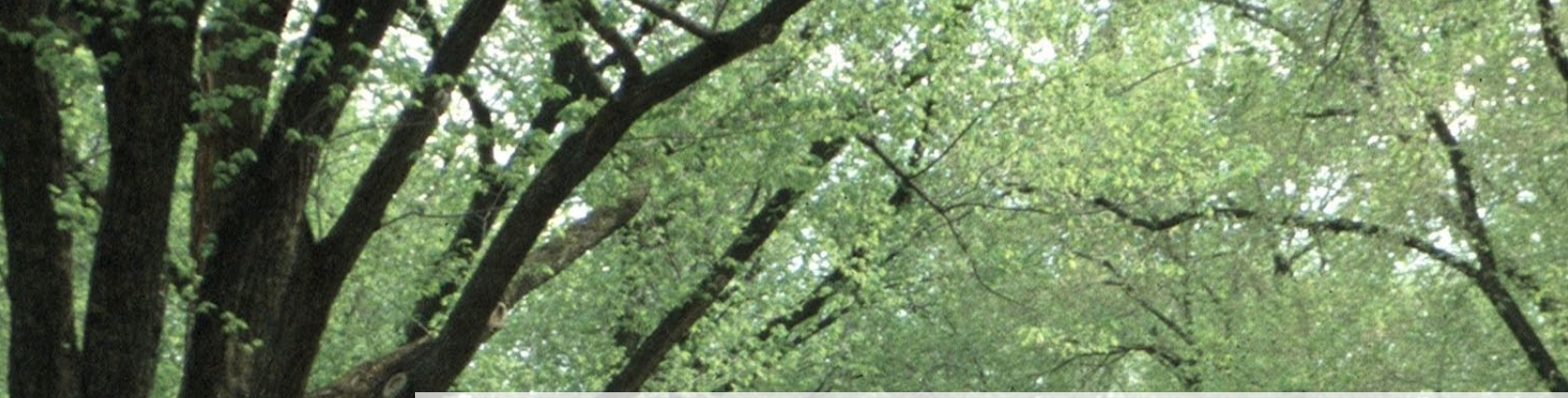

Street Tree Assessment Report

Williamsburg, Virginia

Overview

Street trees are a vital community asset that enhance our day-to-day lives and mitigate many of the negative impacts of urbanization. In 2010, a sample street tree inventory was conducted in Williamsburg, Virginia to assess tree abundance, composition, functional benefits, and monetary value. Trees residing within the right-of-way along 13% of public streets were surveyed to determine their species, size, condition, and placement. Inventory data were collected by Virginia Tech for this assessment report. The inventory data were analyzed using i-Tree Streets assessment software developed by the U.S. Forest Service.

Key Findings

- Williamsburg has an estimated 5,641 street trees.
- Williamsburg's five most abundant street tree species are crapemyrtle, eastern redcedar, red maple, loblolly pine, and flowering dogwood.
- Each year, Williamsburg's street trees intercept over 11 million gallons of rainfall and sequester over 1 million pounds of carbon dioxide.
- In total, Williamsburg's street trees provide over $478 thousand in benefits annually or roughly $85 per tree.
- The replacement value of Williamsburg's street trees is estimated at over $19 million.

Prepared by Virginia Tech
Department of Forest Resources and Environmental Conservation

http://urbanforestry.frec.vt.edu/

arborist@vt.edu

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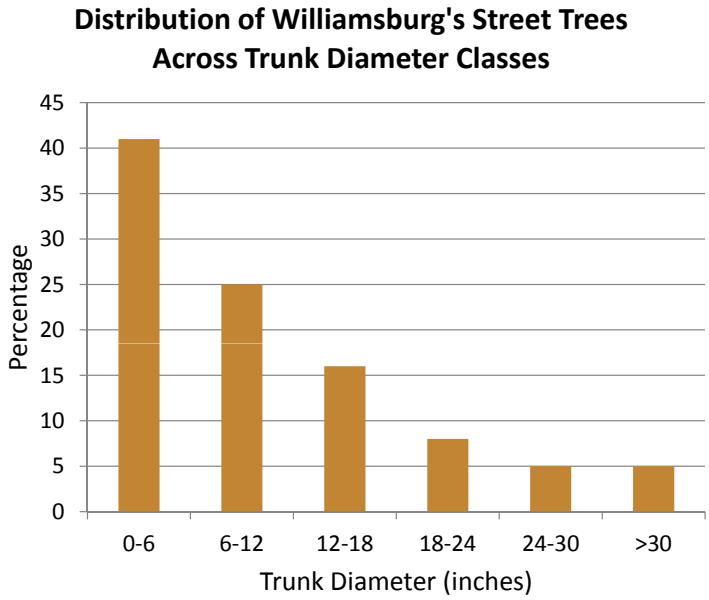
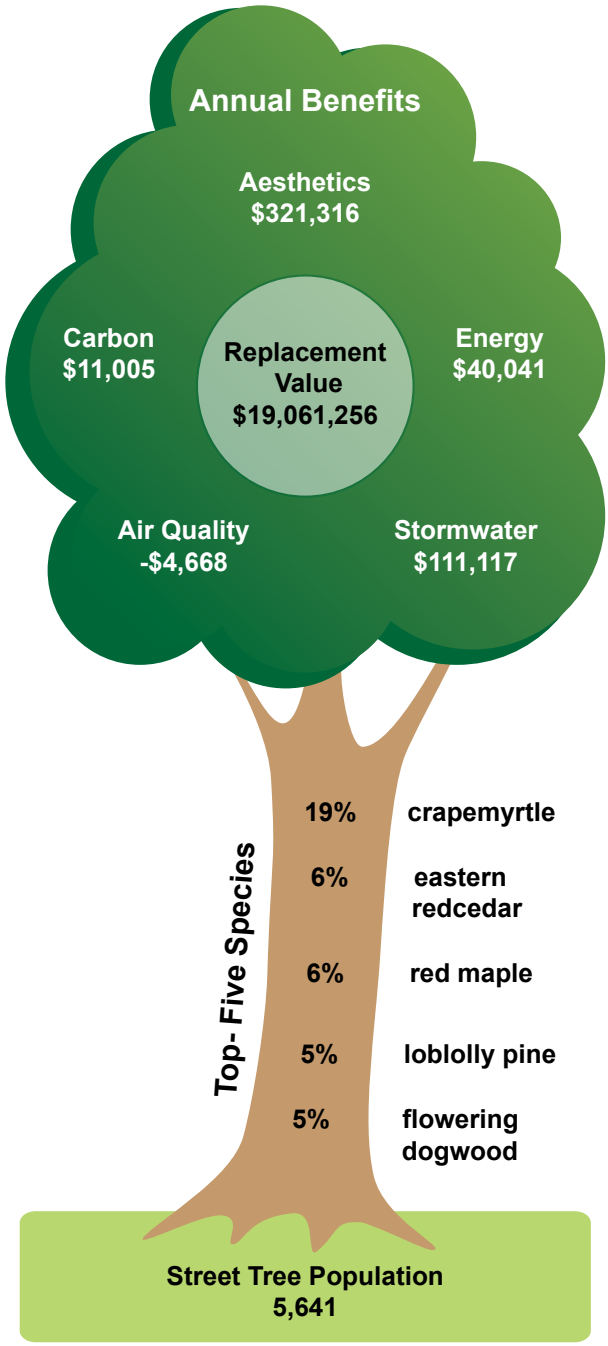
Street Tree Abundance and Composition

Williamsburg's estimated street tree population is 5,641. Williamsburg's street trees provide about 71 acres of canopy, which cover roughly 1.2% of the land area. The five most abundant are crape myrtle (19%), eastern redcedar (6%), red maple (6%), loblolly pine (5%), and flowering dogwood (5%). The most important species (accounting for leaf area and canopy cover in addition to tree count) include crapemyrtle (10%), willow oak (10%), red maple (8%), loblolly pine (7%), and eastern redcedar (5%).

Small-stature, broadleaf deciduous trees are the most common tree form amongst Williamsburg's street trees, but are nearly equaled by large-stature, broadleaf deciduous trees. About 66% of Williamsburg's street trees are smaller than 12 in. trunk diameter while less than 5% are larger than 30 in. The majority of Williamsburg's street trees (~94%) were rated in fair to good condition.





Relative abundance of Williamburg's street trees by foliage type and mature height class.

Foliage Type	Small (< 25')	Medium (25 - 45')	Large (> 45')	Total	% of Total
Broadleaf Deciduous	1,929	727	1,500	4,156	73
Broadleaf Evergreen	597	46	15	658	12
Conifer Evergreen	0	452	375	827	15
Total	**2,526**	**1,225**	**1,890**	**5,641**	**100**
% of Total	**44**	**22**	**34**	**100**	

Street Tree Benefits and Value

Gross annual benefits provided by Williamsburg's street trees are valued at $478,811. These benefits come from contributions that street trees make to real estate aesthetics, rainfall interception, energy conservation, air pollution reduction, and CO_2 sequestration. Each year, Williamsburg's street trees intercept roughly 11 million gallons of rainfall, conserve a combined 354 megawatt-hour of electricity and 12 thousand therms of natural gas for home cooling and heating, and remove about 1.5 million pounds of carbon from the atmosphere. In addition, Williamsburg's street trees currently store about 17 million pounds of carbon, which is valued at over $125 thousand. Although Williamsburg's street trees have a net positive impact on air pollution – removing over 899 pounds of pollutants annually – its current mix of tree species heavily emits biogenic volatile organic compounds (BVOCs), which results in a negative monetary value for pollution reduction.

On a per-tree basis, the most beneficial tree species are American elm ($268 per year), southern red oak ($240 per year), willow oak ($224 per year), American sycamore ($221 per year), and silver maple ($207 per year). These values reflect the large size that these trees have attained, providing abundant leaf area and canopy cover. The average street tree provides about $85 in gross benefits annually. Gross benefits do not account for annual costs associated with planting, maintenance, or removal, which were not available for this analysis.

The replacement value of Williamsburg's street trees is estimated at $19,061,256. This is the value of street trees as a structural asset, and reflects the cost to replant trees in a quantity sufficient to replace their current level of functional benefits. Because a large street tree produces the same amount of benefits as numerous nursery-sized trees, replacing a large tree would require significant resources that may not be feasible due to both spatial and budgetary constraints.

Gross annual benefits provided by Williamsburg's street trees.

Benefit Type	Resource Units	Total $	Avg. $/Tree
Aesthetic enhancements	–	321,316	56.97
Rainfall Interception (gallons)	11,223,128	111,117	19.70
Energy Conservation[1]	–	40,041	7.10
Electricity (MWh)	354	26,876	–
Natural Gas (therms)	12,586	13,165	–
Air Pollution reduction (lb)[2]	899	-4,668	-0.83
CO_2 sequestration (lb)[3]	1,467,281	11,005	1.95
Total Benefits	**–**	**478,811**	**84.89**

[1]Sum of electricity and natural gas conservation.

[2]Net pollution reduction (O3, NO2, PM10, and SO2) accounting for pollutant deposition, pollutant avoidance, and BVOC emissions. Note, if Resource Units value is negative, BVOC emissions exceeded pollution reduction. If only total $ is negative, then BVOC pricing exceeded pollutant pricing, but pollution reduction still occurred.

[3]Net sequestration accounting for gross tree sequestration, tree decomposition emissions, and tree maintenance machinery emissions.

Street Tree Opportunities

Williamsburg has a highly valuable street tree population. To sustain this resource and its benefits, the city should continue to focus on planting diverse, functional species and maintaining trees to ensure their health, safety, and appearance. Urban forestry experts generally recommend that a municipal tree population comprise no more than 10% of a single species and 20% of a single genus in order to minimize impacts of pest outbreaks and other species-specific disorders. At 19% of the street trees, crapemyrtle exceeds the species threshold. Although crapemyrtle is a popular species, planting efforts should temper its use to ensure the diversity and heath of Williamsburg's street trees.

One of the most noxious pests threatening Virginia's street trees is emerald ash borer, an insect introduced from Asia that has killed millions of native ash trees in the United States. Fortunately, native ash species comprise just 0.14% of Williamsburg's street trees and account for only 0.32% of the street tree canopy cover. However, Williamsburg must remain vigilant in managing street tree diversity because there is ongoing risk of unforeseen introduction of noxious tree pests into the United States.

The size distribution of Williamsburg's street trees suggests a stable age structure. Because street trees inevitably grow old and die or must be removed to accommodate land use changes, an ample number of young trees must always exist in order to sustain street tree benefits. The fact that the two diameter classes that encompass the largest percentage of the total street tree population are the 0-6 and 6-12 inch diameter classes, respectively, is a source of optimism. However, there are relatively few street trees greater than 18 inch diameter, which probably reflects the dominance of small-stature, broadleaf deciduous trees such as crape myrtle and flowering dogwood. While these species are proven performers, particularly in small spaces under utility lines, the value of their annual benefits are only 12-16% of the benefits provided by large-stature trees such as sugar maple. Ongoing planting efforts, with particular focus on large stature, highly functional tree species, should be taken to ensure a high level of benefits will be provided by Williamsburg's street trees for the future.

Williamsburg's street trees comprise a number of species that produce large amounts of BVOCs, which are precursors to ground-based ozone. Heavy emitters of BVOCs in Williamsburg include American elm, southern red oak, and American sycamore. Williamsburg should consider planting more low-BVOC street trees such as gingko, linden, and certain maples if maximizing air quality benefits is a key community objective. However, this planting strategy should not compromise efforts to maximize canopy cover or species diversity. Urban forestry experts generally believe that trees have a net positive impact on air quality, regardless of BVOC emissions, by lowering air temperature and reducing fossil fuel combustion in urban areas.

This assessment has reported gross benefits of Williamsburg's street trees, which may not fully reflect the true value of this vital resource. Direct and indirect costs of administering and managing street trees can vary considerably based on species composition, tree size distribution, and other local environmental and economic factors. Therefore, findings of this report should be carefully interpreted in the context of local circumstances that impact tree benefits and costs.

About This Report

This report was co-authored by Eric Wiseman and Julia Bartens with the Department of Forest Resources and Environmental Conservation at Virginia Tech. Report layout and design by Sarah Gugercin.

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Inventory data were analyzed using i-Tree Streets assessment software version 4.0.4. Benefit estimates were based on i-Tree modeling data from the Charlotte, North Carolina reference city in the South Climate Zone. The 2010 median home price, used to calculate street tree aesthetic benefits for Williamsburg was $344,800 as reported by the U.S. Census Bureau in http://quickfacts.census.gov/qfd/index.html. Additional information about methods used in this street tree assessment can be found on our website.

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