



i-Tree Streets Inventory

The City of Martinsburg



What is i-Tree Streets?



The City of Martinsburg worked with the Martinsburg Shade Tree Commission to conduct an i-Tree Streets ("i-Tree") inventory of trees in the public right of way. Martinsburg appreciates the technical support provided by Cacapon Institute and the WV Division of Forestry in conducting the survey and drafting this report. i-Tree Streets is a USDA Forest Service assessment tool used to gauge the "ecosystem services and structure of a city's street tree population." Based on a random sample of street segments and user defined input i-Tree estimates a value on trees' annual environmental and aesthetic benefits.

Purpose

Street trees provide a variety of functions and play a crucial role in creating healthy, vibrant communities. Street trees provide shade and wind protection for pedestrians, clean the air and water, lower ambient air temperatures, reduce the urban heat island effect, beautify neighborhoods, and increase property values.

The purpose of the i-Tree Inventory was to assess the **structure, function, value, and management needs** of Martinsburg's street trees.

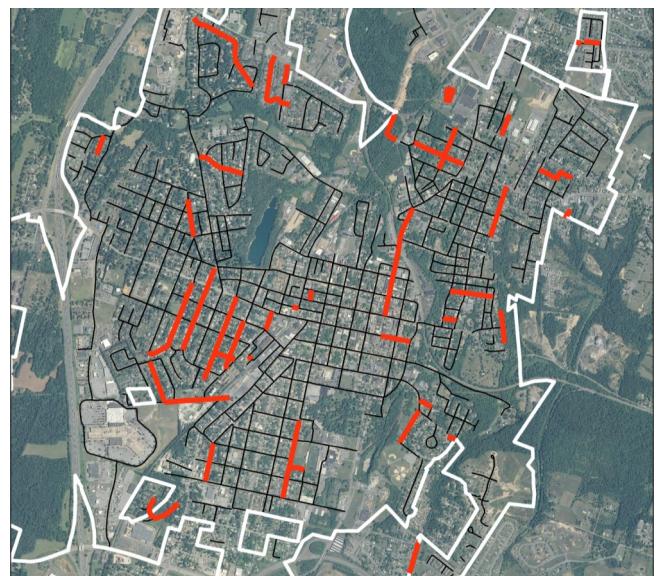
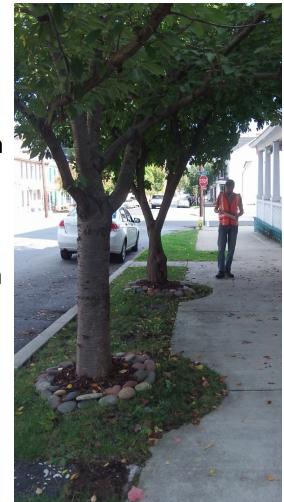
- Structure:** The species composition and size distribution assists City officials in anticipating future planting opportunities and the potential for engaging the community in education and action.
- Function:** i-Tree analyzes the ecosystem services, i.e., the function, the urban forest is providing. Functions include energy conservation, air quality improvement, stormwater management, and carbon dioxide reduction, among others.
- Value:** i-Tree quantifies the environmental and other benefits that the urban forest is providing, both in unit terms (e.g., kilowatt hours of electricity conserved) and in dollar terms. Based on historic management costs, i-Tree can determine the return on investment that the trees are providing. This assists City officials in developing cost-effective street tree management programs.
- Management Needs:** Based on tree condition data collected in the random sample, i-Tree forecasts maintenance requirements and priority tasks based on infrastructure conflicts to help City officials effectively resolve community issues regarding street trees.



Crabapple tree in planting strip on Martin Street

Project Development

The City of Martinsburg has a total of 715 street segments (blocks or portions of roads and drives). To maximize the cost benefit, the inventory focused on municipally controlled streets. Segments less than 50 feet in length were excluded (e.g. alleys and driveways). This resulted in a total of 413 street segments under investigation. To achieve a high degree of statistical confidence in the results, 10% of these street segments were randomly selected (this exceeds the 6% recommended by the USDA Forest Service for similar municipalities). Based on the 10% sample, results were extrapolated in i-Tree to estimate the total City owned street tree population. A total of 6 miles of street segments were inventoried.



City of Martinsburg outlined in white with the 42 randomly selected street segments highlighted in red.

Key Terms

Street Tree—Defined as any tree that is located in between the road and the sidewalk OR any tree that has a canopy which extends beyond the centerline of road

Tree Canopy—Tree Canopy is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above.

i-Tree Software Suite—a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools.

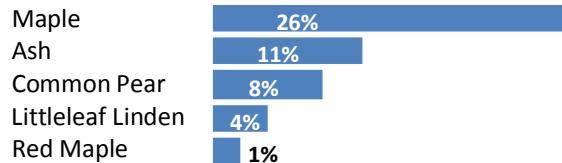
Structure

Managing urban forests requires a basic understanding of the species composition and size distribution. The City of Martinsburg randomly sampled 10 % of streets and used USDA Forest Service's i-Tree Streets software to estimate the number of street trees under the City's responsibility. The majority of the street trees are deciduous. Deciduous trees, because they lose their leaves, help conserve energy and save money by providing shade in the summer and allowing light through in the winter. The majority of Martinsburg's street trees are 6-24 inches in diameter when measured at "standard height" of 4.5 feet from the ground.

Quick Facts

- i-Tree estimates there are 1770 municipally controlled street trees in The City of Martinsburg

- Top 5 Species** (all other species total 51%):



Species Class	Diameter (in) at Standard Height (DSH)										Estimated Number per Species Class (±Standard Error)
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42		
Broadleaf Deciduous—Large	0	30	157	305	187	79	10	30	10		806 (±197)
Broadleaf Deciduous—Medium	20	49	236	177	118	10	0	0	0		610 (±244)
Broadleaf Deciduous—Small	89	148	79	10	10	10	0	0	0		344 (±156)
Coniferous Evergreen—Medium	0	0	0	0	0	10	0	0	0		10 (±9)
Estimated total per category	109	227	472	492	315	109	10	30	10		1770 (±494)

Function

Ecosystem services provided by urban trees

Function of Martinsburg's Street Trees	
Stormwater	Rainfall Intercepted (Gallons) 2,451,986
Air Quality	Net Emissions Captured (lbs) 3,863
Energy Savings	Electricity Reduced (MWh) 307
CO2 Reduction	Net CO2 Sequestered (lbs) 1,077,312

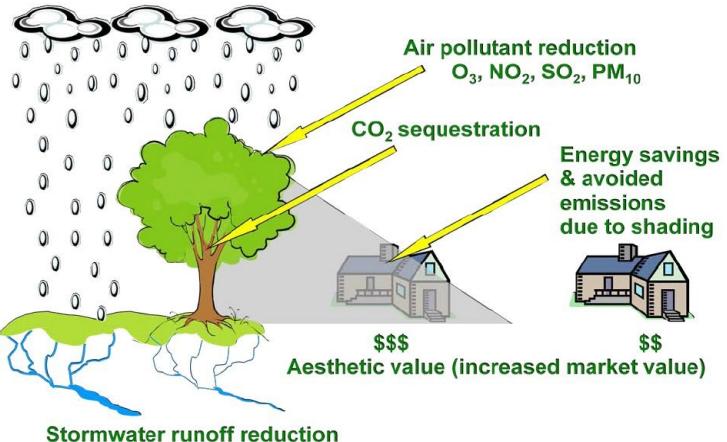


Image provided courtesy of US-EPA.

Quick Facts

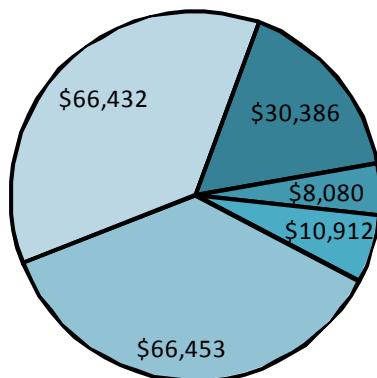
- 30 acres of tree canopy cover
- 15% of Martinsburg's streets and sidewalks currently receive the benefits of canopy cover
- 56% of Martinsburg's street trees are either in planting strips or tree pits
- 62% of Martinsburg's street trees are located adjacent to single and multi-family residential sites

Street Trees perform a variety of functions. They clean our air by filtering airborne pollutants and protect our water by reducing stormwater runoff pollution. Trees save money through reduced heating and cooling costs and increase property values with their beauty. All these functions benefit the economy of communities. The majority of these functions are performed by the tree canopy—the layer of leaves, branches, and stems that cover the ground like a natural umbrella. Many of the street trees in the City of Martinsburg are located adjacent to residential sites and provide benefits directly to Martinsburg residents.

Value

The City of Martinsburg has a strong commitment to protecting local waters and quality of life. The City is also under US EPA Municipal Separate Storm Sewer System (MS4) regulation to reduce stormwater runoff pollution. The USDA Forest Service assigns a monetary value to the functions performed by street trees' environmental benefits. i-Tree Streets quantifies these benefits to air & water pollution removed, or prevented, in terms of dollars saved. These values can be used by City officials to make informed decisions regarding the maintenance and long-term care of street trees. Today, the total annual benefit of the City's street trees is estimated to be \$182,262.

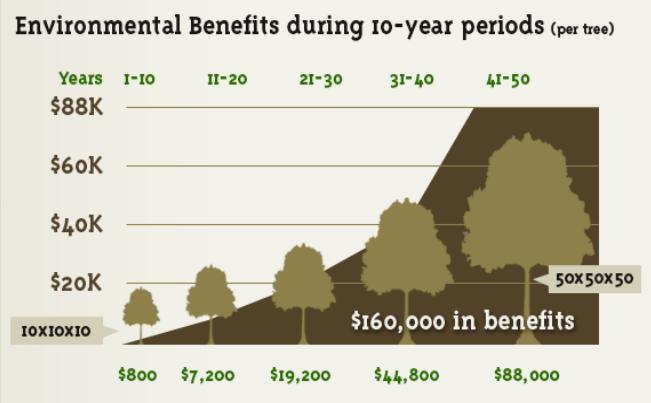
With care, as healthy safe trees mature, the benefit



Annual Benefits

- Energy
- CO2
- Air Quality
- Stormwater
- Aesthetic/Other

Annual benefits of Martinsburg's Street Trees.



Quick Facts

- **Martinsburg's 5 Most Beneficial Species (Annual \$/Tree)**

Honey Locust	\$224
Black Walnut	\$146
Maple	\$145
American Sycamore	\$121
Ash	\$105

- Total annual benefits = \$182,262 ($\pm \$50,850$)

Maintenance Needs

Quick Facts

• Tree Condition

Good	77%
Fair	16%
Poor	6%
Dead/Dying	1%

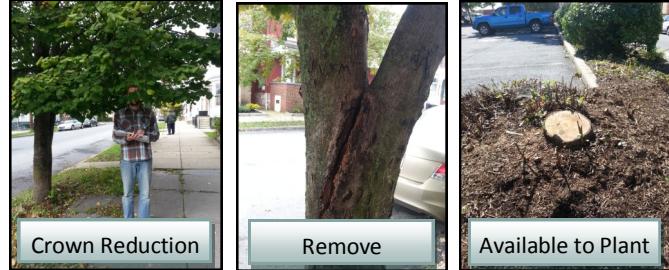
- Replacement Value of all trees = \$1,926,258 ($\pm \$537,412$)

The condition of Martinsburg's street trees suggests a relatively stable population, with 77% estimated to be in good condition. Maintenance was split into two categories: Maintenance Recommendations and Priority Tasks. Successful maintenance regimes require pruning, removal, and planting of new trees. Department of Public Works is responsible for the publicly owned street trees and has begun to address this study. The replacement value, the cost to replace a tree with one of similar size, species, and condition, for all of Martinsburg street trees is \$1,926,258.

Maintenance Recommendation*	
Small Tree - Routine	67
Small Tree - Immediate	1
Large Tree - Routine	112
Large Tree - Immediate	9
Critical Concern	3



Priority Task*	
None	156
Crown Reduction and Thinning	23
Remove	13
Available to Plant (# Trees)	52



*Maintenance recommendations & tasks are only for trees surveyed.

Net Annual Benefits

Martinsburg's street trees provide \$182,263 in net annual benefits before annual maintenance costs of \$20,257. i-Tree Streets quantifies the net annual benefits that Martinsburg receives from their street trees by subtracting the maintenance costs from the total benefits. The benefit cost ratio for maintaining Martinsburg's street trees is 9:1, meaning the city annually gains the equivalent of \$9.00 in benefits for every \$1.00 spent on maintenance, for a total of \$162,006 in net annual benefits.

Benefits (\$)			
Benefits	Benefits Provided (\$)	\$/Tree	\$/Capita
Energy	\$ 30,386	\$ 17.17	\$ 1.74
CO2	\$ 8,080	\$ 4.56	\$ 0.46
Air Quality	\$ 10,912	\$ 6.16	\$ 0.62
Stormwater	\$ 66,453	\$ 37.54	\$ 3.80
Aesthetic/Other	\$ 66,432	\$ 37.53	\$ 3.80
Total Benefits	\$182,263 ($\pm 50,850$)	\$103 ($\pm 28.73$)	\$10.42 ($\pm 2.91$)
Costs (\$)			
Equipment	\$ 12,505	\$ 7.05	\$ 0.71
Labor	\$ 5,752	\$ 3.24	\$ 0.33
Tree Maintenance	\$ 2,000	\$ 1.13	\$ 0.11
Total Costs	\$ 20,257	\$ 11.42	\$ 1.15
Benefit : Cost Ratio			
Net Benefits	\$162,006 ($\pm 50,850$)	\$91.58 ($\pm 28.73$)	\$9.27 ($\pm 2.91$)
Benefit-Cost Ratio	\$9.0 ($\pm 2.51$)		

Benefits, costs, and net benefits for The City of Martinsburg's street trees. Benefits are i-Tree estimates based on the 10% random sampling of street segments. Costs are fixed based on historical maintenance costs in Martinsburg.

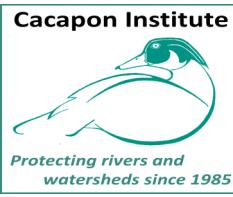
Conclusions and Recommendations

- Based on this 10% random sampling, it is estimated the City has 1770 street trees (± 494).
- Martinsburg's street trees provide \$182,263 in environmental and aesthetic benefits annually ($\pm \$50,850$).
- The City of Martinsburg spends \$20,253 annually on tree maintenance.
- Total annual net benefits, and therefore savings, are \$162,006 ($\pm \$50,850$).
- The benefit ratio is approximately 9:1—meaning, the city of Martinsburg saves \$9:00 annually for every \$1:00 spent on tree maintenance.
- In 1994, The City of Martinsburg completed a comprehensive inventory of all the street trees throughout the City. The 2012 random sampling is being statistically compared to the 1994 study. A statistical comparison will provide an indication for where tree canopy has changed over time, provide a general indication of tree health, and compare the availability of planting sites.
- The City will continue to work with the Martinsburg Shade Tree Commission to expand on this 10% sampling, conduct further assessments, and increase the City's urban tree canopy.



City of Martinsburg
WEST VIRGINIA

The City of Martinsburg appreciates the support of Cacapon Institute and the WV Division of Forestry in completing this inventory and for the preparation of this report. Funding for the project was provided by WV Division of Forestry. Technical support was provided by the USDA Forest Service.



Additional Information

For more information and to see the full reports, visit www.cacaponinstitute.org.

For more information about i-Tree Software Suite and i-Tree Streets, visit <http://www.itreetools.org>.