

Street Tree Assessment Report

Emporia, 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 2011, a sample street tree inventory was conducted in Emporia, Virginia to assess tree abundance, composition, functional benefits, and monetary value. Trees residing within the right-of-way along 19% 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

- Emporia has an estimated 1,042 street trees.
- Emporia's five most abundant street tree species are crapemyrtle, loblolly pine, sweetgum, eastern redcedar, and black oak.
- Each year, Emporia's street trees intercept about 2.8 million gallons of rainfall and sequester over 317 thousand pounds of carbon dioxide.
- In total, Emporia's street trees provide over \$55 thousand in benefits annually or roughly \$53 per tree.
- The replacement value of Emporia's street trees is estimated at about \$4.8 million.

*Prepared by Virginia Tech
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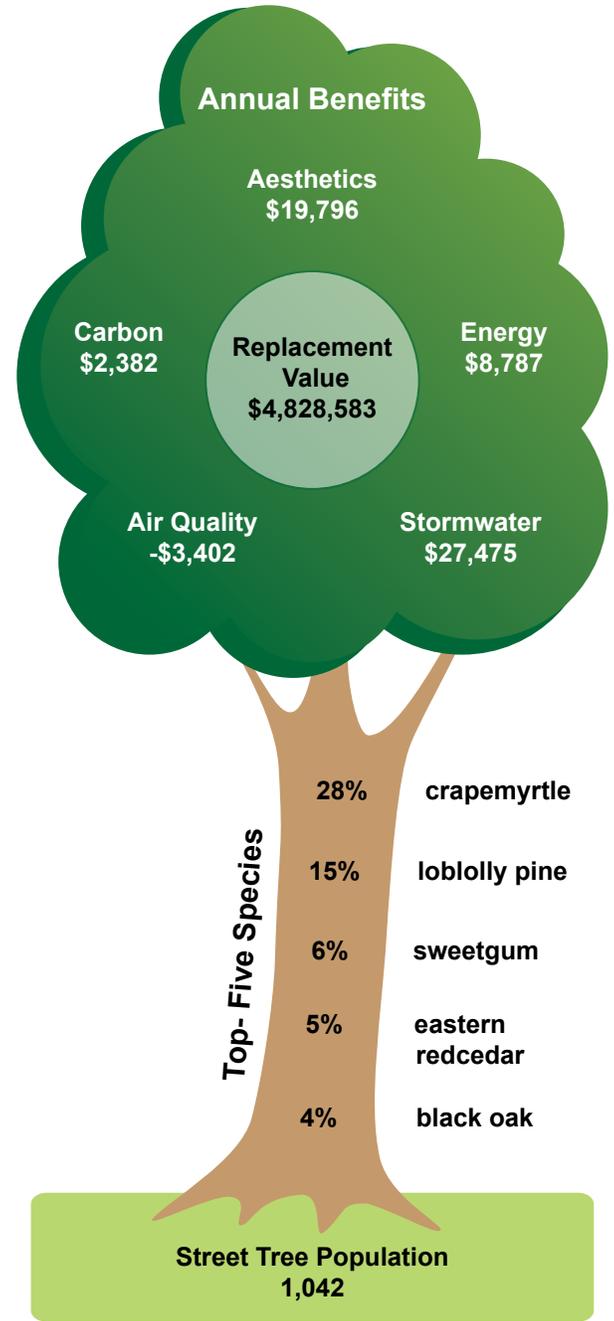
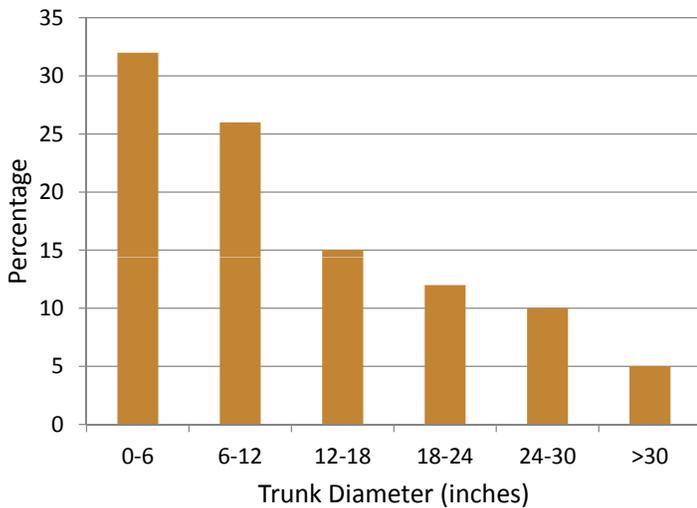


Street Tree Abundance and Composition

Emporia's estimated street tree population is 1,042. Emporia's street trees provide about 16 acres of canopy, which cover roughly 0.4% of the land area. The five most abundant species are crapemyrtle (28%), loblolly pine (15%), sweetgum (6%), eastern redcedar (5%), and black oak (4%). The most important species (accounting for leaf area and canopy cover in addition to tree count) include loblolly pine (29%), crapemyrtle (14%), black oak (5%), sugar maple (5%), and eastern redcedar (4%).

Small-stature, broadleaf deciduous trees are the most common tree form amongst Emporia's street trees. About 60% of Emporia's street trees are smaller than 12 in. trunk diameter while less than 5% are larger than 30 in. The majority of Emporia's street trees (~96%) were rated in fair to good condition.

Distribution of Emporia's Street Trees Across Trunk Diameter Classes



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

Foliage Type	Small (< 25')	Medium (25 - 45')	Large (> 45')	Total	% of Total
Broadleaf Deciduous	371	52	304	727	70
Broadleaf Evergreen	57	5	5	67	6
Conifer Evergreen	0	57	191	248	24
Total	428	114	500	1,042	100
% of Total	41	11	48	100	

Street Tree Benefits and Value

Gross annual benefits provided by Emporia’s street trees are valued at \$55,038. These benefits come from contributions that street trees make to real estate aesthetics, rainfall interception, energy conservation, air pollution reduction, and CO₂ sequestration. Each year, Emporia’s street trees intercept roughly 2.8 million gallons of rainfall, conserve a combined 80 megwatt-hour of electricity and 2,609 therms of natural gas for home cooling and heating, and remove about 318 thousand pounds of carbon from the atmosphere. In addition, Emporia’s street trees currently store about 3.6 million pounds of carbon, which is valued at over \$27 thousand. Emporia’s current mix of tree species heavily emits biogenic volatile organic compounds (BVOCs), which interact with other air pollutants to create ground-based ozone. As a result, Emporia’s street trees do not positively influence air quality in terms of pollution mitigation.

On a per-tree basis, the most beneficial tree species are eastern white pine (\$145 per year), loblolly pine

(\$119 per year), sugar maple (\$108 per year), red maple (\$100 per year), and silver maple (\$84 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 \$53 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 Emporia’s street trees is estimated at \$4,828,583. 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 Emporia's street trees.

Benefit Type	Resource Units	Total \$	Avg. \$/Tree
Aesthetic enhancements	–	19,796	19.00
Rainfall Interception (gallons)	2,775,050	27,475	26.37
Energy Conservation ¹	–	8,787	8.43
Electricity (MWh)	80	6,058	–
Natural Gas (therms)	2,609	2,729	–
Air Pollution reduction (lb) ²	-149	-3,402	-3.26
CO ₂ sequestration (lb) ³	317,537	2,382	2.29
Total Benefits	–	55,038	52.83

¹Sum of electricity and natural gas conservation.

²Net 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.

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

Street Tree Opportunities

Emporia 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. Emporia's street trees are predominantly naturally-occurring species that tend to develop in monoculture stands such as loblolly pine. In such cases, it is difficult to influence species diversity. However, crapemyrtle is a purposefully planted species, and at 28% of the total street tree population, it is excessively abundant. Planting efforts should temper the use of crapemyrtle to ensure the diversity and health of Emporia'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 1.4% of Emporia's street trees and account for only 1.6% of the street tree canopy cover. However, Emporia must remain vigilant in managing street tree diversity because there is ongoing risk of unforeseen introduction of noxious tree pests into the United States.

About 40% of Emporia's street tree population comprises small-stature species such as crapemyrtle, which make a substantially smaller contribution to annual benefits than large-maturing trees. For example, the average sugar maple in Emporia provides over 7 times the gross annual benefits of the average crapemyrtle. As such, preference should be given to planting large-maturing trees whenever landscape conditions allow.

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 Emporia was \$97,700 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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The size distribution of Emporia'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, 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 Emporia's street trees for the future.

Emporia'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 Emporia include loblolly pine, black oak, sweetgum, and American elm. Emporia should consider planting more low-BVOC street trees such as ginkgo, 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 Emporia'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.