TREES AS BMPS

Using Tree Canopy for Stormwater Runoff Reduction

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Comprehensive Environmental Inc.

Presented at CEI’s Navigating the New Stormwater Permit on March 30, 2017 in Marlborough, MA
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Runoff reduction benefits of tree canopy
- Why consider tree canopy?
- Can we quantify the benefit?
- Sustainability

Tree Canopy & the MS4 Program
- New development/redevelopment credits
- Community tree programs

Other considerations
- Safety
- Nutrient Management
Ecological Services of Trees

Municipal Forest Resource Analysis: New York City (Center for Urban Forest Research, 2007)

- Tree inventory & benefit analysis quantified:
  - Energy savings
  - CO2 reduction
  - Other air pollutant reduction
  - Enhanced property value
  - Stormwater runoff reduction

Source: CUFR 2007
Annually, trees provide $121.9 million in ecological services for NYC.
- $209 per tree
- $5.60 in benefits for every $1.00 for tree planting and care

Trees provide $35.6 million annual savings in treating stormwater, because of rainfall interception
- Average reduction of 1432 gallons per tree per year
Stormwater Benefits of Trees

The Tree Benefit Calculator indicates a 12-inch Red Maple in the Northeast intercepts 1353 gallons of water per year (~3.8” over the area of its crown).

National Tree Benefit Calculator
https://www.arborday.org/calculator/index.cfm

http://www.publicdomainpictures.net/
Stormwater Benefits of Trees

- CEI Project: “Tree Canopy Stormwater Implementation & Outreach Program”
  - Quantify stormwater benefits of trees
  - Explore use of tree canopy for stormwater management under Federal and State programs
  - Develop implementation and outreach tools to promote tree canopy management as a BMP
- Financed with Federal Funds from the EPA under § 319 (MassDEP Project 14-07/319)
- Developed by USDA Forest Service & partners
  Arbor Day Foundation  Davey Tree Expert Company
  Society of Municipal Arborists  Casey Trees
  International Society of Arboriculture

- Suite of Software Applications & Utilities
  - i-Tree Design
  - i-Tree Hydro
  - i-Tree Species
  - Other “urban forest management” applications
Stormwater Benefits of Trees

- Apply *i-Tree Hydro* to prototype scenarios:
  - Subdivision roads
  - Urban streets
  - Parking lots

(Alex92287 – Flickr.com)

(Using Trees to Reduce Stormwater Runoff - Center for Watershed Protection/USDA Forest Service)
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Runoff reduction
Phosphorus reduction
Subdivision Road Alternatives

Total area under canopy 41% 57% 81%
Impervious under canopy 31% 41% 74%
Urban Street Alternatives

<table>
<thead>
<tr>
<th>Description</th>
<th>11%</th>
<th>41%</th>
<th>53%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area under canopy</td>
<td>11%</td>
<td>41%</td>
<td>53%</td>
</tr>
<tr>
<td>Impervious under canopy</td>
<td>11%</td>
<td>41%</td>
<td>53%</td>
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</tbody>
</table>
Parking Lot Alternatives

<table>
<thead>
<tr>
<th>Total area under canopy</th>
<th>11%</th>
<th>25%</th>
<th>38%</th>
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</thead>
<tbody>
<tr>
<td>Impervious under canopy</td>
<td>7%</td>
<td>18%</td>
<td>26%</td>
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Results of i-Tree Hydro Analysis

Runoff reduction ~ 15% for impervious surface located beneath tree canopy

Range for scenarios analyzed = 7 to 74%

Impervious Area Beneath Canopy as % of Total Impervious Area

Runoff Reduction Over Total Impervious Area

y = 0.1524x

Range for scenarios analyzed = 1.1 to 12.4%
Runoff Reduction WQV Credit

- Shaded Impervious Surface Only
Section 2.3.6. of Permit issued in 2016 requires:

- MS4’s must have a program to address post construction stormwater management
- New development and redevelopment projects must retain runoff and/or treat for specified removals of TSS (and other pollutants)

<table>
<thead>
<tr>
<th>New development</th>
<th>Retain 1.0-inch runoff volume from total post-development impervious surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redevelopment</td>
<td>Retain 0.80-inch runoff volume from total post-development impervious surface</td>
</tr>
</tbody>
</table>
US EPA NPDES MS4 Permit

- Regulatory language for credits for tree canopy:
  - Preserve existing trees overhanging pavement
  - Provide new trees that will grow to overhang pavement
  - Provide for long term viability
- Credits designed to allow a reduction in volume of runoff retained and/or treated for either new or redevelopment projects
Runoff Reduction Credit

- Limits on disturbance around existing an existing trees

How close can new pavement encroach without damaging tree?

Recommend requiring assessment by a qualified tree professional

Tree species vary in sensitivity:

http://www.extension.umn.edu/garden/yard-garden/trees-shrubs/protecting-trees-from-construction-damage/#pavement

http://www.seattle.gov/trees/treeCare.htm
Runoff Reduction Credit

- New tree plantings – need to account for variation over the lifetime of the tree.

![Graph showing annual interception in gallons for different tree species over years after planting.](image-url)
Runoff Reduction Credit

- Applies to pavement with overhanging canopy
- Existing trees:
  - 15% volume reduction for qualifying trees
  - Protection of trees during construction
  - Limits on new pavement beneath the tree
- New tree plantings
  - 7.5% volume reduction for qualifying trees
  - Provision of adequate soils volume for long term viability
- Requires maintenance and replacement
Canopy Tree/Pavement Relationship

Will the tree destroy the pavement...

...or will the pavement kill the tree?

(MassDOT)

(Using Trees to Reduce Stormwater Runoff- Center for Watershed Protection/USDA Forest Service)

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Tree versus pavement...

Source: McPherson & McDonagh, 2012
Average life expectancy of urban tree = 7 to 10 years
Limited by soil water and nutrient storage
Solution = ~ 2 cu. ft. of soil volume per sq. ft. of crown

Properly sized planting beds - assist where needed using:

- Suspended pavement/structural cells
- Structural soil material

http://www.davey.com/media/183712/Stormwater_to_Street_Trees.pdf

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Long term management considerations

- Prevention of future removal
- Provision for replacement
- Provision for tree maintenance
- Provision for pavement sweeping
Tree Canopy BMP Website

www.treecanopybmp.org

- Information about the study
- Links to resources
- Model regulatory language
- Outreach materials
Community Programs

Links to resources

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* We anticipate this language will be compatible with model bylaw & regulations under development by MAPC/Neponset Stormwater Partnership, to be available mid-2017

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Community Programs

Map/Inventory Public Trees and Benefits

GIS-based canopy mapping utility

Tree inventory protocol & supporting analysis software
Community Programs

Map/Inventory Public Trees and Benefits

sUAV mapping & analysis

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Safety Considerations

How much “clear zone” is enough? (context sensitive)

MassDOT
Nutrient Loading Considerations
Questions?

Tree Canopy Stormwater Implementation & Outreach Program

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