Stormwater Best Management Practice

Urban Forestry

Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment
Subcategory: Innovative BMPs for Site Plans

Description

Urban forestry is the study of trees and forests in and around towns and cities. Since trees absorb water, patches of forest can help provide stormwater management to an urban setting. Urban forests also help break up a landscape of impervious cover, provide small but essential green spaces, link walkways and trails, improve overall air and water quality, attract wildlife, and provide opportunities for community recreation.

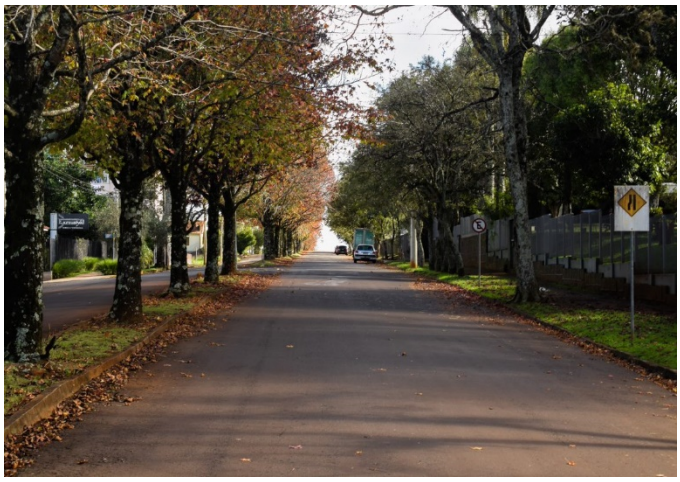
Applicability

Municipalities can apply urban forestry practices by preserving existing trees or planting new trees. In addition to providing stormwater management benefits, urban forests also provide aesthetic amenities in public spaces. For stormwater management, urban forestry is especially useful along roadways, around retention basins, along the banks of waterbodies and in sloping areas to catch excess stormwater and prevent soil erosion. Generally, it is ideal to preserve as much contiguous forest as possible; however, this may not be an option in many urban areas. If municipalities fragment forested areas, it is ideal for them to retain the closest fragments together.

Implementation

Critical Root Zone (CRZ)

The concept of a Critical Root Zone (CRZ) is essential to a proper management plan. The CRZ is the root area around a tree necessary for the tree's survival. Tree size, tree species and soil conditions determine the CRZ. Typically, the CRZ is the area around the tree's base that extends approximately 1 to 1.5 feet radially for every inch of the tree's diameter. The tree's diameter is measured at "breast height," which is 4.5 feet above grade. The CRZ can also be defined as the tree's drip line, which is the area under the tree's canopy. Whichever measurement is larger should define the CRZ, or an arborist or State Urban Forestry Coordinator—who can assess the importance of other environmental factors, such as tree age, soil conditions and others—should decide the CRZ. Municipalities should not disturb the CRZ for the sake of the tree's stability (North Carolina Urban Forest Council, n.d.).



Trees installed on both sides of a roadway.
Photo Credit: Mateus Campos Felipe/Unsplash

Urban Forestry Plans and Ordinances

Urban forestry plans and ordinances are tools municipalities can use to ensure the preservation and promotion of urban trees. An urban forestry plan should include measures to establish, conserve or reestablish preservation areas. The following are some typical elements of a forest conservation plan (MNCPP, 2011):

- A map and a narrative description of the forest and surrounding area that include topography, soils, streams, current forested and unforested areas, tree lines, critical habitats, and 100-year floodplain.
- An assessment that establishes preservation and reforestation areas, including any calculations, local requirements and tables summarizing forest areas.

> Organizations like American Forests dedicate themselves to helping municipalities focus on forest preservation and establishment. They provide updated research, tools, collaboration atmospheres, funding and organization partnerships to create policies and programs for local, state and federal organizations to empower the forestry field. Another program, the Urban and Community Forestry Program, provides information, tools, funding and even job opportunities in forestry.

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- A forest conservation map that outlines forest retention areas, reforestation, protective devices, limits of disturbance and stockpile areas.
- A schedule of any additional construction in and around the forest area.
- A specific management plan, including permanent tree and forest protection measures.

The Urban and Community Forestry Program of the North Carolina Forest Service and the North Carolina Wildlife Resources Commission provides a guide to creating a tree protection ordinance. According to the guidance, goals for a tree protection ordinance should include (Nicholas Institute, 2017):

- Reducing stormwater discharge.
- Moderating temperature and promoting energy conservation.
- Improving air quality.
- Improving surface drainage and aquifer recharge.
- Preventing soil erosion while promoting soil stabilization and enrichment.
- Improving water quality.
- Conserving natural resources and maintaining tree canopy.
- Providing wildlife habitat.
- Encouraging the protection and planting of native trees.
- Protecting, facilitating and enhancing the aesthetic qualities of the community to ensure that tree removal does not reduce property values.

A forest preservation ordinance is another way for a municipality to set design standards outlining how to preserve and manage a forest. Ordinances can apply to a site both during and after construction. Ordinances can stand on their own, or municipalities can require developers to integrate them into a proposed development's erosion and sediment control and stormwater pollution prevention plans, which many communities require of new developments. Resources like the Center for Watershed Protection's *Better Site Design Code and Ordinance Worksheet* (CWP, 2018) can help communities develop and evaluate codes and ordinances, especially those with the purposes of minimizing impervious cover, conserving natural areas and promoting practices that reduce stormwater discharge.

Trees as Urban Stormwater Management Systems

The prevalence of hard surfaces such as concrete in urban areas provides location limitations for new trees. However, municipalities can utilize structural cell systems on sidewalks and other paved areas to provide space for trees and underground stormwater management that would otherwise not exist. A typical structural cell system should incorporate suspended pavement with support from a network of pillars to allow for a large volume of soil, load-bearing capacity, drainage and root growth beneath the pavement. The cell should allow for stormwater capture and drainage during flooding. To further manage stormwater, green infrastructure such as permeable pavement, bioretention and green roofs can supplement the streetscape plots. For further structural information, see EPA's *Stormwater to Street Trees* report (U.S. EPA, 2013).

Limitations

One of the biggest limitations to urban forestry is development pressure. Incorporating ordinances, conservation easements and other techniques into management programs can help alleviate future development pressures. The size of the land may also limit the ability to protect individual trees. In such areas, a tree ordinance may be a more practical approach.

Forests may also harbor undesirable wildlife elements such as insects and other pests. If forests border houses, this may be a concern for residents. Additionally, the species and age of the tree affect its effectiveness as a stormwater management practice. Finally, as droughts, wildfires and higher-intensity storms become more frequent, trees may struggle to survive.

Maintenance Considerations

Maintenance considerations for urban forests may include fringe landscaping, trash pickup, watering and even removal. Municipalities can minimize maintenance efforts by using native vegetation and keeping the area as natural as possible.

Effectiveness

There are numerous environmental and stormwater benefits to urban forestry. Urban forests can:

- Act as natural stormwater management areas by filtering particulate matter, nutrients, sediments and pesticides. An acre of urban forest can reduce the annual load of nitrogen in stormwater by 21 to 82 pounds, phosphorus by 0.31 to 1.3 pounds, and total

suspended solids by 520 to 1500 pounds (CBP, 2018).

- Reduce stormwater discharges by intercepting water in their canopies and root zones. The stormwater then evaporates and transpires instead of converting to discharge. Through transpiration, tree roots also reduce soil moisture levels, which further increases the soil's infiltration and storage capacity.
- Reduce soil erosion by intercepting rainfall in their canopies, therefore reducing the volume and velocity of the rainfall hitting the soil.
- Absorb carbon dioxide and airborne pollutants, resulting in improved air quality.
- Absorb, transform or store trace amounts of pollutants from the soil and stormwater. These include metals, organic compounds, fuels and solvents.
- Provide habitat for urban wildlife.
- Provide recreational benefits and engage the community. Trees can provide attractive meeting places for the community, reduce the area's noise level and provide opportunities for education through organized planting events.

Cost Considerations[1]

Costs associated with implementing urban forestry practices can vary widely, especially when comparing the cost of conservation versus reforestation. Costs can be minimal when simply conserving existing trees and may only be due to planning and maintenance activities.

The costs associated with new urban forest areas can also vary depending on whether construction staff need to remove existing pavement or infrastructure, whether they need to purchase land, and what type of trees they are planting. As an average, the Maryland Department of the Environment estimates that the planting of urban trees or forest buffers costs roughly $13,000 per acre, not including the cost of impervious surface removal (King & Hagan, 2011). This cost is likely to be less if the area already has native trees. Moreover, urban forests can be a much cheaper option for cities than traditional landscaping. According to a 2008 forum that the American Society of Landscape Architects and the Urban Land Institute co-sponsored, preserving existing forested areas can save $530,000 per acre in development costs compared to conventional landscape solutions (SSI, 2009).

Urban forests require routine maintenance that, depending on the type of trees, can include watering, pruning, mulching and crown thinning. The Maryland Department of the Environment estimates the annual cost of maintaining an urban forest to be $470 per acre (King & Hagan, 2011). If municipalities do not maintain trees, the cost of removing dead trees from their plots and the property damage from fallen branches or whole trees can be larger than the annual maintenance cost (Vogt et al., 2015).

In a study by the U.S. Department of Agriculture (USDA) Forest Service, a tree can hold up to 0.008 inches of rainwater per unit area of canopy cover in a given rainfall event. For a typical tree with a canopy area of 3000 square feet, this translates to about 13 gallons of water (USDA Forest Service, 2020).

In addition to typical economic considerations, trees have natural properties that lead to indirect economic benefits for residential and municipal properties (Coder, 2017; U.S. EPA, 2007; Peper et al., 2007). Studies have shown forests to increase property value due to their aesthetic appeal (U.S. EPA, 2007). In a study of New York City trees, Peper et al. (2007) found trees to increase property values by $24 to $155 per tree in an urban setting, depending on the species. The authors also found that each tree provided, on average, a $78 benefit in terms of its stormwater management services through canopy interception and transpiration. In total, by estimating a suite of monetizable benefits that trees provide in an urban setting—which include reducing the energy demand of buildings through shading and passive cooling, carbon capture, improved air quality, stormwater management, and aesthetic benefits—Peper et al. (2007) found that for every $1 spent on tree installation and management, $5.6 were returned to the community.

[1] Prices updated to 2020 dollars. Inflation rates obtained from the Bureau of Labor Statistics CPI Inflation Calculator Web site https://data.bls.gov/cgi-bin/cpicalc.pl.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.