Urban Tree Canopy Assessment & Planting Plan

Asbury Park, New Jersey

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FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

AMERICAN FORESTS

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Acknowledgments

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Introduction

American Forests launched Community ReLeaf in spring 2013 as a replicable three-stage program that combines assessments, strategic restoration and capacity-building for outreach and education in targeted cities across the country. Reaching geographically and culturally diverse communities, American Forests aims to bring national attention to the value of our urban forests and plans to be working in 20 major cities by 2020.

In its inaugural year, Community ReLeaf worked in Asbury Park, N.J.; Atlanta, Ga.; Detroit, Mich.; Nashville, Tenn.; and Pasadena, Calif. This assessment is one of the five completed reports.

Using the best available scientific measures and methods, the results of the assessments provide insight for urban forestry practitioners, city officials and the general public into the overall condition of each city's urban forest and the environmental and socioeconomic benefits it provides at both the local and national levels — thereby informing strategic preservation and restoration activities.

About American Forests

American Forests restores and protects urban and rural forests. Founded in 1875, it is the oldest national nonprofit conservation organization and has served as a catalyst for many milestones in the conservation movement including the founding of the U.S. Forest Service and the national forest and national park systems. American Forests has conducted thousands of forest ecosystem restoration projects and public education efforts; since 1990 it has planted more than 45 million trees in all 50 states and in 44 countries, resulting in cleaner air and drinking water, restored habitat for wildlife and fish, and the removal of millions of tons of carbon dioxide from the atmosphere. Learn more at www.americanforests.org.

About Bank of America's Corporate Social Responsibility

The Bank of America Charitable Foundation's commitment to corporate social responsibility (CSR) is a strategic part of doing business globally. The bank's CSR efforts guide how it operates in a socially, economically, financially and environmentally responsible way around the world, to deliver for shareholders, customers, clients and employees. Its goal is to help create economically vibrant regions and communities through lending, investing and giving. By partnering with stakeholders, the Bank of America Charitable Foundation creates value that empowers individuals and communities to thrive and contributes to the long-term success of its business. The Bank of America Charitable Foundation has several core areas of focus for its CSR, including responsible business practices; environmental sustainability; strengthening local communities with a focus on housing, hunger and jobs; investing in global leadership development; and engaging through arts and culture. As part of these efforts, employee volunteers across the company contribute their time, passion and expertise to address issues in communities where they live and work. Learn more at www.bankofamerica.com/about and follow Bank of America Charitable Foundation on Twitter at @BofA_Community.

About the U.S. Forest Service

The mission of the Forest Service is to sustain the health, diversity and productivity of the nation's forests and grasslands to meet the needs of present and future generations. The agency manages 193 million acres of public land, provides assistance to state and private landowners and maintains the largest forestry research organization in the world. Public lands managed by the Forest Service contribute more than $13 billion to the economy each year through visitor spending alone. Those same lands provide 20 percent of the nation's clean water supply — a value estimated at $7.2 billion per year. The agency also has either a direct or indirect role in stewardship of about 80 percent of the 850 million forested acres within the U.S., of which 100 million acres are urban forests located in or near areas where most Americans live.

Executive Summary

This report was developed by American Forests with a focus on assessing environmental benefits from the urban tree canopy (UTC) of Asbury Park, N.J. The primary project goals of this assessment and report are to establish baseline data on the extent and function of the urban forest and develop tools and resources for reforestation efforts.

American Forests completed a UTC assessment using 2010 aerial imagery, performed a field verification and update to represent tree canopy extent in 2013 and conducted an historical UTC assessment using i-Tree Canopy. Tree functions and benefits were quantified using i-Tree Vue and TR-55 stormwater modeling equations. A prioritized planting plan was developed based on the UTC assessment and other available community geographic information systems (GIS) data. These assessments were completed to gain an understanding of how UTC has changed in Asbury Park and determining a reforestation plan for future tree planting.

The UTC assessment found 23% of the land within the 976 acres citywide is covered with tree canopy and 49% is covered by impervious surfaces. There was minimal change (-0.07%) in UTC from 2010 to 2013; however, between 2002 and 2013 UTC grew by 4%. Based on the UTC assessment, Asbury Park's potential UTC is 35% — equivalent to an additional 120 acres of canopy cover. American Forests assessed and prioritized more than 10,000 "preferred planting sites" based on maximizing ecological services, providing equal access to trees and natural resources, and protecting public health and safety benefits. The UTC assessment and prioritized planting plan suggest tree plantings in the Residential and Redevelopment zoning classes will result in the greatest benefit.

The annual benefit Asbury Park received in 2013 is estimated to be more than $585,790. Tree canopy in Asbury Park removed an estimated 17,389 pounds of pollutants and 7,944 tons of carbon from the air while slowing more than 8 million gallons of stormwater from entering storm drains during peak storm events. It is estimated that by increasing Asbury Park's UTC by 12%, the community will gain $180,956 annually of improved air and managed stormwater benefits. This figure will increase as existing trees mature and new trees are planted.

It is not enough to simply plant more trees to increase canopy cover and benefits. Planning and funding for tree management must complement planting efforts to ensure the success of new plantings and that desired benefits are being achieved through strategic urban forest management. To make a difference, the City of Asbury Park, its residents and partners can support the urban forestry program by promoting the benefits that trees offer to the community, fulfilling routine maintenance for both public and private trees and maximizing the space available for new trees.

Land Cover

To determine changes in land cover, land cover values were compared with results from i-Tree Canopy, which allows users to interpret Google® Earth imagery, produce estimates of tree or other cover types and estimate uncertainty. The i-Tree Canopy data is provided with this report to the Department of Public Works, which can manage this information for the Environmental Shade Tree Committee.

Land cover change between 2002 and 2013 is shown in Table 1. The city's canopy is nearly 4% greater today than in 2002 and 1% greater than in 2006 — an increase attributed to the growth of existing trees and the planting of more than 2,000 new ones. The study also generated a Google® Earth KML file from i-Tree for a change assessment from December 2002 and August 2006.

Table 1. Land Cover Change 2002 - 2013

Land Cover Classification	i-Tree Canopy Assessment (%)		
	2002	2006	2013
Tree Canopy	19.1	21.7	22.67
Impervious Surfaces	50.6	46.6	48.52
Grass & Low Vegetation	18.5	18.1	18.11
Bare Soils	7.57	8.76	4.84
Open Water	4.18	4.78	5.86

Urban Tree Canopy

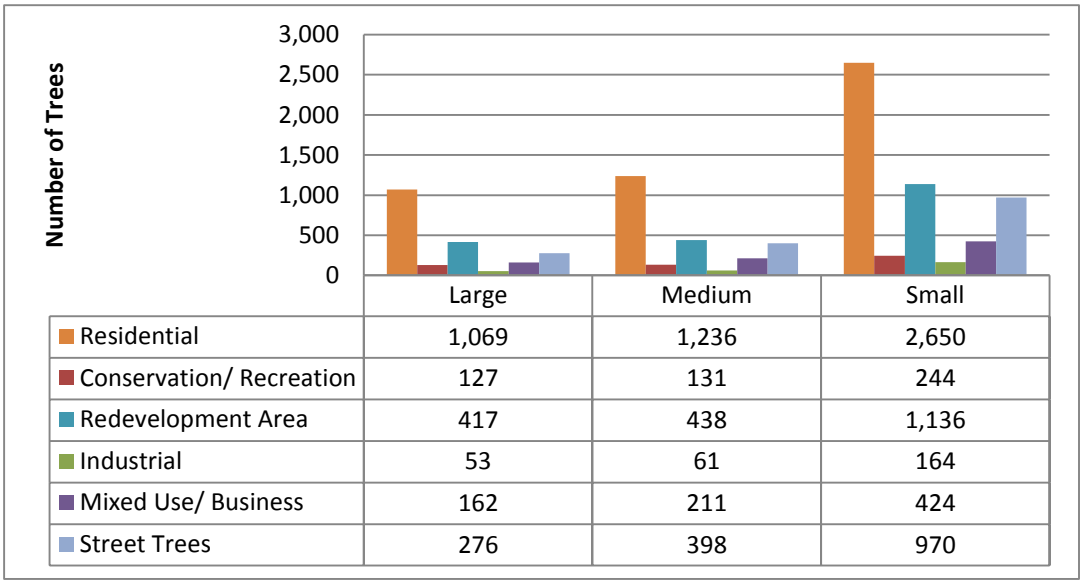
The 2013 UTC used 2010 National Agriculture Imagery Program (NAIP) photography. Field verification allowed for inclusion of canopy changes and calculation of revised land cover percentages. To determine priority areas for tree planting, land cover data (tree canopy, im/pervious surfaces, bare soils and water) were generated using Asbury Park's city boundary as the project area. Note that pervious cover allows rain to infiltrate the soil and typically includes parks, golf courses, and residential areas, whereas impervious cover does not allow rain to infiltrate and typically includes buildings, parking lots and roads. Areas of bare soil can include vacant lots, construction areas and baseball fields.

This study completed a 2013 field-verified UTC to compare it with the existing 2010 UTC assessment. Based on the 2013 UTC, the 976 acres (1.5 square miles) of Asbury Park have canopy coverage of 22.67%. Despite Hurricane Sandy in 2012 — due to growth of existing trees and the planting of more than 2,000 new ones — there has been minimal change (-0.07%) in canopy coverage from 2010 to 2013. The results of the 2010 and 2013 UTC are provided in Table 2.

Table 2. Canopy Coverage Change, 2010 - 2013

Land Cover Classification	Urban Tree Canopy Assessment (%)		
	2010	2013	% Change
Tree Canopy	22.74	22.67**	-0.07
Impervious Surfaces	48.45	48.52	0.07
Grass & Low Vegetation	18.07	18.11	0.04
Bare Soils*	4.89	4.84	-0.05
Open Water	5.84	5.86	0.02

In order to create a prioritized planting plan (PPP), this study assessed and prioritized areas based on three desired outcomes: maximizing ecological services, providing equal public access to natural resources, and protecting public health and safety. The study looked at both "possible planting areas" — land cover that is open ground such as golf courses, agricultural and sports fields — and "preferred planting areas" — areas that are more practical for planting. The study looked at benefits for a variety of land-use classifications to help determine which areas to prioritize. Planting recommendations feature large trees. The GIS layer of the PPP estimates the number and size of trees that can be planted in preferred planting areas; it is provided to the Asbury Park Department of Public Works along with this report to help them manage this information for the Asbury Park Environment and Shade Tree Commission and its partners.



	Large	Medium	Small
Residential	1,069	1,236	2,650
Conservation/ Recreation	127	131	244
Redevelopment Area	417	438	1,136
Industrial	53	61	164
Mixed Use/ Business	162	211	424
Street Trees	276	398	970

Figure 1. Distribution of preferred tree size for planting area by zone classification

Land-use Classification

➢ Residential

This zoning classification contains the largest amount of existing canopy cover, impervious surfaces and preferred places to plant trees. Street tree planting and maintenance should take priority. Preserving existing trees and planting new ones will maintain existing tree canopy and its associated benefits. Community awareness of the benefits trees provide can help encourage planting and maintenance of private trees.

Recommendations for Residential Classification:

- Implement routine tree maintenance, enforce tree preservation policies and plant replacement trees.
- Increase canopy by adding trees to residential properties.
- Plant a mix of sizes that correlates with available planting space.
- Conduct a public awareness campaign to encourage tree planting on private property.

➢ Conservation and Recreation

The conservation and recreation zoning classification contains the largest amount of open water and the smallest amounts of existing tree canopy, impervious surfaces and preferred places to plant trees. Increasing canopy within these areas may be difficult because of the lack of space; priority should therefore be given to maintenance. When possible, trees should be planted along trails and riparian areas to protect the watershed.

Figure 2. Possible planting locations near conservation and recreation areas

Recommendations for Conservation and Recreation Classification:

- Maintain existing trees to preserve them and maximize their benefits.
- Plant large trees in non-recreational areas to maximize canopy cover.
- Plant salt-tolerant trees with strong roots to reduce erosion from storms.
- Plant along trails and within riparian areas to increase tree canopy in conservation and recreation areas.

➢ Redevelopment Area

The redevelopment zoning classification contains a fair amount of existing tree canopy, impervious surfaces and preferred places to plant trees. Tree planting, maintenance and preservation should be given priority as well as installation of green infrastructure devices such as suspended pavement with structural cells, structural soil, tree pits, permeable pavements and vegetative swales.

Recommendations for Redevelopment Areas Classification:

- Redevelop in a manner that retains stormwater.
- Plant a mix of tree sizes that correlates with available space.
- Design parking lots to include areas for trees within pavement and along edges.

Figure 3.
Redevelopment areas contain many modifiable spaces for new trees

➢ Industrial/Mixed Use Business

This zoning classification contains a fair amount of existing tree canopy, impervious surfaces and preferred places to plant trees. Priority should be given to street tree planting and maintenance as well as installation of green infrastructure devices such as tree pits and permeable pavement. Plantings within 30 feet of parking areas should be considered to expand existing UTC. Parking lots are great places to add canopy to reduce runoff and urban heat island temperatures.

Recommendations for Industrial and Mixed Use/Business Classification:

- Install tree boxes in front of businesses to lessen stormwater runoff.
- Plant a mix of tree sizes in parking lots and along parking lot edges to reduce stormwater runoff. Species selection should correlate with available planting space.
- Replace impervious pavement with permeable infrastructure when updating parking lots and sidewalks.

Tree Planting

To ensure tree planting meets intended goals, it is critical that species are carefully selected, correctly planted and maintained. Species diversity affects maintenance costs, planting goals, canopy continuity and the ability to respond to invasive pests and diseases. Low species diversity can lead to severe losses in the event of species-specific epidemics such as Dutch elm disease, emerald ash borer and Asian longhorned beetle. A tree population should follow the "10-20-30 Rule" for species diversity that states "a single species should represent no more than 10% of the population, a single genera no more than 20%, and a single family no more than 30%." When planning a tree planting program:

- Consider the specific purpose of the tree planting.
- Assess the site and know its limitations (overhead wires, confined spaces, soil type, etc.).
- Select the species or cultivar that best matches site conditions.
- Examine trees before buying to ensure best quality.

Ecosystem Benefits

Ecosystem benefits were quantified to better understand the services provided by the canopy to Asbury Park. The study found Asbury Park's entire urban forest annually removes 17,389 pounds of pollutants from the air (a benefit of $64,453), stores approximately 7,691 tons of carbon ($175,356) and sequesters approximately 253 tons of carbon dioxide ($5,781). Trees also intercept more than 8 million cubic feet of runoff every year, ($340,200). By increasing canopy from 22.67% to 35%, the volume of runoff will not decrease but peak flow will reduce overall stormwater costs by limiting the need for man-made stormwater control devices. Table 3 lists total annual ecosystem benefits based on the current 22.67% canopy, the short-term goal of 25% canopy and the maximum potential 35% canopy.

Increasing UTC by just 2% will produce additional annual benefits of nearly 5%. Achieving 25% canopy cover reaches 70% of the city's potential for canopy cover given existing conditions. Increasing UTC by 12% will produce additional annual benefits of nearly 24%.

The study developed an ecosystem benefit-cost calculator to project benefits from new trees; these were quantified and projected over 40 years in five-year increments. The basis for the projected net benefit comes from the *Northeast Community Tree Guide: Benefits, Costs and Strategic Planting* report prepared and published by the Forest Service, Pacific Southwest Research Station, Center for Urban Forest Research[1].

Planting about 254 trees per year for 40 years would result in an average benefit of $8,373,059.

[1] McPherson, E.G., J.R. Simpson, P.J. Peper; S.L. Gardner, K.E. Vargas, Q. Xiao. 2007. Northeast Community Tree Guide: Benefits, Costs, and Strategic Planting. USDA. Forest Service, Pacific Southwest Research Station, Center for Urban Forest Research. General Technical Report PSW-GTR-202. Albany, CA. August.

Stormwater

Urban trees help manage stormwater runoff depth, time of concentration, peak flow and volume. This project uses data from the past two years for a 24-hour storm of more than 3.5 inches.

Asbury Park's trees intercept an additional 0.46 inches of runoff depth, increasing the time of concentration by slowing down the time for stormwater flows to reach pre-storm flow rates. The gain of 25 minutes decreases peak flow rates by 290 cubic feet per second (CFS). By reducing these rates, Asbury Park benefits from slower velocities, which reduce erosion and overall runoff volumes by 1,651,190 cubic feet.

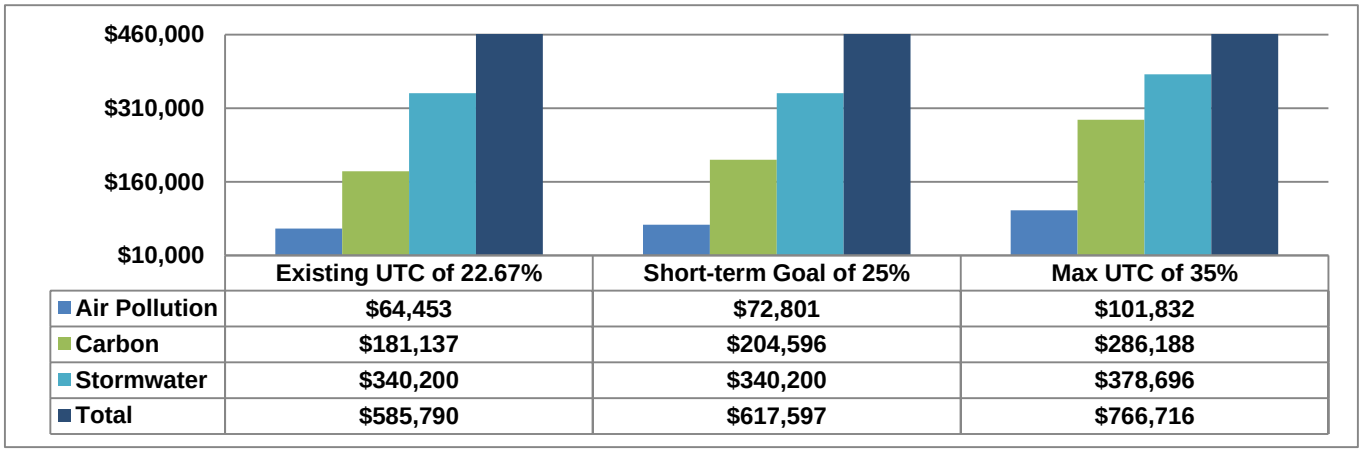
An increase of 2.33% canopy cover — or 22.74 acres — to meet the short-term goal of 25% will have no immediate stormwater benefit, but Asbury Park will receive some benefit by meeting this short-term goal.

An increase of 12.33% to the 35% maximum potential canopy — equal to 120.31 acres — will greatly affect stormwater systems. Asbury Park will benefit from this scenario by intercepting an additional 0.11 inches of runoff depth, gaining an additional five minutes of runoff concentration. This will reduce peak flow rates by 72 CFS and decrease overall runoff volume by 356,821 cubic feet (Table 3).

Methods

- *For Air Quality:* I-Tree Vue uses NLCD imagery to assess removal from different land classifications of pollutants such as carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10}) and sulfur dioxide (SO_2).
- *For Carbon:* I-Tree Vue evaluates carbon sequestration and storage. Along with air quality analysis, the software is calibrated with land cover and impervious surface percentages to model carbon benefits. Results demonstrate the amount of UTC correlated to current and future carbon reduction.
- *For Stormwater:* A stormwater assessment was completed with TR-55 hydrologic equations, which model stormwater runoff and generate a curve number correlated with hydrologic soil groups that identify a soil's permeability. To calculate runoff, the equation uses rainfall data, potential retention and initial abstraction. CITYGreen® for ArcView® 3.x software was utilized to quantify pollution and runoff reduction.

Figure 4. Annual ecosystem benefits provided by Asbury Park's urban tree canopy



	Existing UTC of 22.67%	Short-term Goal of 25%	Max UTC of 35%
Air Pollution	$64,453	$72,801	$101,832
Carbon	$181,137	$204,596	$286,188
Stormwater	$340,200	$340,200	$378,696
Total	$585,790	$617,597	$766,716

Table 3. Annual Ecosystem Benefits Provided by Asbury Park's UTC[1]

Ecosystem Factor	Current 22.67%		Short-term Goal 25%		Max Potential 35%	
	Units	Value	Units	Value	Units	Value
Air Pollution (pounds)						
CO_2	389	$248	439	$280	614	$392
NO_2	3,600	$16,299	4,000	$18,410	5,800	$25,752
O_3	6,600	$29,516	7,400	$33,339	10,400	$46,634
SO_2	1,200	$1,353	1,400	$1,528	2,000	$2,138
PM_{10}	5,600	$17,037	6,400	$19,243	9,000	$26,917
Subtotal	17,389	$64,453	19,639	$72,801	27,814	$101,832
Carbon (tons)						
Storage	7,691	$175,356	8,687	$198,067	12,151	$277,054
Sequestration	253	$5,781	286	$6,530	401	$9,134
Subtotal	7,944	$181,137	8,973	$204,596	12,552	$286,188
Stormwater (cubic feet)	8,035,127	$340,200*	8,035,127	$340,200*	8,035,127	$378,696*
Reduction of Peak Flow (cubic feet)	1,978,554		1,978,554		2,202,498	
Subtotal	10,013,681	$340,200**	10,013,681	$340,200**	10,237,625#	$378,696**
TOTAL		$585,790		$617,597		$766,716

[1] Air pollution and carbon values are derived using i-Tree Vue and stormwater values are calculated in CityGreen.
* Stormwater values are calculated based on the cost of building man-made structures to hold peak runoff flows.
**Annual stormwater costs are derived by taking the actual cost of the man-made structures financed at 6% interest.
The total volume of runoff did not decrease, but the additional canopy did decrease the peak flow, reducing the stormwater cost.

Table 4. Projected Net Benefits of Preferred Trees to Plant Based on an Interval Planting of Five Years

Planting Interval	Year 5	Year 10	Year 15	Year 20	Year 25	Year 30	Year 35	Year 40
Year 5 Planting	-$376,688	$340,371	$614,039	$954,488	$1,268,138	$1,616,685	$1,794,008	$2,162,017
Year 10 Planting	-	-$376,688	$340,371	$614,039	$954,488	$1,268,138	$1,616,685	$1,794,008
Year 15 Planting	-	-	-$376,688	$340,371	$614,039	$954,488	$1,268,138	$1,616,685
Year 20 Planting	-	-	-	-$376,688	$340,371	$614,039	$954,488	$1,268,138
Year 25 Planting	-	-	-	-	-$376,688	$340,371	$614,039	$954,488
Year 30 Planting	-	-	-	-	-	-$376,688	$340,371	$614,039
Year 35 Planting	-	-	-	-	-	-	-$376,688	$340,371
Year 40 Planting	-	-	-	-	-	-	-	-$376,688
TOTAL	-$376,688	-$36,317	$577,722	$1,532,210	$2,800,349	$4,417,034	$6,211,042	$8,373,059

Table 5. Recommended Tree Species Based on Tolerance of Saline Soils, Salt Spray, High Winds and Periodic Inundation

Scientific Name*	Common Name	Suggested Cultivar	Notes
Acer pseudoplatanus	sycamore maple		Very salt tolerant. Used in polders in The Netherlands.
Aesculus × carnea	ruby red horsechestnut	'Fort McNair'	
Alnus glutinosa	common alder	'Pyramidalis'	Tolerates wide range of soil pH and salty sea winds.
Betula papyrifera	paper birch		
Diospyros virginiana	common persimmon		Withstands high winds; tolerates salt spray and saline soil.
Gleditsia triacanthos var. inermis	thornless honeylocust	'Shademaster'	
Juglans nigra	Black walnut		
Juniperus virginiana	Eastern red cedar		Useful for windbreaks. Cultivars from rooted cuttings should be examined for sufficient root systems.
Koelreuteria paniculata	goldenraintree	'Rose Lantern'	A very tolerant small tree.
Larix decidua	European larch		Very tolerant of salt spray.
Magnolia grandiflora	Southern magnolia	'Bracken's Brown Beauty'	
Nyssa aquatica	water tupelo		High salt tolerance. Good for stabilizing seaside dunes.
Nyssa sylvatica	black tupelo		
Pinus nigra	Austrian pine		Very tolerant of salt spray.
Pinus thunbergii	Japanese black pine	'Majestic Beauty'	Very high salt tolerance. Used for dune stabilization.
Platanus × acerifolia	London plane tree	'Bloodgood'	Tolerates wet soils and salt. Does not do as well in high-pH soils. Withstands high winds.
Quercus lyrata	overcup oak		A good oak for this application.
Quercus palustris	pin oak		As the name suggests, very tolerant of inundation.
Quercus phellos	willow oak	'Hightower'	
Quercus virginiana/lyrata hybrid			Difficult to source. Recommend contract growing.
Taxodium distichum	common baldcypress	'Shawnee Brave'	Withstands high winds, tolerates salt spray, saline soil, and inundation.
Taxodium distichum imbricarium	Pond cypress		Withstands high winds, tolerates salt spray, saline soil, and inundation.
Ulmus parvifolia	Chinese elm	Allée®	Tolerates urban soils and a wide range of pH.

Recommendations

- Utilize preferred planting plan GIS data to enhance planning.
- Plant large trees where possible to maximize canopy cover.
- Maintain trees to maximize their benefits.
- Conduct a public awareness campaign to encourage tree planting on private property.
- Plant a mix of sizes that correlates with available planting space.
- Target areas including parking lots and wide sidewalk areas where green infrastructure devices such as manufactured tree box filters and pervious pavement could expand plantable areas.
- Include runoff retention facilities on developed properties to make use of stormwater for watering trees.