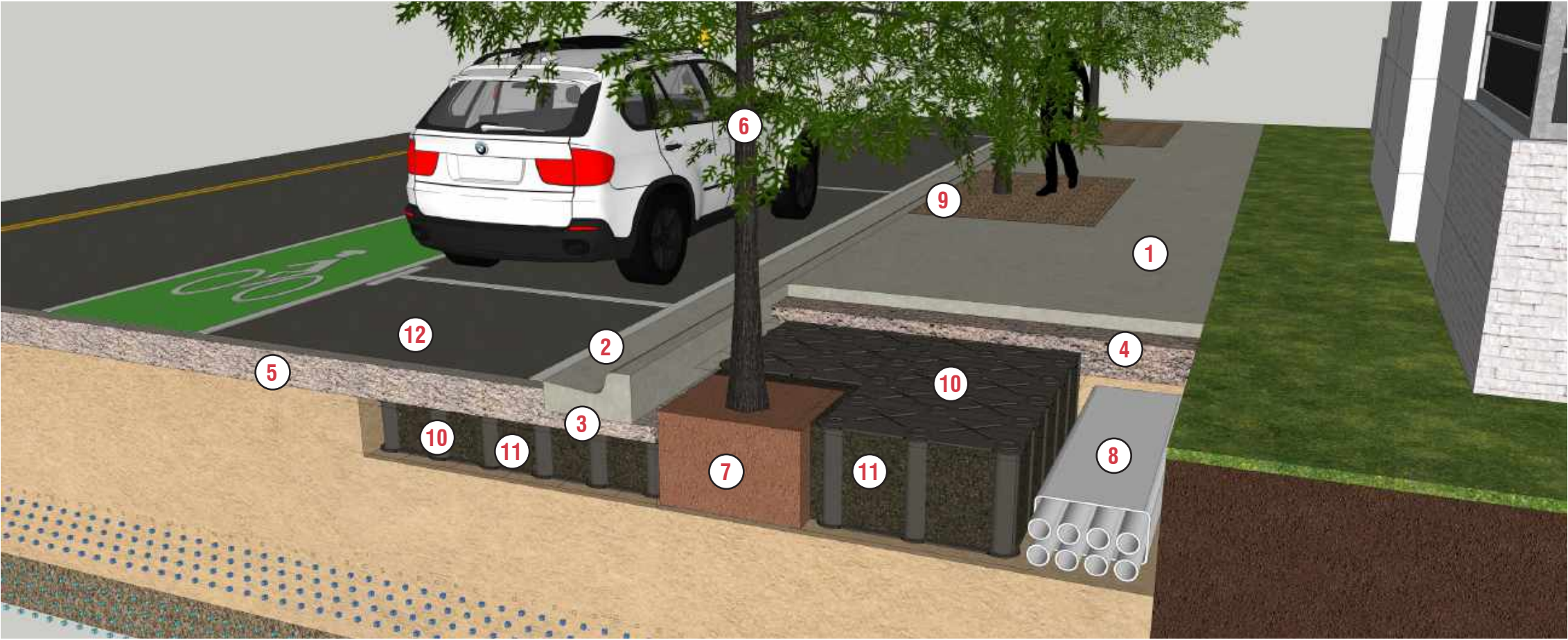
- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 30% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 4 feet wide
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [12] - a portion of the parking area may be constructed out of pervious concrete instead of asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [8] - Utilities could be installed beneath the parking strip

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig
- Palms:
- All allowable species, without exception



LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

R|U|6-10|-PRKG

RESIDENTIAL STREET FRONTAGE
URBAN CONDITION
WIDTH GREATER THAN 6-FEET BUT LESS THAN 10 FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 30% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** Yes, Minimum 4 feet wide
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [12] - The bike lane may be constructed out of pervious asphalt instead of regular asphalt. This could be installed directly over the soil cell system, eliminating the need for a roadway sub-base [5] in that specific area and allowing any runoff to percolate directly into the uncompacted soil area where the tree's roots could absorb water and possibly help to filter any pollutants it may carry.
2. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [8] - Utilities could be installed beneath the Bike Lane

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig
- Palms:
- All allowable species, without exception

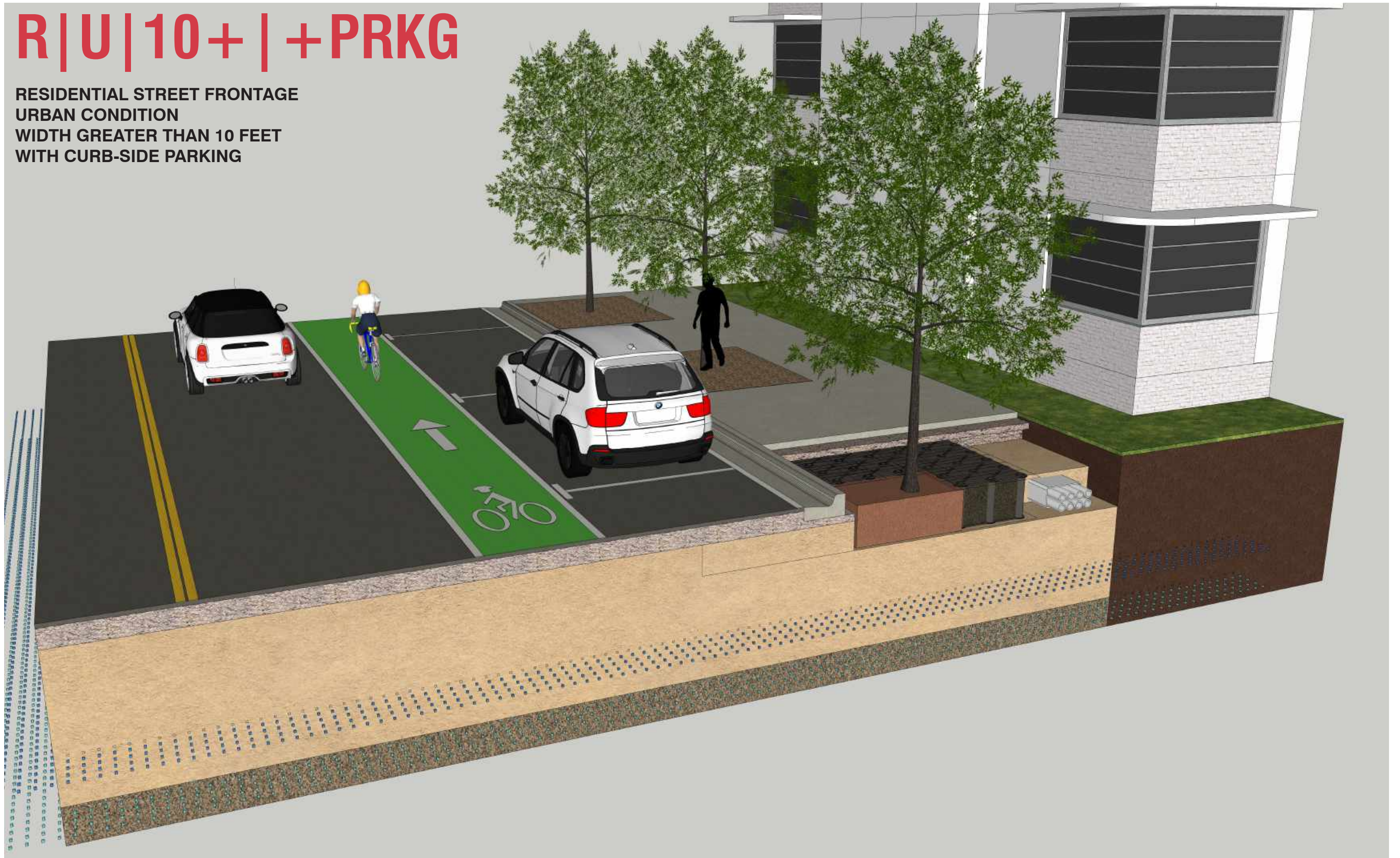


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

R|U|10+|+PRKG

RESIDENTIAL STREET FRONTAGE
URBAN CONDITION
WIDTH GREATER THAN 10 FEET
WITH CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 50% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
2. [8] - Utilities could be installed beneath the parking strip
3. [10] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided and a minimum of 50% of the concrete sidewalk [1] is constructed out of pervious concrete

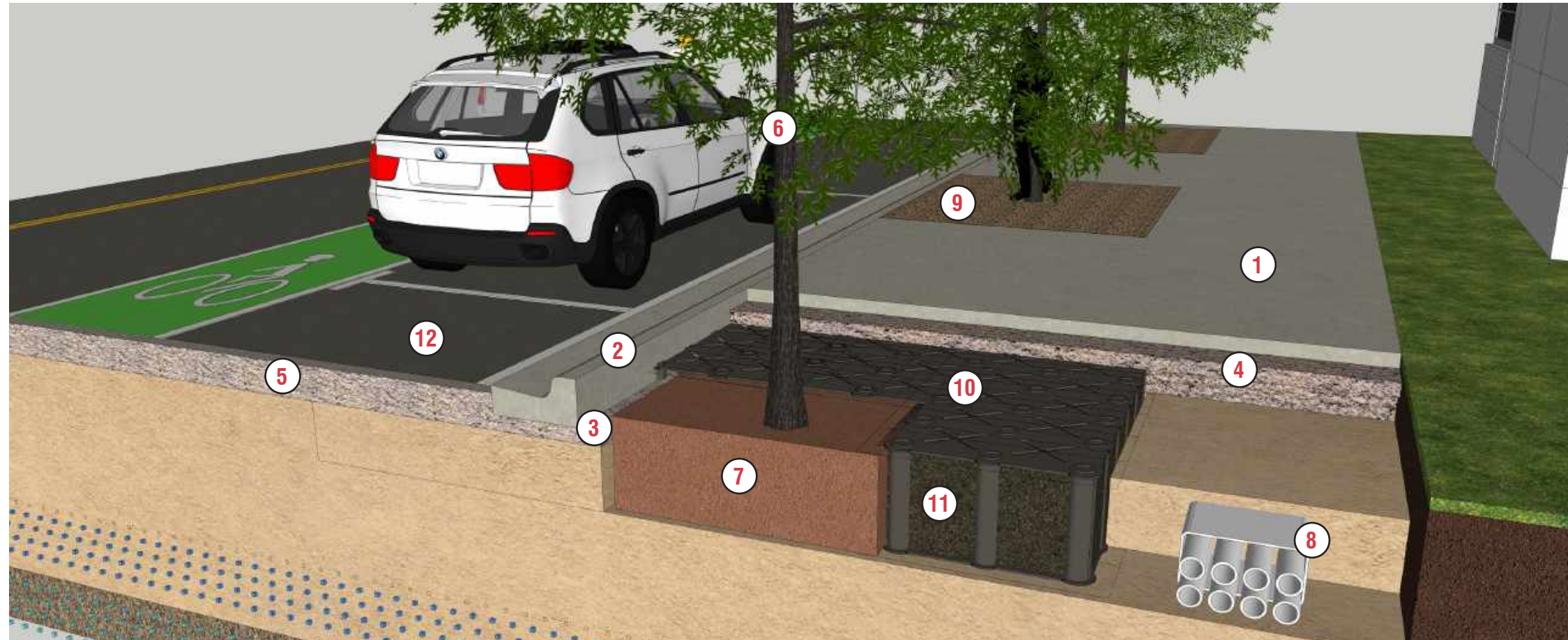
RECOMMENDED SPECIES INCLUDE:

Trees:

- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig

Palms:

- All allowable species, without exception

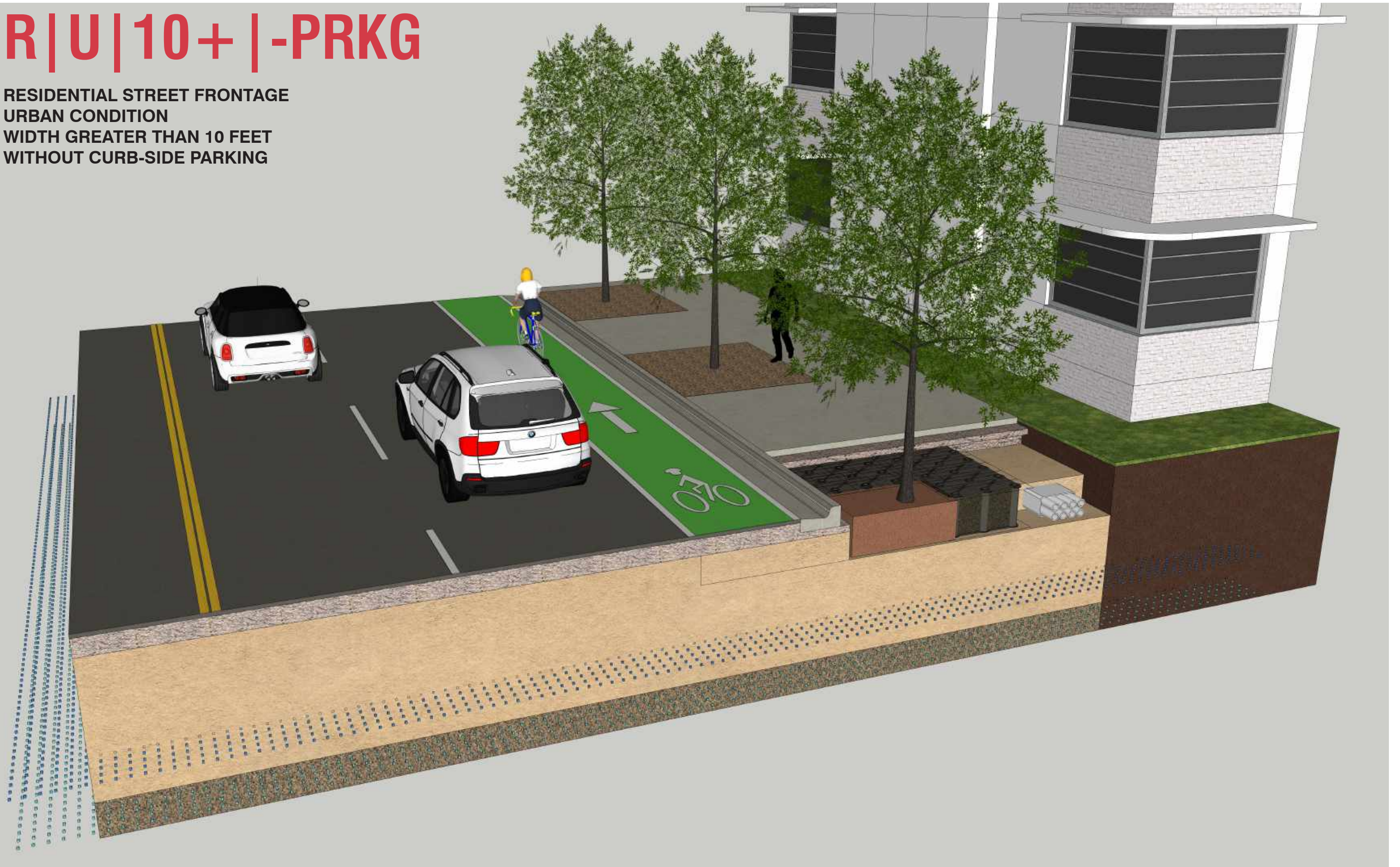


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

R|U|10+|-PRKG

RESIDENTIAL STREET FRONTAGE
URBAN CONDITION
WIDTH GREATER THAN 10 FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

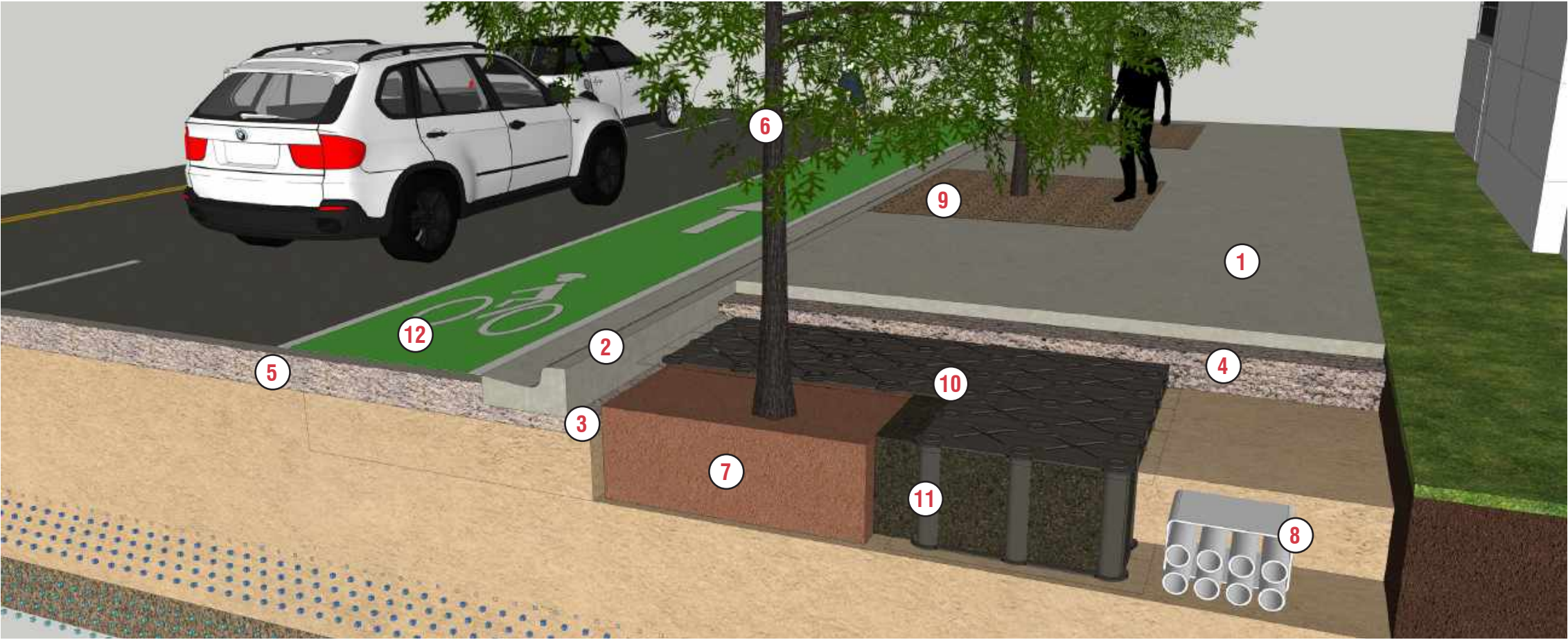
- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 50% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for medium shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Encouraged
- **Irrigation:** Permanent, Required

DESIGN ALTERNATIVES:

1. [2] - Portions of the curb and gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
2. [8] - Utilities could be installed beneath the parking strip
3. [10] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided and a minimum of 50% of the concrete sidewalk [1] is constructed out of pervious concrete

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig
- Palms:
- All allowable species, without exception

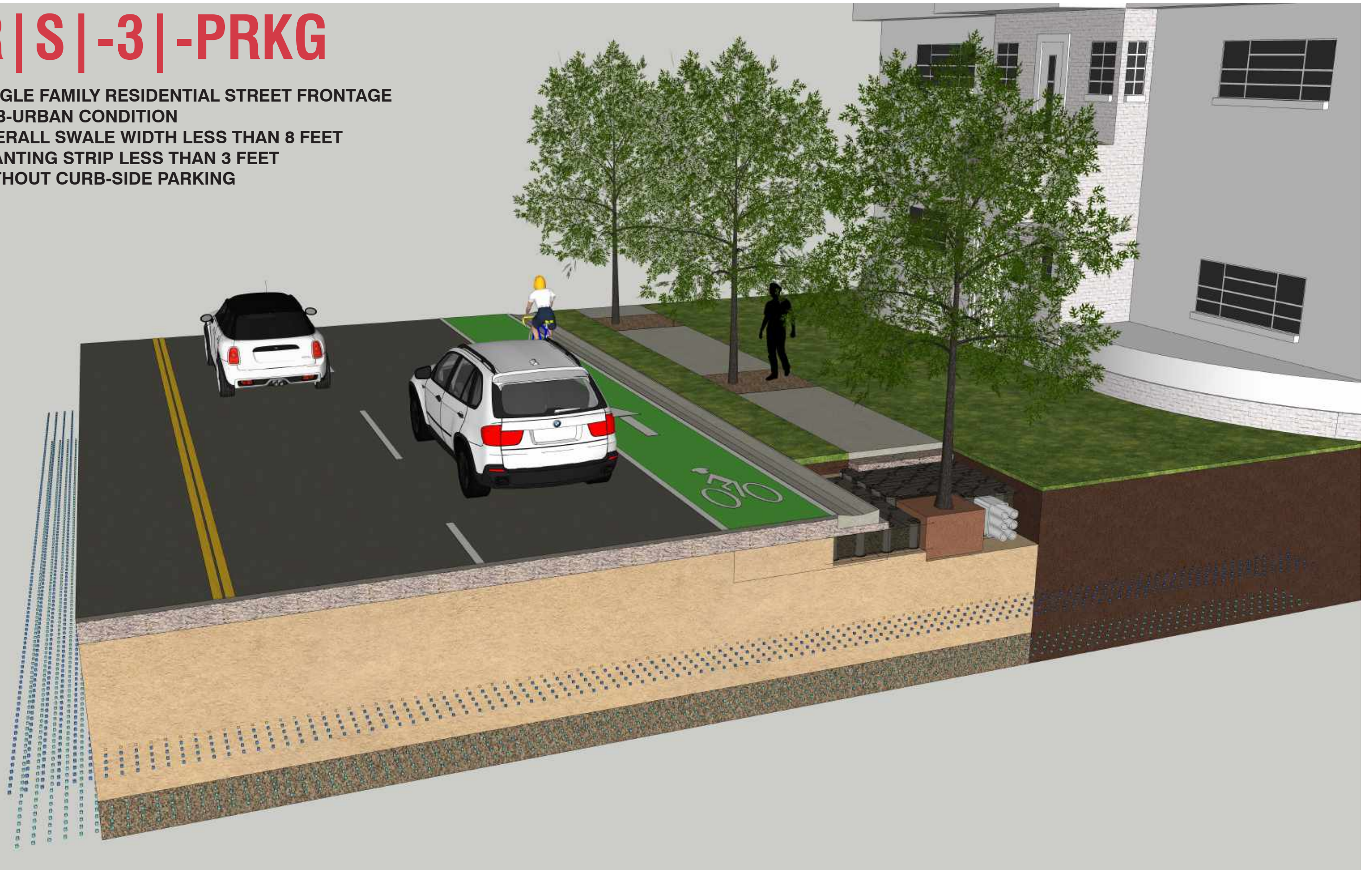


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Asphalt Paved Area

R|S|-3|-PRKG

SINGLE FAMILY RESIDENTIAL STREET FRONTAGE
SUB-URBAN CONDITION
OVERALL SWALE WIDTH LESS THAN 8 FEET
PLANTING STRIP LESS THAN 3 FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

- **Green Infrastructure:** Required
- **Preferred Green Infrastructure Method:** Structural Soil Required, Soil Cell Preferred. (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 50% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for large shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Not Required
- **Irrigation:** Temporary Required, Permanent Encouraged

DESIGN ALTERNATIVES:

1. [8] - Utilities may be constructed in a duct beneath the bike lane
2. [2] - Portions of the gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [[10] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided and 100% of the concrete sidewalk [1] is constructed out of pervious concrete

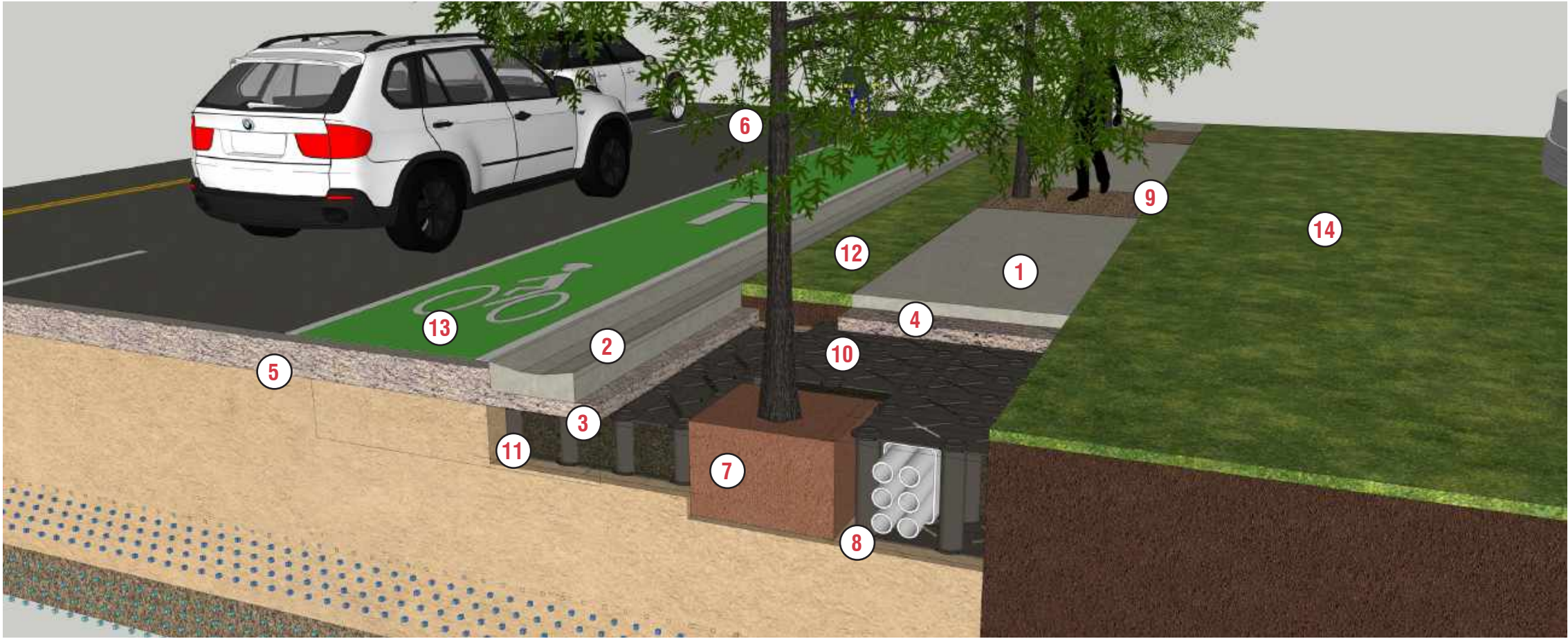
4. RECOMMENDED SPECIES INCLUDE:

Trees:

- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig

Palms:

- All allowable species, without exception

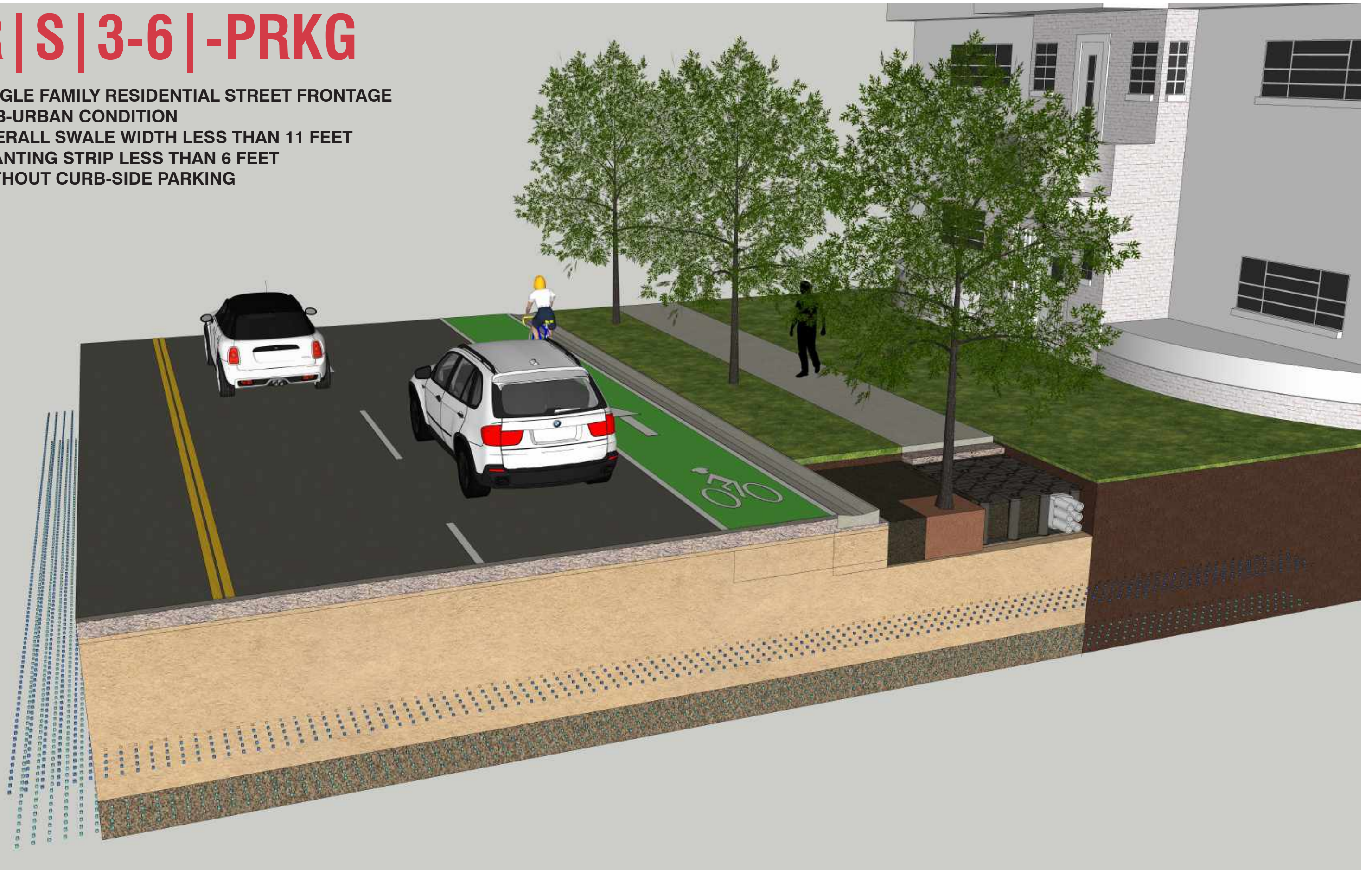


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Pervious Aggregate Covering
10. Soil Suspension System
11. Amended Soil Planting Mix
12. Pervious Planting Strip
13. Asphalt Paved Area
14. Private Property

R|S|3-6|-PRKG

SINGLE FAMILY RESIDENTIAL STREET FRONTAGE
SUB-URBAN CONDITION
OVERALL SWALE WIDTH LESS THAN 11 FEET
PLANTING STRIP LESS THAN 6 FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

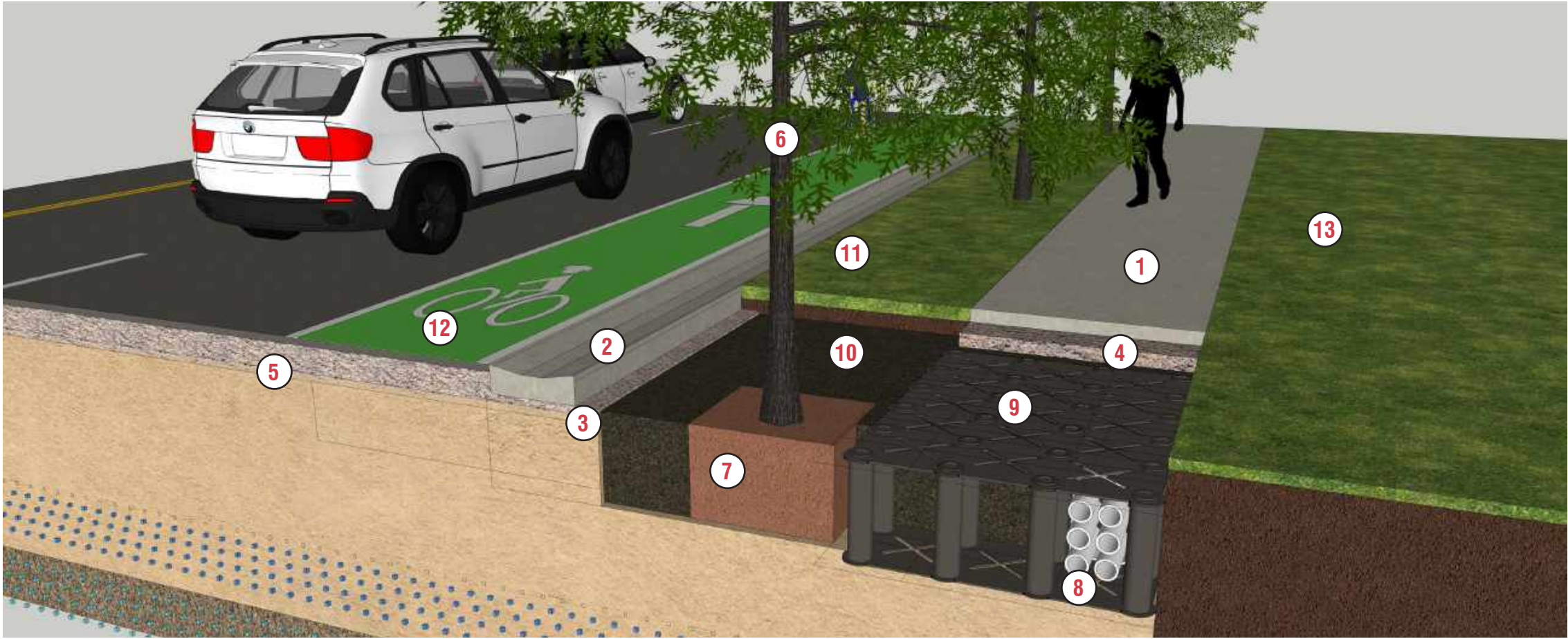
- **Green Infrastructure:** Recommended
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 50% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for large shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Not Required
- **Irrigation:** Temporary Required; Permanent Recommended

DESIGN ALTERNATIVES:

1. [8] - Utilities may be constructed in a duct beneath the bike lane
2. [2] - Portions of the gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
3. [9] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig
- Palms:
- All allowable species, without exception

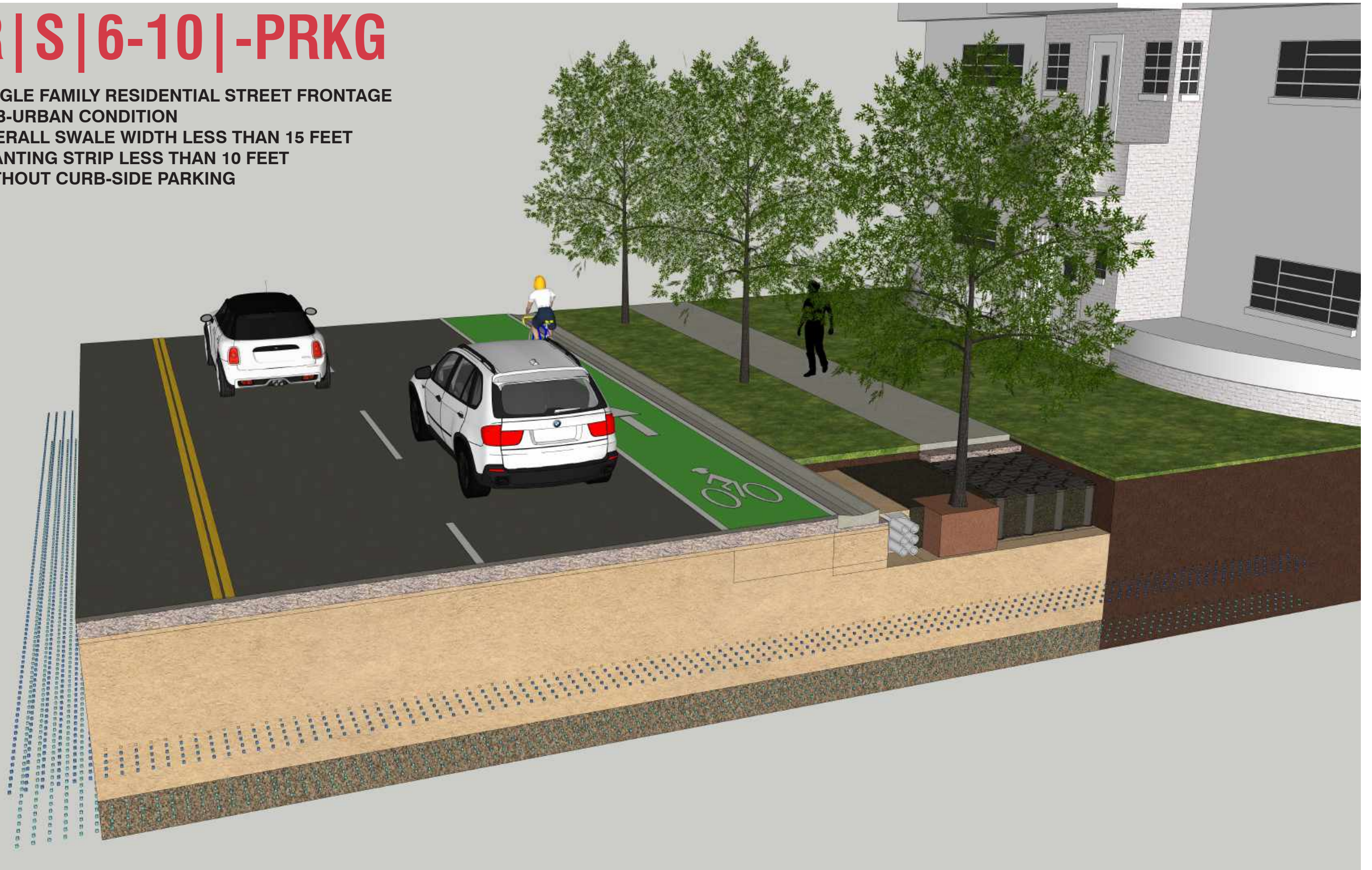


LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Soil Suspension System
10. Amended Soil Planting Mix
11. Pervious Planting Strip
12. Asphalt Paved Area
13. Private Property

R|S|6-10|-PRKG

SINGLE FAMILY RESIDENTIAL STREET FRONTAGE
SUB-URBAN CONDITION
OVERALL SWALE WIDTH LESS THAN 15 FEET
PLANTING STRIP LESS THAN 10 FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

- **Green Infrastructure:** Recommended
- **Preferred Green Infrastructure Method:** Soil Cell System (Pavement Suspension System if abutting property has an existing tree with roots extending into the right-of-way)
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** total volume may be reduced by 50% if soil volume areas are shared by two trees/palms or more
- **Suitability:** Best suited for large shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Encouraged
- **Perforated drainage pipe and pervious water capture strip:** Not Required
- **Irrigation:** Temporary Required; Permanent Recommended

DESIGN ALTERNATIVES:

1. [2] - Portions of the gutter could be constructed using pervious concrete to allow for runoff to be directed directly to the tree pit and the tree's rootball.
2. [9] Soil cells can be substituted with structural soils provided that the correct, equal volume of soil is provided

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, without exception
- Palms:
- All allowable species, without exception



LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Soil Suspension System
10. Amended Soil Planting Mix
11. Pervious Planting Strip
12. Asphalt Paved Area
13. Private Property

R|S|10+|-PRKG

SINGLE FAMILY RESIDENTIAL STREET FRONTAGE
SUB-URBAN CONDITION
OVERALL SWALE WIDTH GREATER THAN 15 FEET
PLANTING STRIP GREATER THAN 10 FEET
WITHOUT CURB-SIDE PARKING



DESIGN RECOMMENDATIONS:

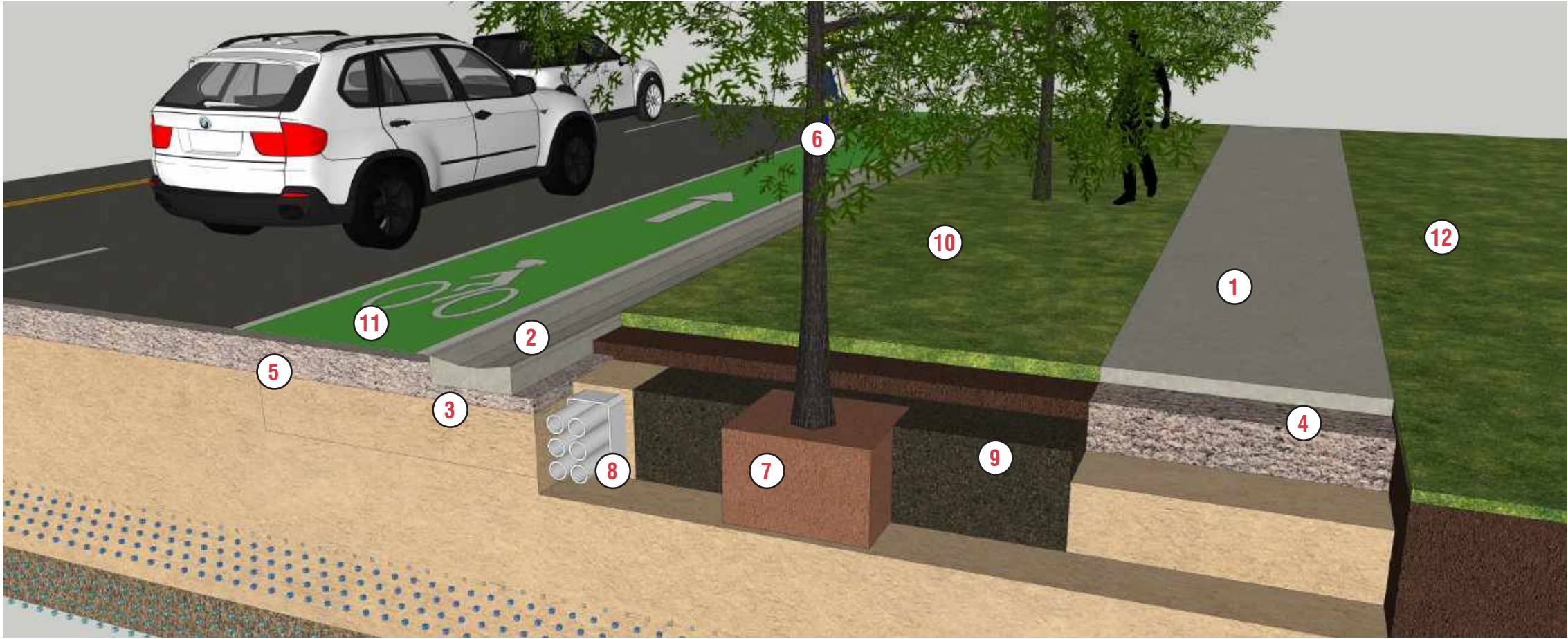
- **Green Infrastructure:** Recommended
- **Preferred Green Infrastructure Method:** Structural Soil System
- **Minimum Soil Volume Required:**
 - 1,000 cf of uncompacted soil per tree;
 - 700 cf of uncompacted soil per palm
- **Allowances for soil volume reduction:** N/A
- **Suitability:** Best suited for large shade trees
- **Preferred tree canopy growth habit:** Spreading
- **Soil volume area to extend beneath abutting asphalt area:** No
- **Pervious Concrete Sidewalk:** Not Required
- **Perforated drainage pipe and pervious water capture strip:** N/A
- **Irrigation:** Temporary Required, Permanent Recommended

DESIGN ALTERNATIVES:

1. [1] - Concrete sidewalk may be substituted for pervious concrete

RECOMMENDED SPECIES INCLUDE:

- Trees:
- All allowable species, without exception
- Palms:
- All allowable species, without exception



LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Slab Sub-base
5. Roadway Sub-base
6. Tree
7. Tree Critical Rootball Area
8. Underground Utilities (Wrapped in Root Barrier)
9. Amended Soil Planting Mix
10. Pervious Planting Strip
11. Asphalt Paved Area
12. Private Property

APPENDICES

REVIEW OF CITY DOCUMENTS AND ADOPTED MASTER PLANS

Policy and Regulation:

The development of Miami Beach’s Urban Forestry Master Plan included a comprehensive review of the City’s policies, tree preservation ordinance, landscape requirements, and other standards from the Urban Forestry Division. These policies and regulations provide the foundation for the City’s urban forestry program. They establish the regulatory framework for the protection and preservation of the urban forest, as well as the standards for planting, installation, and care of the City of Miami Beach’s trees. The following provides a summary of the review process and key findings.

Review of the City’s Tree Preservation Ordinance:

Overall, the City of Miami Beach’s existing tree preservation ordinance is very comprehensive and fairly strong. Some of the main goals and objectives of the ordinance correlate very closely with the recommendations of the Urban Forestry Master Plan. These objectives are included in the Purpose of Intent section of the ordinance. More specifically, some of them are to:

- Promote optimum sustainable amount of tree cover on public and private lands.
 - *The Miami Beach Urban Forestry Plan (U.F.M.P.) – Will recommend goals to enhance tree canopy coverage and improve maintenance. It will also recommend goals to make the City’s tree canopy more sustainable in the future, as well.*

- Establish and maintain diversity in tree species and age classes.
 - *The U.F.M.P. – Will recommend ways to achieve more species diversity, and will recommend ways to achieve more equally distributed age classes.*
- Minimize tree loss.
 - *The U.F.M.P. – Will recommend objectives to further reduce loss due to developers, current and proposed City projects, as well as private property owners.*
- Maintain City of Miami Beach’s trees in healthy and non-hazardous condition through good management practices.
 - *The U.F.M.P. – Will recommend objectives to better manage the City’s public trees, and may recommend strategies to transition maintenance of the street trees from the adjacent private property owners to the City staff and its contractors.*
- Minimize maintenance costs and damage to walks, streets, and infrastructures by appropriate tree species planting and providing for sustainable growing space.
 - *The U.F.M.P. – Will recommend a Toolbox of strategies to do that and to guide City staff in making decisions about trees in all future projects.*
- Preserve the communities’ character and quality of life.
 - *The U.F.M.P. – Will identify the City’s character (maybe by neighborhood) and recommend enhancing that aesthetic, and also enhancing the quality of life by providing more shade, walkability, and improving stormwater runoff and quality, as well.*

Review of the City’s Landscape Requirements:

Overall, the City of Miami Beach’s landscape code is very good and quite stringent. In addition, the City Staff are currently in the process of further strengthening the requirements. In that way, the City Staff are consistently keeping the current code requirements up to date. This is something that should be done on a prescribed regular basis. The recommendations of the Urban Forestry Master Plan shall only serve to reinforce the purpose and intent of the landscape code requirements. Some of those main goals and objectives include to:

- a. Prevent the destruction of the City’s existing tree canopy and promote its expansion.
- b. Improve aesthetic appearance of new development and protect historic landscapes.
- c. Promote sound landscaping principles through the use of drought tolerant and salt tolerant plant species, and also promote “right tree, right place”
- d. Promote use of trees and shrubs for energy conservation
- e. Provide shade
- f. Improve stormwater management
- g. Ameliorate noise impacts and light pollution
- h. Promote use of canopy trees to sequester carbon dioxide emissions

The U.F.M.B - Will recommend goals and objectives to help the City achieve all of these things, especially prevent destruction of existing trees, promote use of Florida Friendly trees and more sustainable trees, provide more shade and energy savings, improve stormwater management and quality , and reduce the City’s carbon footprint.

Some of the more interesting and restrictive requirements that are specific to the City of Miami Beach’s landscape code are the following:

- In terms of the number of street trees required to be planted on sites, the maximum average spacing is 20’ on center, which is very close together, and results in lots of trees being required, and ultimately, planted on sites.
 - Over time, this will increase the amount of canopy coverage in the City.
- Under the tree planting requirements, palms are allowed to be planted, but do not count towards the number of required trees. They can be planted, but are only in addition to the required trees.

- *This is also good, because the City currently has an overabundance of palms, which do not provide the same benefits as shade or canopy trees. This requirement will continue to help the City to encourage its residents, developers and businesses to plant more shade trees to increase canopy coverage throughout the City.*
- The code requirements include a species diversity requirement chart.
 - *The U.F.M.B. will also recommend goals and objectives that will promote increased diversity of tree species.*
- The code also requires at least two lot trees to be planted in an “energy conservation zone” within the lot.
 - *This is very good because it encourages residents to plant shade trees where they can provide the maximum amount of energy savings. However, there is not much information in that section of the code to explain where exactly that zone is located. The U.F.M.P. will recommend possibly adding some more illustrations to better define where the energy conservation zone is located within each type of property.*

The City’s landscape code also includes specifications and requirements for landscape maintenance. Some of the items addressed include:

- In terms of tree pruning, it describes the manner/ method for pruning.
 - *This section could be enhanced even further with information from the International Society of Arboriculture (ISA) and other organizations. Or, the City could develop some more detailed guides or brochures to illustrate proper tree care to the public.*
- Stipulates that all street trees are to be maintained by the adjacent property owner.
 - *The U.F.M.B – Will encourage better public information and educational materials to show residents how to properly maintain their trees, and could also result in community activist groups/ volunteers to help with tree pruning and care, or planting projects in neighborhoods.*
 - *The U.F.M.B may also encourage City Officials to seriously think about taking back the maintenance of all street trees – to ensure long term survivability, as well.*

In addition to reviewing the City’s existing tree preservation ordinance and landscape code requirements, one of the other Studies that was reviewed included

some recommendations for improvements to the City’s ordinances. That study is the G.I.C.’s Maximizingstormwater benefits using green infrastructure in Miami Beach “A codes and ordinance audit for integrating trees into stormwater management program and reducing imperviousness”.

The recommendations for the tree preservation ordinance in that study include:

1. Require sturdy chain link tree protection fence in high risk areas.
2. Use a full spectrum of tree protection devices and methods and provide guidance to developers about when to use each device.
3. Define “critical root zone” as an area 1.5 times the diameter of the tree trunk (D.B.H.)
4. Require informative tree protection signage- summarizing the “do’s and don’ts”.
5. Enforce City’s tree removal permits and ensure compliance is upheld. Educate Special Magistrates and staff about importance of tree canopy to City.
6. City could incorporate new trenchless technical requirements into their code.
 - *The U.F.M.P. - Will reinforce all these recommendations.*

Comprehensive Master Plans and Studies:

The development of Miami Beach’s Urban Forestry Master Plan included a thorough review of many of the City’s existing Master Plans and previous studies that have been adopted recently. Some of these Master Plans directly relate to the recommendations and findings of the Urban Forestry Master Plan - either by calling the City of Miami Beach to action on certain issues or to implement new policies and standards to accomplish the goals of the master plan or study. In many cases, those action items or goals are aligned with the recommendations contained in the Urban Forestry Master Plan. In other cases, the proposed policies and objectives outlined in a previous master plan or study may actually be in conflict with the recommendations and objectives of the Urban Forestry Master Plan. The Master Plans and previous Studies that were reviewed are as follows, along with the main points and key elements that correlate with the Urban Forestry Master Plan:

Review of the City of Miami Beach’s Sustainability Plan – Energy Economic Zone Work Plan:

- A. Water Conservation and Quality:
 - Major Goals:
 - Decrease water consumption
 - *The U.F.M.P. – Will encourage planting*

- Florida Friendly trees and landscaping that will reduce irrigation needs*
- Improve water quality of discharges
 - *The U.F.M.P. – Will demonstrate that trees will intercept rainwater and their roots will clean stormwater.*
- Improve the capacity of City’s stormwater system to reduce flooding
 - *The U.F.M.P. – Will verify that trees will absorb and diffuse stormwater – thus, reducing runoff.*
- Important Indicators are:
 - Urban runoff – No downward trend – Existing initiatives: Green alleys, green parking lots and green pocket parks.
 - *The U.F.M.P. – will identify locations where there are opportunities to plant trees*
 - Existing initiatives: Stormwater pollution prevention education.
 - *The U.F.M.P. – May recommend educational materials on how trees improve this.*
 - Existing initiatives: Stormwater master plan (Jacobs Engineering’s Plan-pending)
 - *The U.F.M.P. – Will create a Toolbox and Strategies that will work with this plan (in the future).*

- B. Energy Conservation:
 - Goals:
 - Reduce energy consumption
 - *The U.F.M.P. – Will emphasize that trees cool buildings.*

- C. Alternative Transportation:
 - Benefits:
 - Improved air quality and overall community health. Greater opportunities for residents to engage in social interaction and exercise.
 - *The U.F.M.P. – Will recommend trees along streets, walks, and bike paths that will improve air quality, provide shaded alternate trnsportation methods, and encourage more social interaction and exercise.*

- D. Natural Resource and Ecosystem Management
 - Major Benefits/Goals:
 - Enhance, restore and protect natural resources which increases biodiversity and resiliency of City’s ecosystem.
 - Increase canopy coverage and reduce

<div> <div>stormwater runoff, improve air quality, beautify neighborhoods and provide shade for pedestrians.</div> <div> <ul style="list-style-type: none"> Decrease heat island effect, which reduce energy costs. <i>The U.F.M.P. – Will become the “blue print” on how to do all of these things.</i> </div> <div> <ul style="list-style-type: none"> Important Indicators are: <ul style="list-style-type: none"> Biodiversity – No downward trend—Existing initiatives: Bird sanctuary designation <ul style="list-style-type: none"> <i>The U.F.M.P. – Will result in providing more wildlife habitat and food source.</i> Urban Reforestation – Upward trend – Existing initiatives: Urban reforestation program; Community Gardens; Tree City U.S.A; (Xeriscaping)/Florida Friendly Landscaping; Landscape Code; Tree Preservation Ordinance Major Goals: <ul style="list-style-type: none"> Increase the percentage of R.O.W.s that are fully planted with trees. Reduce the attrition rate, or net loss, of trees in the City (i.e. plant more trees than are being removed). <ul style="list-style-type: none"> <i>The U.F.M.P. – Will establish an urban forestry management plan to better reforest the City and plan, protect and manage the City’s trees.</i> <i>The U.F.M.P. - Will continue Tree City USA programs and will strengthen City’s Landscape Code and Tree Preservation Ordinance.</i> </div> </div>	<div> <div>Existing initiatives: Integrated Pest Management (IPM) systems; (Xeriscape) Florida Friendly Landscaping</div> <div> <ul style="list-style-type: none"> <i>The U.F.M.P. - Will promote I.P.M. systems and Florida Friendly trees and landscaping</i> </div> <div> <div>G. Economic Development and Planning:</div> <div> <ul style="list-style-type: none"> Major Goals: <ul style="list-style-type: none"> Maintain neighborhood character and satisfaction with quality of life Maximize Miami Beach as a destination brand <ul style="list-style-type: none"> <i>The U.F.M.B - Will recognize that trees in neighborhoods are known to enhance its character and improve the quality of life for its residents, and will recommend the protection and care of signature/heritage trees and palms in the City, as well as the planting of more trees that will only serve to enhance the branding of the city as an iconic place to visit, work and live.</i> </div> </div> </div>	<div> <div><i>groundwater and increased sea water inundations.</i></div> <div> <ul style="list-style-type: none"> <i>The U.F.M.P. – Will recommend objectives incorporating trees into these stormwater systems that will not destruct, but rather enhance, the effectiveness of those systems in both reducing the quantity of stormwater runoff but the quality of it being discharged into the bay.</i> </div> <div> <div>Conclusions:</div> <div> <ul style="list-style-type: none"> Objective No. 4 – Augment existing infrastructure for storage and treatment with solutions to improve water quality, increase recharge, and provide water for potential irrigation. Objective No. 6 – Identify stormwater harvesting, reuse and recharge well opportunities for conservation of fresh water. Develop storage solutions that promote irrigation and re-use of treated stormwater. <ul style="list-style-type: none"> <i>The U.F.M.P. – Will highlight the opportunity for tree lined streets and parks/open spaces to be irrigated with stored (re-use) rainwater.</i> </div> </div> </div>	<div> <div><i>sustainability, and ecological purposes versus those trees that may be occasionally planted for aesthetic reasons primarily.</i></div> <div> <div>From Recommendations:</div> <div> <ul style="list-style-type: none"> Enhance strategies to clean and treat runoff water before it is pumped into the bay. Maximize biological stormwater infiltration systems (i.e. bioswales) as the first layer of treatment before polluted stormwater is treated mechanically within the stormwater system. <ul style="list-style-type: none"> <i>The U.F.M.P. – Will recommend objectives that promote the creation of bioswales, including planting trees, to increase infiltration of stormwater.</i> Encourage programs that promote environmental education, restoration, and stewardship. Furthermore, performative vegetation can be a didactic tool to teach lessons about natural sustainability and resiliency. <ul style="list-style-type: none"> <i>The U.F.M.P. – Will encourage educational programs on the benefits of planting appropriate tree species and their role in improving sustainability and enhancing resiliency.</i> Transition from planting non-native trees to native, salt-tolerant trees, particularly in urban areas covered primarily by asphalt and hardscape. As the City elevates both roads and buildings, the City should develop strategies to incorporate salt-tolerant vegetation to ensure their future growth and resilience. <ul style="list-style-type: none"> <i>The U.F.M.P. – Will include objectives to strongly recommend the use of more salt- tolerant trees, especially in areas that will be affected by rising sea levels and water tables.</i> Develop a catalog of cross-section types that mediate between the changing elevations of roads, sidewalks, and buildings. <ul style="list-style-type: none"> <i>The U.F.M.P – Will initiate the creation of such a catalog of cross-section types that will guide the planting, design, and construction of future infrastructure, stormwater, and flood mitigation projects.</i> </div> </div> </div>
<div> <div>E. Community Outreach and Participation:</div> <div> <ul style="list-style-type: none"> Major Goals: <ul style="list-style-type: none"> Increase awareness and stewardship of sustainable concepts through community outreach and educational programming. Increase participation of community members in civil affairs. <ul style="list-style-type: none"> <i>The U.F.M.P. – Will recommend educational materials and programs, such as brochures on proper tree care and importance of trees; more tree give-aways; and may even result in possible volunteer tree programs, as well.</i> </div> </div>	<div> <div>H. Air Quality and Climate Change:</div> <div> <ul style="list-style-type: none"> Benefits and Goals: <ul style="list-style-type: none"> Reduce the city’s carbon footprint and improve local air quality. Decrease risk of severity of climate change impacts, such as flooding, sea-level rise, and storms/extreme weather and temperatures. <ul style="list-style-type: none"> <i>The U.F.M.B - Will recommend goals that will reduce the City’s carbon footprint and improve the air quality, and will recommend goals that will seek to better prepare the City for climate change impacts, especially for flooding and groundwater rise, and extreme high temperatures.</i> </div> </div>	<div> <div>Review of Blue Ways Master Plan</div> <div> <ul style="list-style-type: none"> Talks about landscaping improvements and mangrove preservation and restoration: <ul style="list-style-type: none"> Encourages pedestrian connectivity Proposes boardwalks and promenades along the waterways Encourages creation of living shorelines (instead of just seawalls) <ul style="list-style-type: none"> <i>The U.F.M.P. – All of which would be enhanced by tree planting.</i> </div> </div>	<div> <div>Review of Pedestrian and Bicycle Master Plan</div> <div> <ul style="list-style-type: none"> Major Goals: <ul style="list-style-type: none"> Encourage people to travel by walking, bicycling, and transit Reduce energy consumption and improve air quality Acknowledges that streets are civic spaces with a social function that connects people through everyday interaction </div> </div>
<div> <div>F. Green Procurement:</div> <div> <ul style="list-style-type: none"> Important Indicators are: <ul style="list-style-type: none"> Landscaping Number of bids that specify green products or recycled alternatives—Upward trend— </div> </div>	<div> <div>Review of City Wide Comprehensive Stormwater Management Master Plan</div> <div> <div>Executive Summary: Guide to improving City’s stormwater management system, flood control and water quality performance over next 20 years, with considerations for sea level rise, and a 50 year planning horizon for sea wall heights. Sea level rise will worsen flooding potential by raising tidal level and water table and making it more difficult to discharge stormwater out of the area.</div> <div> <ul style="list-style-type: none"> <i>The U.F.M.P. – Will outline strategies for the sustainability of both existing, future and newly planted trees in rights-of-way to deal with rising</i> </div> </div> </div>	<div> <div>Review of Harvard Study - South Florida and Sea Level – The Case for Miami Beach</div> <div> <div>From Summary Statements:</div> <div>Objective No. 5 – The City of Miami Beach should incorporate landscape ecology into the evaluation and design of all infrastructure projects. The City should commission a study of the resilience metrics for local species and ecologies to inform ongoing and future flood mitigation projects. Finally, the City should differentiate between plants used for ecological versus aesthetic purposes and deploy them accordingly.</div> <div> <ul style="list-style-type: none"> <i>The U.F.M.P. – Is that study that will provide the metrics for resiliency of different tree species and will result in a toolbox that can be used to inform future stormwater improvements and flood mitigation projects</i> <i>The U.F.M.P. – Will recommend objectives that will help differentiate between trees that that are the most appropriate for infrastructure needs,</i> </div> </div> </div>	<div> <div>Review of Pedestrian and Bicycle Master Plan</div> <div> <ul style="list-style-type: none"> Major Goals: <ul style="list-style-type: none"> Encourage people to travel by walking, bicycling, and transit Reduce energy consumption and improve air quality Acknowledges that streets are civic spaces with a social function that connects people through everyday interaction </div> </div>

- Involve the community in shared responsibility for street design
- Create inviting places (that reflect culture of Miami Beach)
- Create inviting neighborhoods
- Reduce street water runoff and pollution, and maximize infiltration and re-use of stormwater
 - *The U.F.M.P. – Will help to achieve all of these goals by making recommendations that will result in providing shaded facilities that will promote these objectives.*

Review of Street Design Plan and Guidelines

- Presentation of “Street Types” includes street trees, whether planted in swales, medians, tree pits, or “connected” tree pits.
- Also, includes a table in which every street type being proposed requires street trees.
- Streetscape section states that “shade in the form of street trees or shade structures and/or trellises” is an element for success.
- Streetscape-Landscape Elements include shade trees, vertical landscaping, bioswales, planters, and landscape plazas.
- Also, includes a Planting Standards section with some details and specifications.
 - *The U.F.M.P – Will help to further define how to integrate trees into various streetscape designs through a series of methodology types and schematic plans for 3 sample street types found in the City of Miami Beach.*

Review of U.L.I. Study – Sea Level Rise

- Panel Recommendations – Continue actively using green and open space. These offer an important opportunity to manage and infiltrate water, given their permeability and sponge functions – meaning the ability to absorb water naturally.
 - *The U.F.M.P. – Will highlight the benefits of trees and their ability to intercept rainfall, as well as act as a “sponge” in absorbing and filtering runoff through their root systems.*
- Environmental Resources and Green Infrastructure - Enhancing and using natural resources is a critical component of Miami Beach’s resiliency strategy and broader work in planning policy. Potential exists for natural resources to play a more prominent role in the City’s stormwater management strategy and urban design aesthetic.
 - *The U.F.M.P – Will do exactly this. Perhaps there is no better statement that underscores that*

critical importance of implementing the goals and recommendations of the Urban Forestry Master Plan than this one.

Review of Updated Transportation Master Plan – Final Report

- Goal # 1 – Prioritize the people, the pedestrians. Encourage City residents and visitors through safe and engaging infrastructure, to resort to walking for their short trips within their respective living and staying areas.
 - *The U.F.M.P – Will recommend planting more street trees along sidewalks to provide shade.*
- Transportation Policies: #3 Roadway Planning, Design and Construction. The City shall continue to provide for a safe, convenient, efficient, and effective transportation system, which sustains the City’s natural, aesthetics, social, and economic resources.
 - *The U.F.M.P. – Will recommend ways to preserve, protect and sustain the natural resources and aesthetics along the City’s transportation corridors.*
- # 7- Enhance, Protect and Preserve the City’s Neighborhoods
 - The City shall provide a safe and attractive transportation system throughout the City that meets the needs of users of the Right-of-Ways, the neighborhoods, the neighboring communities, and the environment.
 - *The U.F.M.P. – Will aim to enhance neighborhoods aesthetics and preserve and protect the environment throughout the entire city.*
- Pedestrian Mode- “Mode Share Vision”
 - Provide sufficient shading and lighting on the frontage zone, furnishing zone, and/or median of a street. Providing enough shade may be achieved through the use of landscaping, required canopies on adjacent developments, overhangs, awnings, arcades and/or other non-permanent architectural sun-controlling devices above sidewalks.
 - *The U.F.M.P. – Will outline ways to incorporate trees into these areas to provide shade through natural methods.*

Review of G.I.C.’s-Integrating Trees into The City’s Stormwater Management Strategy

- This study called for the City to complete an urban forest management plan.

- *The U.F.M.P. –Will be that urban forestry management plan.*
- This plan calls for City to use the Urban Forestry. funding calculator to determine an achievable urban tree canopy coverage goal.
 - *The U.F.M.P. - Will set that canopy coverage goal, and outline the objectives, means, and methods of how to get there.*
- The study determined that the current canopy coverage in the City is 17%, and that the total possible tree canopy coverage is 26.2%
 - *The U.F.M.P. will determine what percentage may be achievable*
- The plan presented E.P.A data on how much stormwater trees take up on average, as well as how trees benefit the quality of life of City residents.
- The study also identified potential planting sites throughout the City.
- The plan presented these top recommendations to improve forest care in Miami Beach:
 1. Use G.I.C.S’ Stormwater Uptake calculator to determine the benefits of maintaining or increasing tree canopy goals by neighborhoods.
 2. Use G.I.C.S’ Urban Forestry funding calculator to assist in setting tree planting goals.
 3. Develop a stormwater best management practices design manual for the City. Include trees and constructed green infrastructure. Without standards, innovative stormwater techniques such as green roofs, suspended pavement systems, vegetated swales, and tree pits cannot be credited toward stormwater requirements.
 - *The U.F.M.P. will continue to build on these tools and techniques, and the City is currently undertaking the Stormwater Management Master Plan*
 4. Develop an Urban Forest management plan for the City.
 - *The U.F.M.P. will describe the condition of the Urban Forest, current maintenance costs, Urban Tree Canopy coverage goals and the process to achieve them.*
 5. Continue the integration of planning for trees in all planning and development activities. (Holding pre-development conferences, allow for exploration of ideas for tree conservation before extensive funds are spent on planning, design and construction of projects/developments).
 - *The U.F.M.P. will make recommendations on how to better communicate and coordinate between City departments in planning and*

doing projects.

6. Prioritize forestry activities. Develop a contingency budget for the Urban Forest to allow for critical urban forestry maintenance items to continue through economic downturns (establish a minimum budget requirement).
 - *The U.F.M.P. will provide facts and information to help the City staff make the justification for adequate or increased funding for U.F. programs.*
7. Require and enforce 600, 1,100, & 1,500 Cu. Ft. soil volume planting requirements for small, medium, and large trees, respectively.
 - *The U.F.M.P. will provide recommendations and details on how to do this.*
8. Identify key streets where green infrastructure and bike lanes are needed. Use the street tree coverage map (by G.I.C.) to target streets with low tree canopy coverage and work with transportation staff to continue to expand the shaded bike network in Miami Beach.
 - *The U.F.M.P. will look to these maps to make recommendations on neighborhoods and streets to prioritize for new tree planting and set goals for these areas. It will also assist City Transportation Department staff to better understand how to integrate trees into their designs and projects.*
9. Develop more information for citizens detailing how they can engage in supporting the City’s urban canopy. For example, the City could create A Tree Stewards Group and provide them with resources and guidance concerning U.F. management. A Tree Stewards group can partner with H.O.A.’s, Parks Dept., etc. to accomplish tree planting projects that City Staff may not be able to budget or undertake.
 - *The U.F.M.P. will make recommendations to the City on how to enhance public education programs and Citizen Initiatives.*

Review of G.I.C.’s Maximizing stormwater benefits using green infrastructure in Miami Beach “A codes and ordinance audit for integrating trees into stormwater management program and reducing imperviousness”.

This study made some recommendations for the City’s Tree Preservation Ordinance:

1. Require sturdy chain link tree protection fence in high risk areas.
2. Use a full spectrum of tree protection devices and methods and provide guidance to developers about

- when to use each device.
3. Define critical root zone as an area 1.5 times the trees diameter (D.B.H.).
 4. Require informative tree protection signage-summarizing do’s and don’ts.
 5. Enforce City’s tree removal permits and ensure compliance is upheld. Educate Special Magistrates and staff about importance of tree canopy to City.
 6. City could incorporate new trenchless technical requirements into their code.
 - *The U.F.M.P. will reinforce all these recommendations.*
 - This study also recommended that the City conduct a land cover assessment every four years to measure and compare tree canopy coverage and change over time.
 - *The U.F.M.P. will make a similar recommendation.*
 - The study stated that the City should require minimum soil volumes for new tree plantings, and where not achievable, should require suspended pavement (Silva Cells) or structural soils to provide adequate soil volume and support for urban trees.
 - The study also stated that the City should develop a Tree Care Ordinance for City-owned trees which requires maintenance activities by year.
 - The plan recommended reducing parking lot imperviousness through a variety of methods and techniques.
 - *The U.F.M.P. – Will recommend incorporating some, or all, of these items into the City’s codes and ordinances.*

More Specific Plans and Focused Studies:

These plans were more project specific or may have had a narrower focus that limited how much they correlated with the Urban Forestry Master Plan. Nonetheless, they had some points that were directly related to the recommendations of the U.F.M.P. which are as follows:

Review of “Million Trees Miami” Initiative and Miami Dade County Urban Tree Canopy Assessment

- **Goals:**
 - Establish baseline data on the existing urban forest and provide a resource to guide future community forest management and restoration efforts.
- **Results:**
 - Tree canopy in Miami-Dade County is 19.9%
 - A large portion of area offers potential for additional tree canopy. (These areas consist of previous and impervious surfaces).
 - Residential housing represents 42% of existing

- tree canopy and 33% of possible tree canopy on pervious surfaces.
- Tree canopy and water bodies are associated with lower surface temperature. So, planting trees in targeted areas can reduce heat islands.
 - Specific Data pertaining to the City of Miami Beach:
 - Existing Tree Canopy % =5%-15% (With exception of Indian Creek)
 - Possible U.T.C. (Pervious Surfaces) %= 13%-24%
 - Possible U.T.C. (Impervious Surface) %=26%-30%
 - Not suitable % = 36%-45%
 - Summary for Miami Beach - Existing U.T.C.% = 11.6% / Possible U.T.C. – Pervious = 21.6%/ Possible Impervious = 26.8%, Unsuitable = 37.9%
 - *The U.F.M.P. – Will utilize all of this good existing data in making its recommendations.*
 - *Note: This study also stated that the percentage of older trees within the City is relatively low, and that the City must take better care of its maturing trees... in order to reverse this trend.*
 - **Summary and Conclusions:**
 - Miami Dade County and Million Trees Miami has set a goal of 30% U.T.C. by the year 2020. That includes Miami Dade County planting 30%, or 300,000, of the trees for that total, and the rest of the cities in the County to plant 70%, or 700,000, of the trees for that total.
 - *The U.F.M.P. will support the reaching of that goal by encouraging the planting of trees in both the pervious and impervious surface areas within the City of Miami Beach.*

Review of Atlantic Greenway Network-Master Plan:

This Plan pertains mostly to C.I.P. and G.O. Bond Projects:

- For this study, most citizen input was regarding streetscaping projects funded by the City’s G.O. Bond. Projects include...additional trees to provide shade for pedestrians, neighborhood entry features, and new bicycle and pedestrian features on local streets.
 - *The U.F.M.P. will encourage these types of enhancements.*
- The plan talks about adding bike lanes and connecting bicycle routes, but does not mention trees, either dealing with existing trees or incorporating new trees to enhance to corridors.

- *The U.F.M.P. will recommend that new bicycle enhancement projects take existing trees into consideration and provide opportunities for new ones.*
- The Master Plan presents typical sections-that show street trees in them.
 - *The U.F.M.P. will include methodologies and details on how to create appropriate planting spaces for those street trees.*

Review of Miami Beach – Beach Front Management Plan

Natural Resource Management and Restoration:

- This plan talks about removing non-native/invasive species, and re-planting with native species and dune vegetation, as well as preserving habitats for wildlife and marine life.
- *The U.F.M.P. – Will list tree species appropriate for beachside planting.*

Review of Washington Avenue – Vision and Master Plan:

This plan doesn’t really talk about trees specifically, but rather mentions implementing streetscape enhancement projects, public Greenspace improvements, and “parklets”.

Review of Lincoln Road – Master Plan:

This plan is very site specific. However, it definitely incorporated strategies for the creation of landscape areas and the planting of large trees and palms within the entire corridor. This has led to the use of suspended pavement systems in order to provide larger soil volumes for the enhanced growth and sustainability of the shade trees in this pedestrian intense streetscape.

- *The U.F.M.P. – Will encourage the use of various types of suspended pavement and structural soil systems in all of types of projects where the planting areas for street trees is restricted and not adequate for the long-term growth and sustainability of large shade trees. In addition, the U.F.M.P. will include schematic plans and details which will illustrate how to install and implement these suspended pavement systems.*



REFERENCES

1. Bastin J.-F., Finegold Y., Garcia C., Mollicone D., Rezende M., Routh D., Zohner C.M., Crowther T.W.(2019) Science, 364 (6448) , pp. 76-79.

2. Dwyer, J., McPherson, E. G., Schroeder, H. W., and Rowntree, R. (1992). Assessing the Benefits and Costs of the Urban Forest. 1992. Journal of Arboriculture 18(5), 1-12.

3. Ulmer, J.A., K.L. Wolf, D.R. Backman, R.L Tretheway, C.J. Blain, J.P.M. O’Neil-Dunne, L.D. Frank. (2016) Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription. Health and Place, 42, 54-62.

4. CUFR. Center for Urban Forest Research, USDA Forest Service Pacific Southwest Research Station

5. Miller, R. W. 1988. Urban Forestry: Planning and Managing Urban Greenspaces. New Jersey: Prentice Hall.

6. Green Infrastructure Center. 2018. Trees to Offset Stormwater Case Study 05: City of Miami Beach, Florida.

7. Source: Miami Beach Historical Association, <http://www.miamibeachhistory.org/mbhistory.html>, accessed 08/04/2019

8. Xiao, Q., McPherson, E.G., Simpson, J.R., Ustin, S.L. 1998. Rainfall Interception by Sacramento’s Urban Forest. Journal of Arboriculture. 24(4): 235-244.

9. McPherson, EG., Xiao, Xl, Maco, S.E., VanDerZanden, A., Simpson, J.R., Bell, N., Peper, P.J. 2002. Western Washington and Oregon Community Tree Guide: Benefits, Costs and Strategic Planting. Center for Urban Forest Research Pacific Southwest Research Station. [Fs.fed.us/psw](https://www.fs.fed.us/psw).

10. Johnson, Zachary S., Koski, T., and O’Conner, A. 2017. The Hidden Value of Landscapes. http://webdoc.agsci.colostate.edu/hortla/Colorado_Water_2017.pdf

11. Energy Information Administration, 2003, Emissions of Greenhouse Gases in the United States 2003. <http://www.eia.doe.gov/oiaf/1605/ggrpt/>

12. Gómez-Baggethun, E. and Barton, D.N., 2013. Classifying and valuing ecosystem services for urban planning. Ecological Economics, 86, pp.235-245.

13. United States Environmental Protection Agency. <https://www.epa.gov/heat-islands>. Accessed 08/19/2019

14. Center for Disease Control and Prevention. 2006. Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety.

15. American Lung Association. State of the Air 2019. <https://www.lung.org/our-initiatives/healthy-air/sota/city-rankings/states/florida/miami-dade.html>. Accessed 08/15/2019.

16. Science Now. Tree Leaves Fight Pollution. October 2010. [sciencemag.org. Web 11/05/2010. <http://news.sciencemag.org/sciencenow/2010/10/tree-leaves-fight-pollution.html>](https://www.sciencemag.org/sciencenow/2010/10/tree-leaves-fight-pollution.html)

17. Kaplan R, Kaplan S. 1989. The Experience of Nature: A Psychological Perspective. Cambridge: Cambridge University Press.

18. Ulrich RS. 1986. Human Responses to Vegetation and Landscapes. Landscape and Urban Planning 13: 29-44.

19. Ulrich, R.S. 1984. View Through A Window May Influence Recovery From Surgery. Science 224:420-421.’

20. Ulmer, J.A., K.L. Wolf, D.R. Backman, R.L Tretheway, C.J. Blain, J.P.M. O’Neil-Dunne, L.D. Frank. (2016) Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription. Health and Place, 42, 54-62.

21. Wolf, K.L. 2007. The Environmental Psychology of Trees. International Council of Shopping Centers Research Review. 14, 3:39-43.

22. Miller, R. W. 1988. Urban Forestry: Planning and Managing Urban Greenspaces. New Jersey: Prentice Hall.

23. Clark, J. R., et al. 1997. “A Model of Urban Forest Sustainability.” Journal of Arboriculture 23(1): 17 – 30

24. Kenney, W. A., et al. 2011. “Criteria and Indicators for Sustainable Urban Forest Planning and Management.” Arboriculture & Urban Forestry 37(3): 108 – 117

25. Source: U.S. Climate Data, <https://www.usclimatedata.com/climate/miami-beach/florida/united-states/usfl0543>, accessed 08/15/2019

26. Source: Southeast Florida Climate Change Regional Compact, <https://southeastfloridacclimatecompact.org/news/new-projections-show-that-south-florida-is-in-for-even-more-sea-level-rise/>, accessed 04/07/2020

27. Clark, James, N. Matheny, G. Cross, V. Wake, 1997, A Model of Urban Forest Sustainability, Journal of Arboriculture 23(1): January 1997

28. DRG conducted an i-Tree Canopy and i-Tree Hydro analysis to determine the ecosystem benefits and services Miami Beach’s urban tree canopy provides.

29. Miami-Dade Urban Tree Canopy Assessment. 2016. https://www.americanforests.org/wp-content/uploads/2016/06/Miami-Dade_UTC-assessment_Final-LR.pdf

30. United States Environmental Protection Agency. <https://www.epa.gov/heat-islands>. Accessed 08/19/2019

31. Center for Disease Control and Prevention. 2006. Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety.

32. National Aeronautics and Space Administration. 2015. <https://climate.nasa.gov/news/2293/nasa-releases-detailed-global-climate-change-projections/>

33. Miami Beach Rising Above. <http://www.mbrisingabove.com/climate-science/miami-beach-temperatures/>

34. USDA Forest Service Climate Change Tree Atlas. Species Winners and Losers by EcoRegion - Everglades. https://www.nrs.fs.fed.us/atlas/tree/ecoregion_ew.html. Accessed June 14, 2019.

35. Downer, A. J., Uchida, J. Y., Hodel, D. R., & Elliott, M. L. (2009). Lethal palm diseases common in the United States. HortTechnology, 19(4), 710-716.

36. University of Florida IFAS Extension. Lethal Bronzing Disease - <https://edis.ifas.ufl.edu/pp163>

37. Elliott, M.L. 2010. Fusarium wilt of queen and Mexican fan palm. University of Florida Institute of Food and Agricultural Sciences Extension. Fort Lauderdale Research and Education Center, Davie, FL. <https://edis.ifas.ufl.edu/pp278>

38. Atkinson, T.H., J.L. Foltz, R.C. Wilkinson, and R.F. Mizell. 2000. Florida Insect Management Guide for insect borers of trees and shrubs. University of Florida. Entomology Circular 310. http://entnemdept.ufl.edu/creatures/trees/asian_ambrosia_beetle.htm

39. Cole, K.W. (2008). Granulate ambrosia beetle. Indiana Department of Natural Resources. <http://www.in.gov/dnr/entomolo/files/ep-GranulateAmbrosiaBeetleFactsheet.pdf>

40. Collins, J. 1996. European Gypsy Moth. University of Kentucky Entomology Fact Sheet-425. Lexington, KY. <https://entomology.ca.uky.edu/ef425>

41. Richards, S., Stutz, B. & K. Yoskowitz. (2004). Interagency Study of Tree Management Practices (OLO Report 2004-9. Montgomery County, Maryland. Office of Legislative Oversight. Retrieved from <https://montgomerycountymd.gov/OLO/Resources/Files/trees.pdf>

42. Clark, J. R., et al. 1997. “A Model of Urban Forest Sustainability.” Journal of Arboriculture 23(1): 17 – 30

43. Kenney, W. A., et al. 2011. “Criteria and Indicators for Sustainable Urban Forest Planning and Management.” Arboriculture & Urban Forestry 37(3): 108 – 117

ADDITIONAL GENERAL REFERENCES

44. Calvin, Giordano and Associates. 2016. Oakland Park – Streetscape and Landscape Standards.

45. Calvin, Giordano and Associates. 2018. Deerfield Beach-Landscape Manual.

46. Crawford P., 2005. Florida Gardening Series, Vol. 3, Stormscaping: Landscaping to Minimize Wind Damage in Florida.

47. Dehgan B., 1998. Landscape Plants for Subtropical Climates.

48. Gilman E., 1997. Trees for Urban and Suburban Landscapes.

49. Haehle R., 1999. Native Florida Plants.

50. Meerow A., 2002. Betrock’s Guide to Landscape Palms.

51. Meerow A., Broschat T.K., 1991. Betrock’s Reference Guide to Florida Landscape Plants.

52. Miami-Dade County. 2005. The Landscape Manual. Department of Planning and Zoning. <https://www.miamidade.gov/zoning/library/studies/landscape-manual-adopted-2005.pdf>.

53. Rogers K. G., 2014. Landscape Plants for South Florida.

54. Rogers K. G., 2013. Native Plants, Weeds, and Sustainable Landscapes in South Florida.

55. Stresau F, 1986. Florida, My Eden.

56. University of Florida. 2010. The Florida Friendly Landscaping Guide to Plant Selection & Landscape Design. <https://ffl.ifas.ufl.edu/homeowners/publications.htm>.

57. Wijaya M., 1999. Tropical Garden Design.

Design Toolbox

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AMENITY
THROUGHOUT
CLOSED



APPENDIX C

RECOMMENDED STANDARD DETAILS

INDEXED URBAN TREE ZONE BUILD-OUT SCENARIOS:
The various scenarios provided are indexed and named so they are easily identified with the various typological conditions they were created for, based on a 4-part naming convention. The following describes the various abbreviations used:

ADAP

|

DESCR

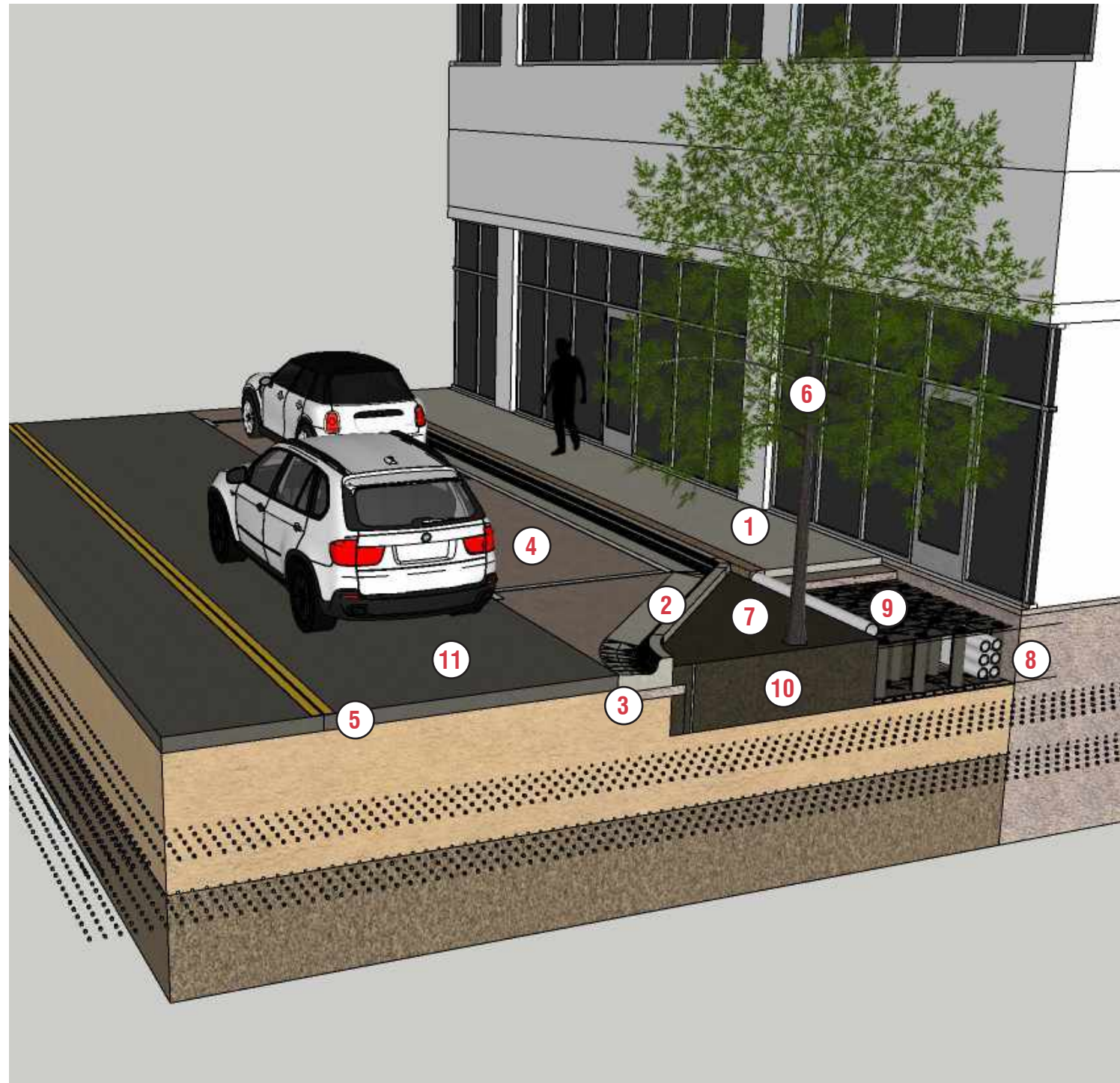
GENRL
General Application

Use application description

ADAP
Adaptability Application

GENRL | BULBOUT

APPLICABLE TO ALL STREET FRONTAGES



UNIQUE OBSERVATIONS

- Extents of the bulbouts should be sized so that they equal the dimensions of a single parking space to provide the amplest uncompacted root growth area.
- Trees should be planted so when they are mature, they are will have a minimum clearance of 2-feet measured from the face of curb to evade potential conflicts with the front overhang of vehicles.

SPECIAL CONSIDERATIONS

- The use of a root barrier between the bulbout and the asphalt area is recommended, especially if the bulbout dimensions are minimal or if the specie of the tree is one that has aggressive root growth.

RECOMMENDED SPECIES

Trees:

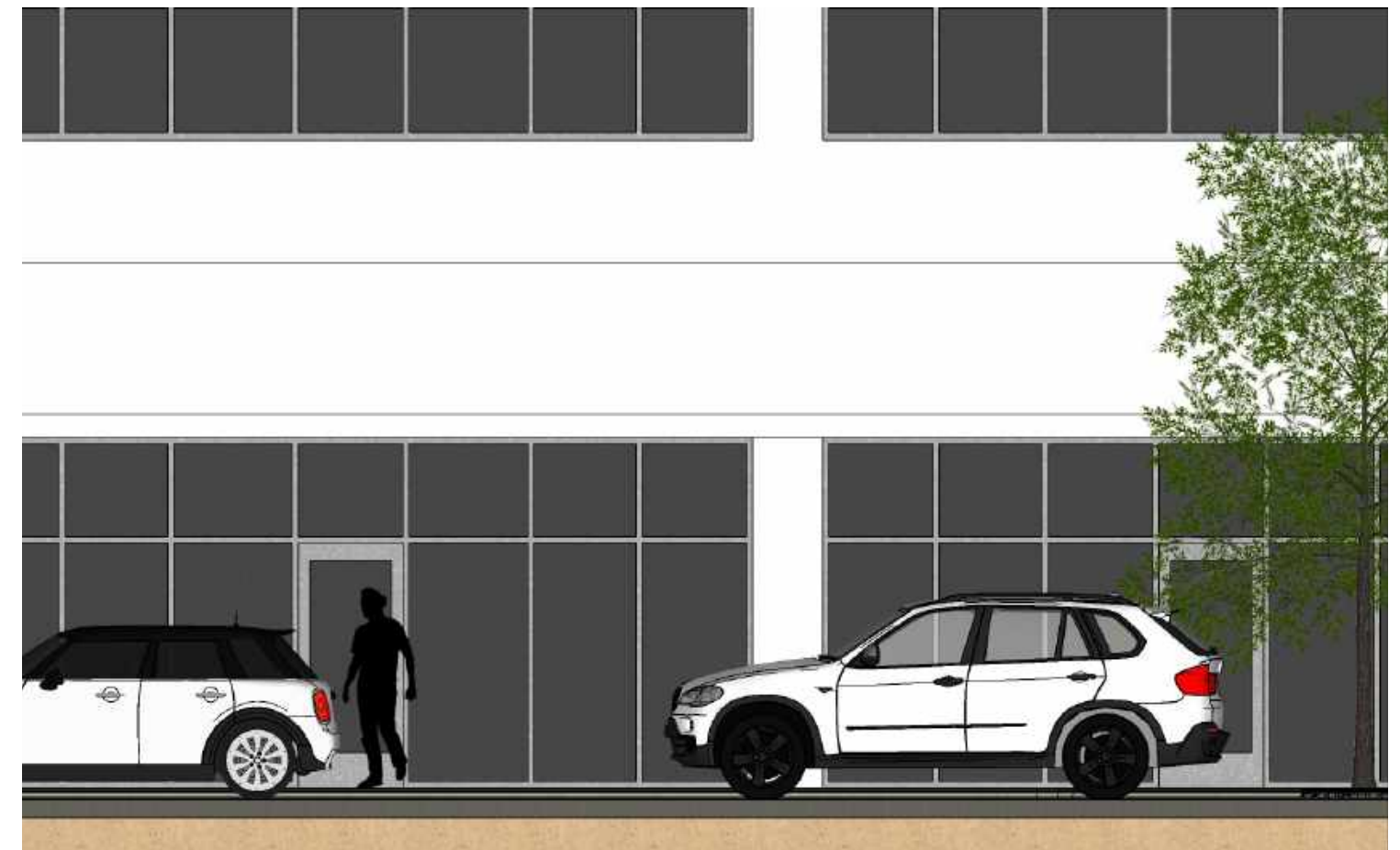
- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig

Palms:

- All allowable species, without exception

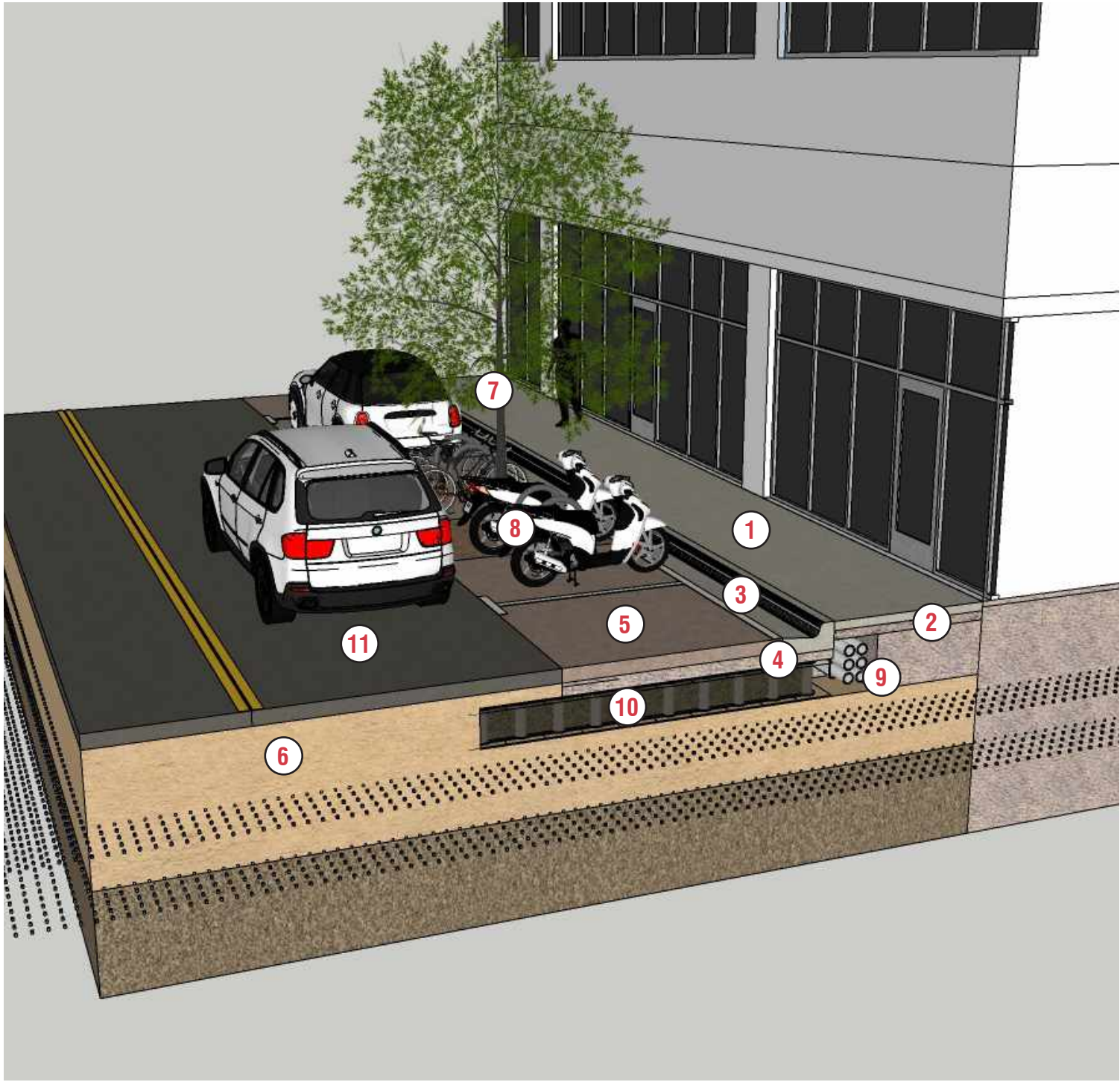
LEGEND

1. Concrete or Paved Sidewalk
2. Concrete Curb
3. Curb Pad
4. Pervious Asphalt Parking
5. Roadway Sub-base
6. Tree
7. Bulbout
8. Underground Utilities (Wrapped in Root Barrier)
9. Soil Suspension System
10. Amended Soil Planting Mix
11. Asphalt Paved Area



GENRL | SCOOTER

APPLICABLE TO ALL STREET FRONTAGES



UNIQUE OBSERVATIONS

- Extents of the selected pavement suspension system or soil cell system should be sized so that they equal the dimensions of two parking spaces to provide the amplest uncompacted root growth area parallel to the curb. The root growth area should also extend a minimum of 2 feet into the travel lane.
- Trees should be planted so when they are mature, they are will have a minimum clearance of 5-feet measured from the edge of the travel lane to evade potential conflicts with passing vehicles.

SPECIAL CONSIDERATIONS

- With an ample root growth area underlaying the asphalt areas, it is not essential to provide a soil suspension or pavement suspension system beneath the abutting sidewalk; however, the specie of the tree is one that is intended to grow to provide substantial clearances, they may be a good option to provide as much structural balance to the tree as possible.

RECOMMENDED SPECIES

Trees: Medium sized species, such as:

- Bridal Veil
- Grape Myrtle
- Japanese Fern Tree

Palms:

- All allowable species, without exception

LEGEND

1. Concrete or Paved Sidewalk
2. Sidewalk Sub-base
3. Concrete Curb
4. Curb Pad
5. Pervious Asphalt Parking
6. Roadway Sub-base
7. Tree
8. Bicycle / Moped Parking w/ Addapave Planter
9. Underground Utilities (Wrapped in Root Barrier)
10. Soil Suspension System
11. Asphalt Paved Area



GENRL | PLNT DETLS

GENERAL PLANTING DETAILS RECOMMENDED TO BE INCORPORATED INTO THE CITY’S STANDARD DETAILS IN THE PUBLIC WORKS MANUAL

SUSPENDED PAVEMENT

1. Concrete Sidewalk, Turn Down to Silva Cell Deck at Edge of Walk.

2. Load Bearing Modular Suspended Pavement System (Silva Cells with Deck, Base and Posts)

3. Curb, Per Civil Plans

4. Curb Sub-Base, Per Civil Plans

5. Roadway Compacted Subgrade, Per Civil Plans

6. 4" Min. Aggregate Base Course, See Specs.

7. Geotextile to Edge of Excavation, See Specs.

8. Backfill, To Within 4-6" Below Top of
9. Geogrid to Line Perimeter of System With 6" Toe (Outward from Base) And 12" Excess (Over Top of Silva Cell Deck)

10. 3/16" X 14" Zip Ties, Securing Geogrid to Silva Cells

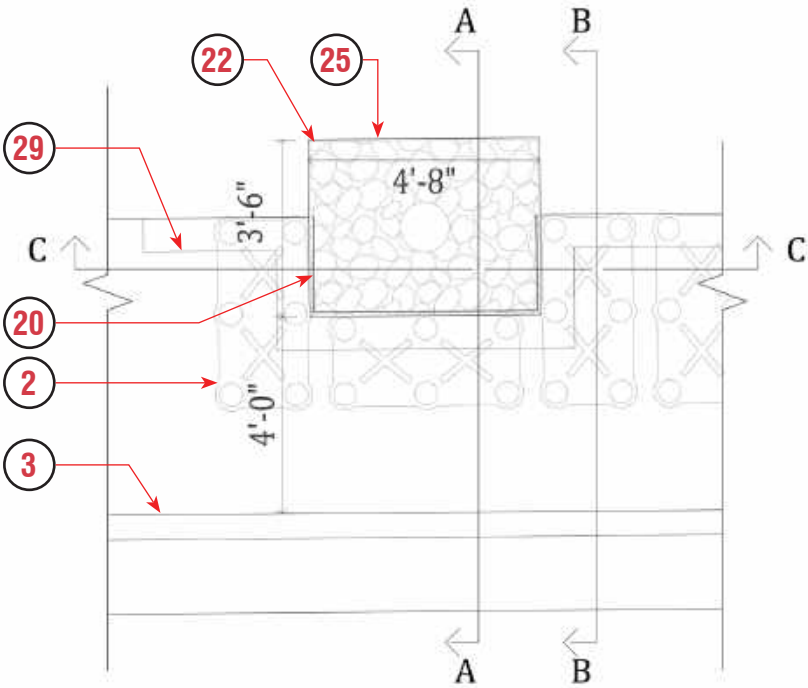
11. Geotextile Fabric, Placed Below Aggregate Sub Base, See Specs.

12. 4" Min. Aggregate Sub Base, Compacted to 95% Proctor

13. Subgrade Below Silva Cells, Compacted to 95% Proctor

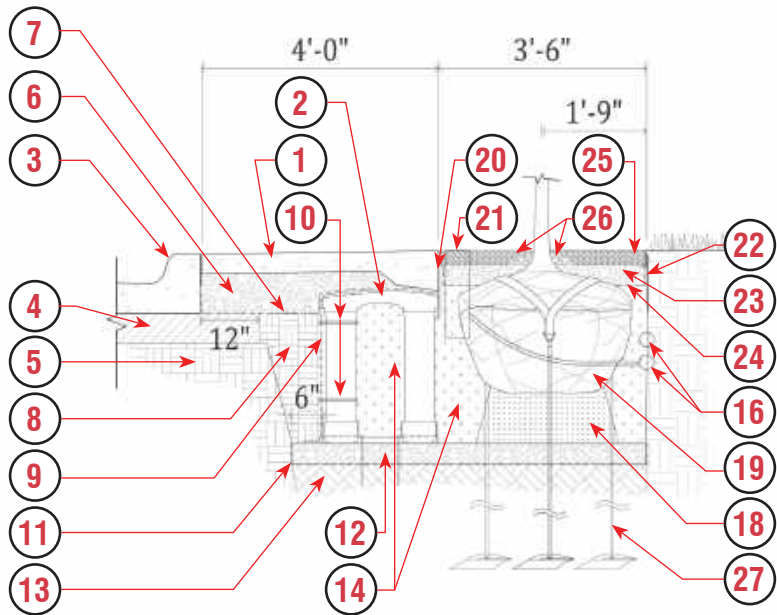
14. Planting Soil Install In 12" Lifts, Each Compacted to 70-80% Proctor.
15. Tree/Palm Beyond
16. Irrigation Laterals, See Irrigation Plans & Details
17. Irrigation Spray, See Irrigation Plans
18. Planting Soil Below Tree Root Package, Compacted To 85-90% Proctor
19. Tree Root Package, Size Varies
20. Root Guide 12" Depth, Install Adjacent Concrete Edge. Top of Root Guide 2" Below Top of Concrete.
21. Root Watering System, See Irrigation Plans
22. 6" Aluminum Edge With 12" Stakes, See Landscape Edge Detail
23. #57 Washed Aggregate Base 3" Depth, Compact to Achieve A Level and Uniform Finish.
24. Geotextile Fabric Separating Aggregate from Planting Soil
25. Addapave Tree Pit Mix (6-

- 10mm Diameter) Bonded Porous Paving 3" Depth Compacted to Achieve A Level and Uniform Finish.
26. Addapave Tree Pit Mix (6-10mm Diameter) Loose Aggregate Wedge Funnel Upward to Within 3/8" To 5/8" Below Final Finished Grade.
27. Tree/Palm Rootball Staking, See Planting Details
28. Compacted Subgrade Below Sidewalks, See Civil Plan & Details
29. Concrete Sidewalk Thickened Edge (Turned Down to Soil Deck) Only Where Soil Cells Are Present
30. Silva Cells Shall Be Placed 1" To 6" Apart, Measured from the Base of the
31. Frames
32. Silva Cell Anchor Spikes Shall Be Used to Maintain Spacing at the Base, Typical

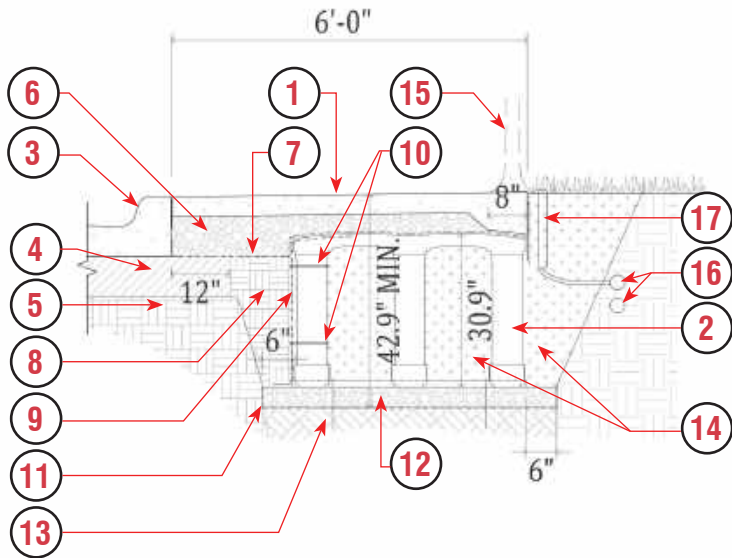


PLAN VIEW (TYPICAL)

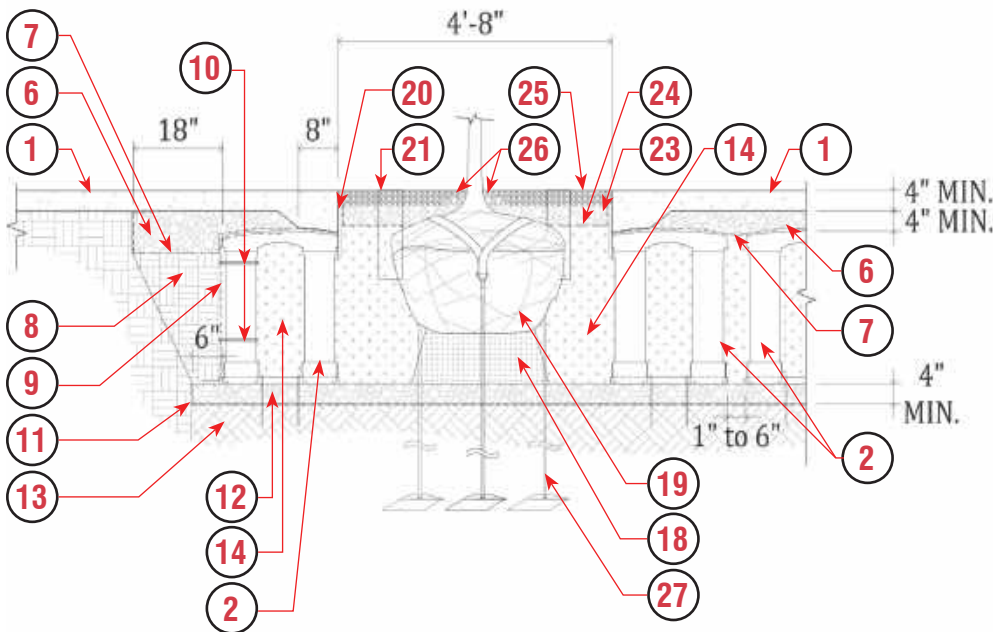
NOTE: Contractor shall install soil cells as per manufacturer’s written specifications and installation instructions, in conjunction with these details and plans.



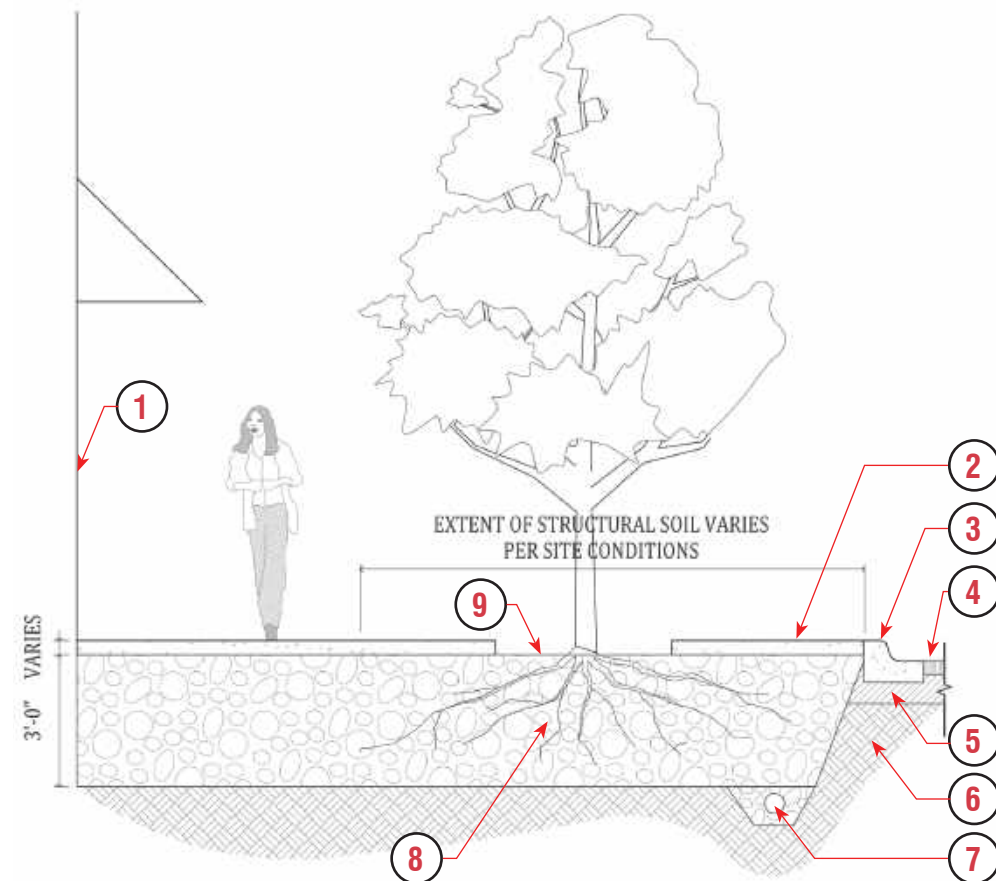
SECTION A-A



SECTION B-B

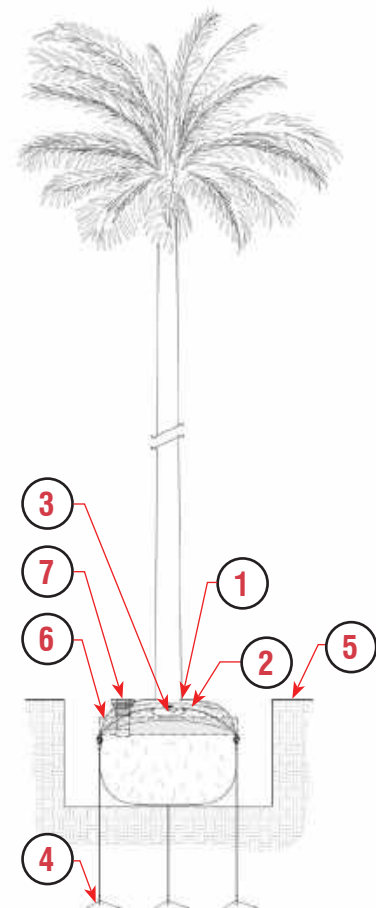


SECTION C-C



STRUCTURAL SOILS TYPICAL STREET PLANTING VIEW

1. Building Face
2. Poured-in-Place Concrete
3. Curb
4. Asphalt Pavement
5. Sub-base
6. Prepared Subgrade
7. Drainage Pipe Tied to Storm Sewer
8. Structural Soil
9. 3" Thick Bark Mulch Layer



PALM TREE FIXING SYSTEM

1. Palm Tree Fixing System:
 - 3 x Alluminum Alloy Anchors
 - 1 x Two way ratchet tensioner galvanized wire
 - 3 x Rootbal protection mesh
2. Rootball Protection Mesh
3. Two Way Ratchet Tensioner Galvanized Wire
4. Aluminum Allot Anchor, Typical
5. Tree Planted at Nursery Line
6. Tree Irrigation System:
 - 5M (16 ft.) of membrane 1 x 30cm (12") header, base and debris cap
7. Aluminum cap 100mm (4")

NOTES:

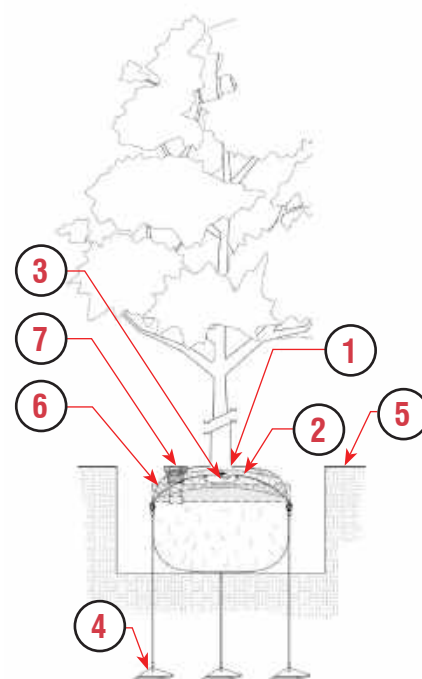
1. Do not scale from this detail. This detail is not drawn to scale.
2. Due to settlement, contractor shall re-tension all trees & palms after planting and as needed.

TREE ROOTBALL FIXING SYSTEM

1. Palm Tree Fixing System:
 - 3 x Alluminum Alloy Anchors
 - 1 x Two way ratchet tensioner galvanized wire
 - 3 x Rootbal protection mesh
2. Rootball Protection Mesh
3. Two Way Ratchet Tensioner Galvanized Wire
4. Aluminum Allot Anchor, Typical
5. Tree Planted at Nursery Line
6. Tree Irrigation System:
 - 5M (16 ft.) of membrane 1 x 30cm (12") header, base and debris cap
7. Aluminum cap 100mm (4")

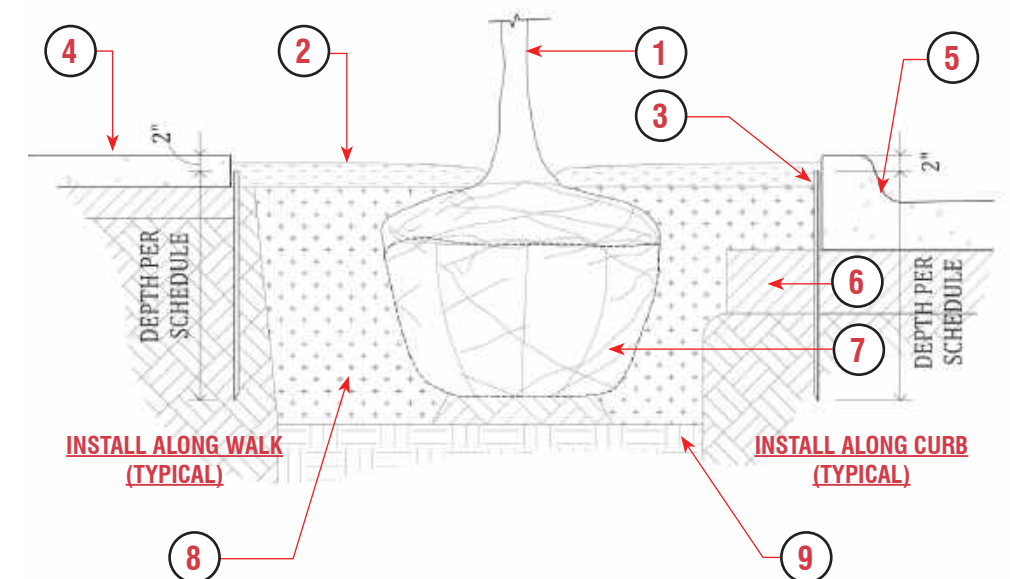
NOTES:

1. Do not scale from this detail. This detail is not drawn to scale.
2. Due to settlement, contractor shall re-tension all trees & palms after planting and as needed.



ROOT BARRIER (LINEAR APPLICATION)

1. Proposed Palm or Tree, Install per Planting Details
2. Mulch Layer, per Planting Details
3. Biobarrier Root Control Fabric: Vertically Placed to Stop Lateral Root Growth. Install Fabric 2 Inches Below Top of Concrete with Adhesive (as Approved by Biobarrier Manufacturer)
4. Existing or Proposed Concrete Surface
5. Existing Curb or Paved Surface
6. Sub-Base for Concrete Surface Typical
7. Proposed Rootball
8. Backfill with Planting Soil Mix, per Specifications
9. Existing Soil Typical

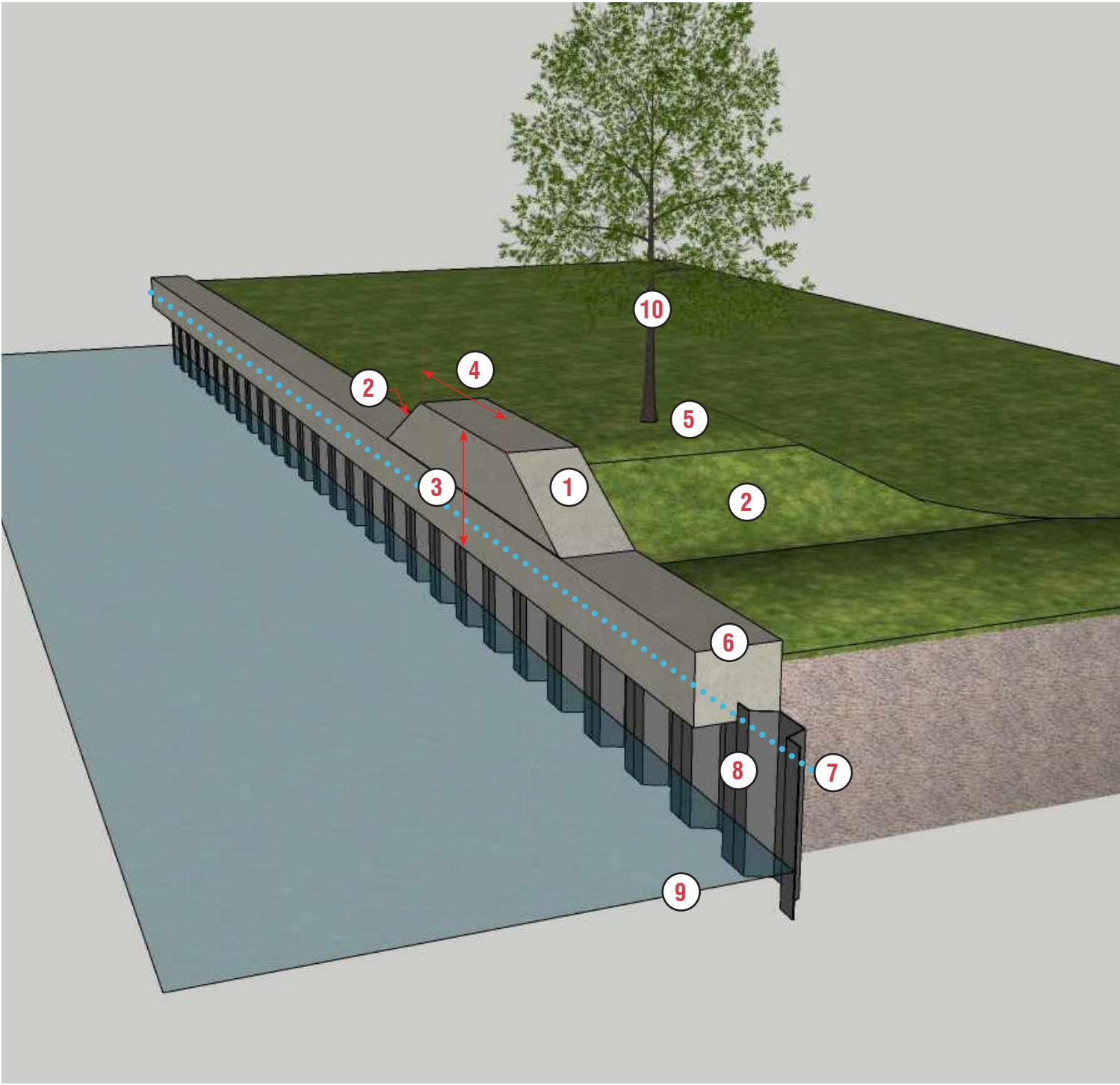


NOTES:

1. Contact Sunshine 811 prior to excavating to locate existing underground utilities.
2. Root barrier fabric roll width shall be as indicated in the reference schedule.
3. Install & cover biobarrier as soon as possible (within 12 hours) after opening. High temperatures and direct sunlight will reduce effective product life.
4. Install biobarrier fabric as shown with modules facing toward root ball.
5. When joining separate pieces of fabric a minimum of 3" overlap is required at all seams. Use a continuous adhesive bead at each seam, per manufacturer's recommendation.
6. Refer to manufacturer's specifications and recommended installation instructions for additional information.

ADAP | SEAWALL

APPLICABLE TO ALL SEAWALL FRONTAGES



UNIQUE OBSERVATIONS

- Trees abutting or near seawalls should be planted at an elevation that is a minimum of 4 feet above the highest sea-level rise datum lines being targeted. This will allow any future responses of climate adaptation to take place without negatively impacting the tree or without needing to eliminate or relocate the tree.

SPECIAL CONSIDERATIONS

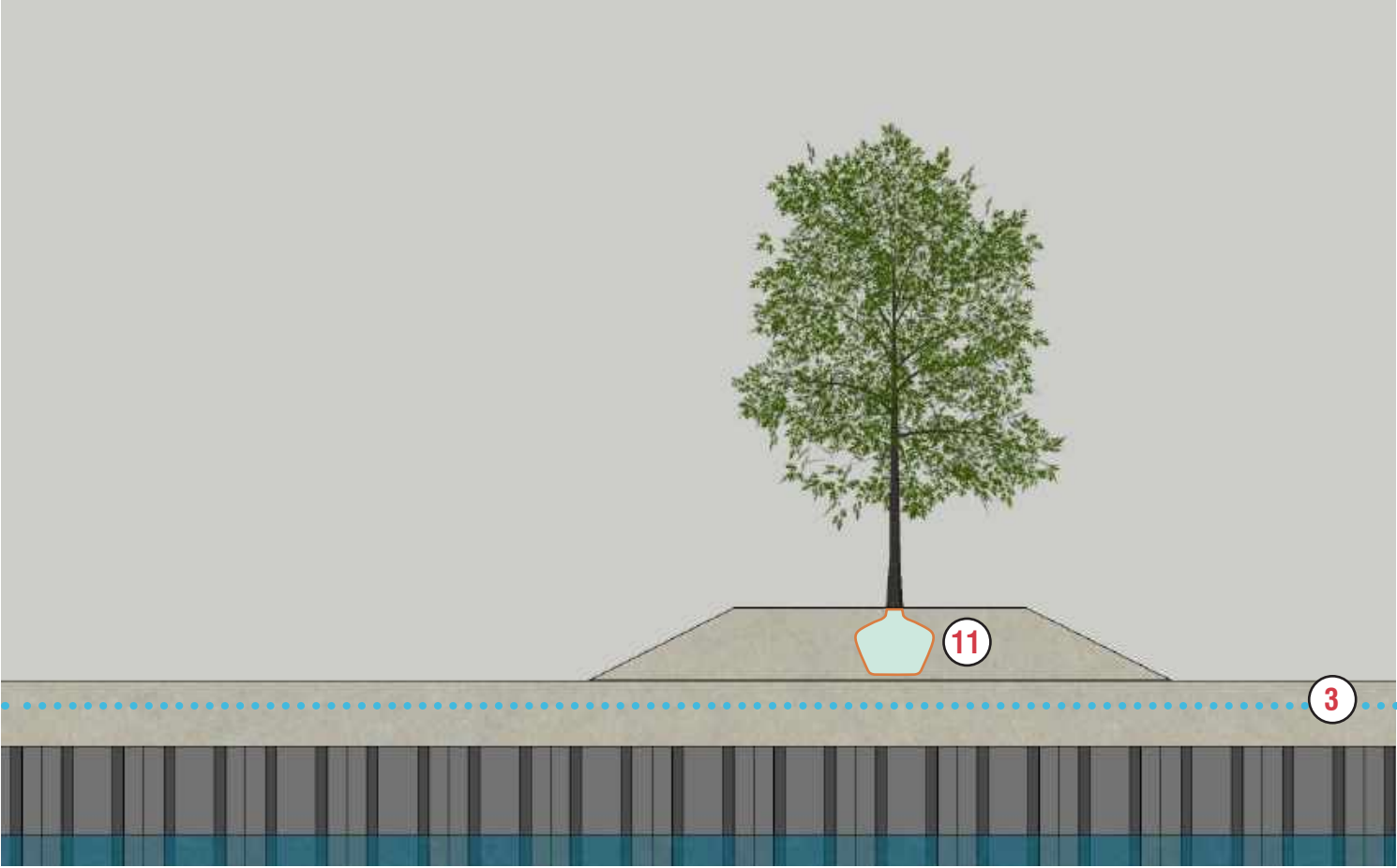
- The concrete cap extension on the seawall bulkhead does not have to be tapered.
- A root barrier should be placed along the inside face of the seawall bulkhead to prevent the roots of the tree from dislodging the anchoring of the cap on the bulkhead.

RECOMMENDED SPECIES

- Trees:
- All allowable species, without exception
- Palms:
- All allowable species, without exception

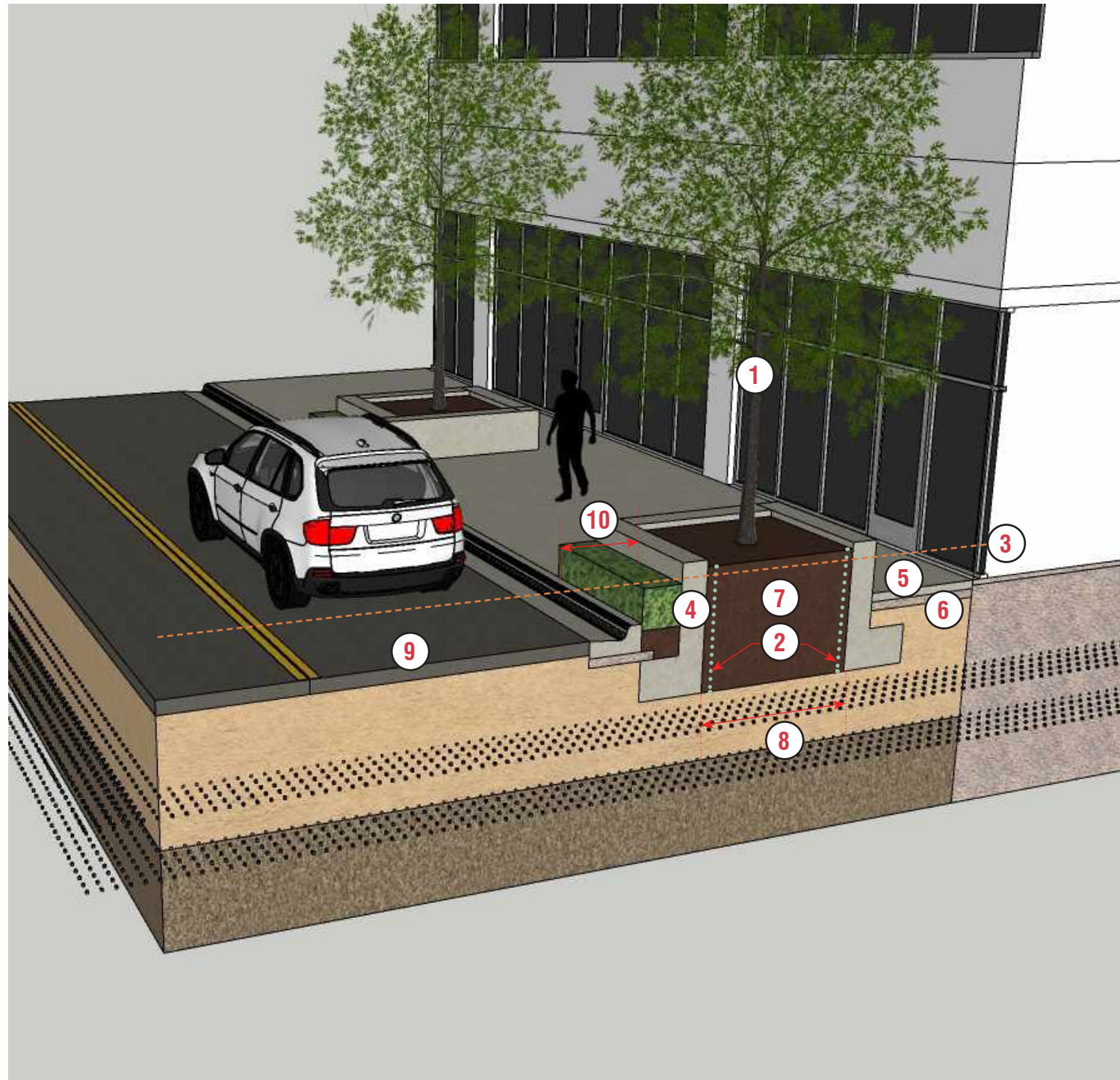
LEGEND

1. Concrete Cap Extension
2. 2:1 Maximum Slope
3. 4 Foot Minimum Height
4. 12 Foot Minimum Width
5. Top of Berm 3 Inches Below Top of Cap
6. Concrete Bulkhead
7. Maximum Targeted Sea Level Rise Projection Datum
8. Metal Sheet Piles
9. Current Water Level
10. Tree
11. Rootball



ADAP | PLANTERS

APPLICABLE TO ALL FRONTAGES WHERE THE REMAINING WALKABLE AREA MEETS THE MINIMUM REQUIRED A.D.A. CLEARANCE REQUIREMENTS.



UNIQUE OBSERVATIONS

- Street trees being planted on streets that are planned to be raised should be planted within a raised container/planter box a minimum 6' x 6'. When the street gets raised, any needed portions of the surrounding retaining walls creating the container/planter can be eliminated and backfilled with amended planting soil. The provision of the geotextile fabric lining the inside of the planter will help facilitate this future improvement.

SPECIAL CONSIDERATIONS

- When aligned with the entrance to a building, planters should be a minimum of 5 feet away from any building façade. This is because entrances (due to hurricane codes) tend to swing open outwards and may impact ADA access along the sidewalk.

RECOMMENDED SPECIES

Trees:

- All allowable species, except species with overly aggressive root structures, such as Strangler Fig and Short-leaf Fig

Palms:

- All allowable species, without exception

LEGEND

1. Tree
2. Geotextile Fabric
3. Datum of Future Road Elevation
4. Retaining Wall
5. Current Sidewalk Height
6. Compacted Sub-base
7. Planting Soil Mix
8. Width Varies Sized to Maximize Area for Root Growth (Optimum is 6' Minimum)
9. Existing Road Elevation
10. Planting Area; Minimum 2' Clearance from Face of Curb





APPENDIX D

MINUTES OF PUBLIC MEETINGS

MEETING MINUTES - PUBLIC ENGAGEMENT SUMMARY:

During the discovery phase of the Urban Forestry Master plan development process the City of Miami Beach and the project consultant team of Davey Resource Group and Calvin Giordano and Associates hosted two public meetings in June 2019. The purpose of the meetings was to share with the community details about Miami Beach's urban forest and get their input and feedback on the issues, challenges, and opportunities they see facing it. The following is a summary of the input heard during the meetings.

Species:

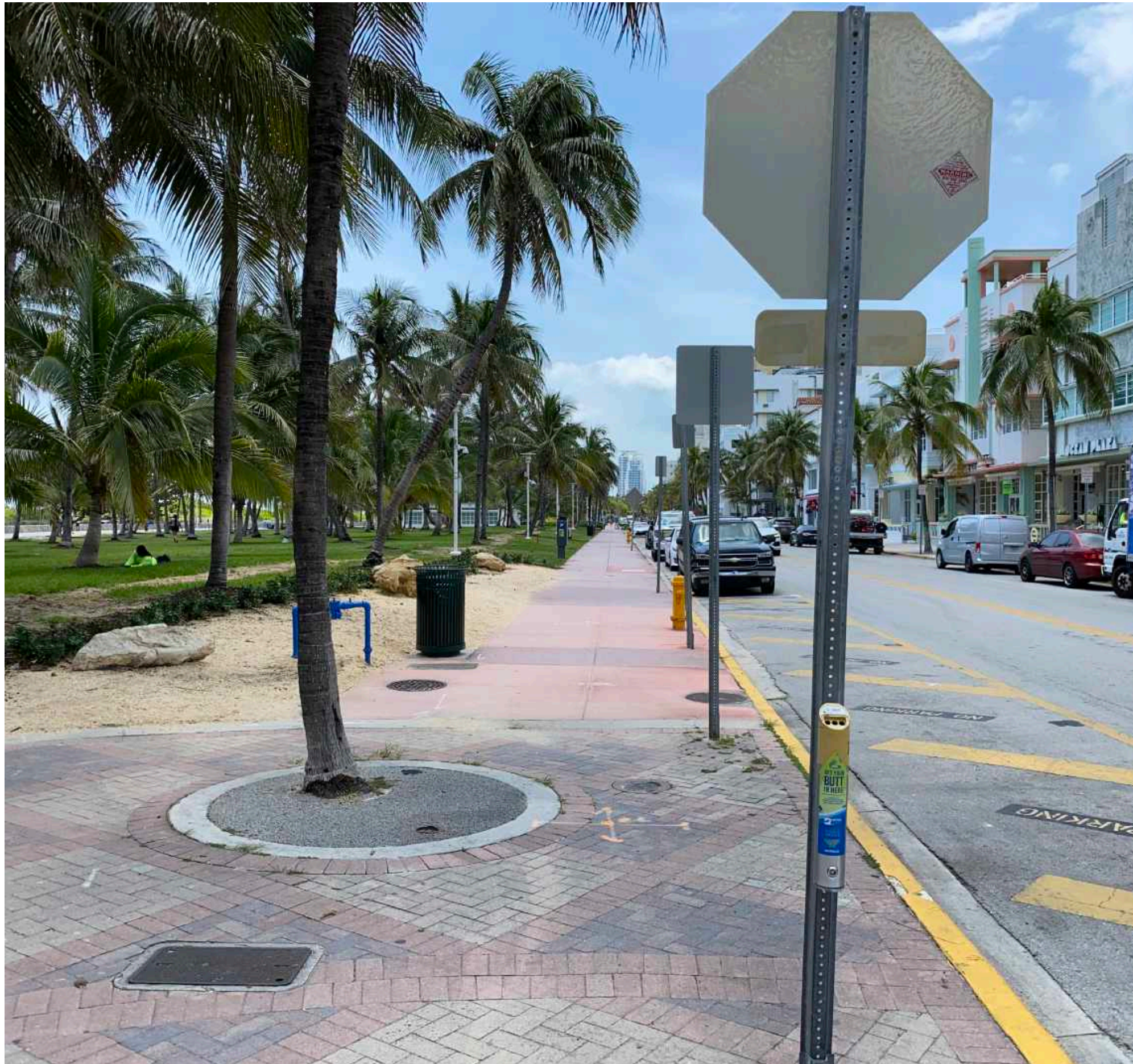
- Focus needs to be shifted on planting more shade trees and less palms.
- Look at the botanical garden for tree species possibilities.
- Why are we planting so many live oaks? Why doesn't the City consider more Ficus trees?
- Increasing species diversity should be a big goal.
- Plant tree species that will absorb water.
- Wildlife should be considered in species selection.

ROW/Swale Trees:

- Maintenance of ROW trees are the responsibility of the private property owners and they are not properly caring for these trees.
 - Policy shows that the City does not value the investment they have made in planting trees.
- Need to start addressing trees in poor condition right now!
- Need budgets that support proper infrastructure to allow trees to grow to maturity
- There are new technologies out there that allow for green infrastructure and root space area under the hardscapes

City Departments & Outside Agencies:

- Identify opportunities to partner with FPL to bury utilities underground so we can plant more shade trees
- Need to prioritize shade trees and ensure that they are not unnecessarily removed to meet other City priorities (i.e. sea level rise mitigation strategies)



- Need to try to keep mature trees instead of losing them to capital improvement projects and having small trees replanted that will take years to grow
- City is good with plan reviews and asking for these things, but when it comes to a City project, they don’t always follow their own requirements (due to budget constraints).
- Need to partner and engage better with F.D.O.T.
- How do we get them to allow trees and vegetation along F.D.O.T. roads?

Private Property:

- The key to increasing canopy cover is planting on private property
- Need to encourage shade tree planting on private property
- Consider tax breaks for residents who are planting shade trees
- Need to have a “blueprint” for residents-what to plant, where to plant, and how to maintain trees.
- Engage with every hotel and business and tell them how to care and plant trees on their property

Development:

- Look at making buildings/new construction greener (e.g. rooftop terraces/gardens; green walls)

General:

- Need to change attitude of community around tree care and protection
- Need to engage the business community in urban forestry
- Reduce/soften the “concrete” look – only if it is adding a planter here and there.
- Get everyone involved and all working together to improve trees and tree canopy in Miami Beach - residents, business, hotels, developers, etc.
- Better utilize resources – use wood from removed trees for furniture, and other home goods.

MEETING MINUTES - PUBLIC MEETING 1

SUBJECT: SOUTH COMMUNITY PUBLIC MEETING

MEETING LOCATION: MIAMI BEACH GOLF CLUB

DATE: 06/18/2019

ATTENDEES:

- **CITY STAFF: OMAR LEON**
- **CGA STAFF: MICHAEL CONNER, GIANNO FEOLI**
- **DAVEY RESOURCE GROUP: KERRY GRAY**

Discussion and Questions:

- How did the consultants get selected and why now? How long is the project going to take?
- Are we going to deal with F.D.O.T.?
- Why are we planting so many Live Oaks?
- Why doesn’t the City consider more Ficus trees?
- We have so much concrete that we don’t allow water to drain thru the soil or Bio-swaes. The City just wants to pump the water out as fast as possible.
 - Omar: Green infrastructure will be coordinated with gray infrastructure
- Re:diseases/pests-By planting trees that are more resilient will help prevent that and having to use more pesticides/chemicals.
 - Omar: That is why we implemented the tree preservation ordinance
- F.D.O.T wants to move traffic as fast as possible
- How do we get them to allow trees and vegetation? The state has used these streets for years with poor planning.
- Doesn’t like the “spongey” poured in place stuff around trees (Flexi pave)
- Increase diversity-big goal
- Will there be any more community meetings in September (for draft of plans)?
 - Omar: we will have one on one meetings with certain neighborhoods/groups. Plus, meeting with Sustainability and Resiliency Committee.
- Also, we are looking specifically at Pine Tree Drive (In conjunction with County’s project to mill and resurface the roads, we will prune Australian Pines, and deal with any structural defects. We are preserving them, not removing them.
- F.D.O.T. is doing a double left turn lane at Alton Road & Michigan; is anyone looking at roots of mahogany trees there?
- I am a Blue water advocate. We need trees that absorb water. Looking at species for this & wildlife. Will plan include recommendations for this to homeowners?
- On Alton Rd. there is a yard that has a big Mahogany with lots of moss, ferns, orchids, etc. Is

that being inventoried along with the trees?

- Can we have trees to be designated historic?
 - Omar: yes, we have trees designated as Heritage Trees.
- More teeth in ordinances: Look at existing ordinances and possibly strengthen them?
- More utilization of resources: Re-use wood being removed, and more recycling of Materials.
 - Omar: Sometimes we use straps for securing root ball instead of 2x4 wood braces for staking trees in tight areas.

MEETING MINUTES - PUBLIC MEETING 2

SUBJECT: NORTH BEACH COMMUNITY PUBLIC MEETING

MEETING LOCATION: NORTH SHORE COMMUNITY CENTER

DATE: 06/19/2019

ATTENDEES:

- **CITY STAFF: OMAR LEON**
- **CGA STAFF: MICHAEL CONNER, GIANNO FEOLI**
- **DAVEY RESOURCE GROUP: KERRY GRAY**

Discussion and Questions:

- To get to 22% canopy-how much of planting sites is private vs public?
- Was the tree canopy assessment broken down that way? Omar: No
- The pattern, I have seen is that R.O.W.s in the City tend to get palms.
- If we get FPL to underground the lines, then we can plant more shade trees.
- Why is that (22%) a goal? (Kerry) It is not the goal just the U.T.C. analysis and results.
- Will we be requiring or encouraging planting on private property?
- Are we looking at making the buildings/new construction greener, too?(i.e. roof-tops, terrace gardens, green walls?).
- The city is trying to get more pervious area by code/ordinance (50%). That was adopted recently
- We are giving away trees to residents, too.
- Omar: Landscape code requires certain number of trees and tree preservation.
- We live in Lake View- getting ready to have lots of trees removed. (under the disguise of sea level rise). I grew up here, City doesn’t care- developers do what they want- why not add color/poincianas. It could be a “garden of Eden” again.
- Kerry: This plan will be a start.
- Need to change attitude of entire community-ruining paradise.
- Please do not plant any more palms in the right of

way/parks, the Coconut palms are not native, and palms do not provide the benefit that shade trees do.

- The City created a commemorative tree program – about 3 years ago.
- How about adding Spanish moss (or air plants) to all those oaks?
- Fairchild Gardens – offered the City free orchids (and not one has planted).
- Where is the business community in all of this?
- Need to talk about climate change, not just sea level rise? Because if we do, then we have to talk about trees, don’t we?
- Did not like this, but the City (a few years ago) passed a policy that maintenance of R.O.W. trees goes to the private property owners, and they don’t do it right a lot of the times.
- Why does the City staff stand back and let this happen? Omar- this plan may include recommendations on maintaining the trees better.
- Need to start addressing trees in poor condition right now!
- Need to try and keep our mature trees instead of losing them in these capital improvement projects (we’ll just remove the large trees and plan to plant new trees to fit better in this place, which will take years to grow).
- Need to get the City to understand that they need to budget more money for the proper infrastructure to allow for these trees to grow to their maturity.
- I am an advocate for benches – there are none on 41st., etc. Make this City more humane. Why not add benches in areas where we plant trees?
- Re: property owners maintaining R.O.W. trees, This City policy shows that it does not value the investment that is being made in planting them.
- Are we reaching out to the County to see they have some incentives?
- Example: possible tax breaks for residents who are planting trees?
- Pine Tree Drive project: Omar: trying to preserve the Australian Pines as much as possible, they are on a 3 year cycle, arborist assessing them -have to prune them a lot to reduce mass & stress on trunks.
- Need to reduce/soften the “concrete” look – only if it is adding a planter here and there.
- Have to change attitude on a whole another level!
- Get everyone involved- residents, business, hotels, developers, etc. All working together.
- Need to have a “blueprint” for residents-what to plant, where to plant, and how to maintain trees.

- Look at the botanical garden for possibilities.
- Note/state th at we need to bring the stress level down for everyone.
- Look at seasonality of flowering trees
- Gianno: we will have a blooming matrix
- Have you looked at Jacobs Eng. Plans, or met with them yet? Omar: we are going to.
- Omar was asked If he is involved with all the neighborhood projects/G.O. Bond projects? Omar: yes, we are usually involved.
- The key is planting trees on private properties
- There are new technologies out there that allow for green infrastructure and root space area under the hardscapes
- City is good with plan reviews and asking for these things, but when it comes to a City project, they sometimes bend the rules (due to budget constraints).
- Need to go to every hotel and business and tell them how to do it.





APPENDIX E

GIS ANALYSIS

MIAMI BEACH GIS DATA ANALYSIS:

Urban Heat Island Effect:
DRG used Landsat 8 imagery that was captured during summer conditions to conduct a land surface temperature analysis. The analysis models surface temperatures and estimate urban heat Island effects. The surface temperature is analyzed from the Landsat data to determine how/if tree canopy is reducing heat islands by measuring land surface temperature emissivity using NDVI values. The temperature analysis was used to determine the highest surface temperature that was observed during the year.

Historical Canopy Assessment:
To assess changes in the city-wide tree canopy cover, DRG compared the percent tree canopy found based on 2017 one-meter NAIP imagery analysis to older aerial imagery that was provided by the City. DRG used point sampling method within ArcGIS to compare/capture City-wide tree canopy cover percent for up to three different periods, 1941 and 1969 historical periods.

ROW Canopy Assessment:
DRG used the tree canopy layer and street centerline data to assess the percent of tree canopy cover within the Right of ways in the City. DRG during the GIS analysis created a buffer distance around the street centerlines to capture the sidewalks. Tree canopy percent was then estimated for the areas within the newly created buffer area around the right of ways.

