



Annual Nonpoint Source Conference

April 29, 2014

IS YOUR ROAD A BMP?



Presented by

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Roads as BMPs

Application of Low Impact Development/
Integrated Site Design to Roadways:

Goal of the design approach is to:

- ▣ First...Significantly minimize or reduce runoff/pollutants
- ▣ Then... treat the remaining runoff.

Roads as BMPs

Integrated Site Design for roadways, involves

- ▣ Minimizing effective impervious cover (EIC):
 - Directly reducing/minimizing pavement
 - Maximizing infiltration
 - Maximizing vegetative uptake
- ▣ Managing pollutants close to their source

Roads as BMPs

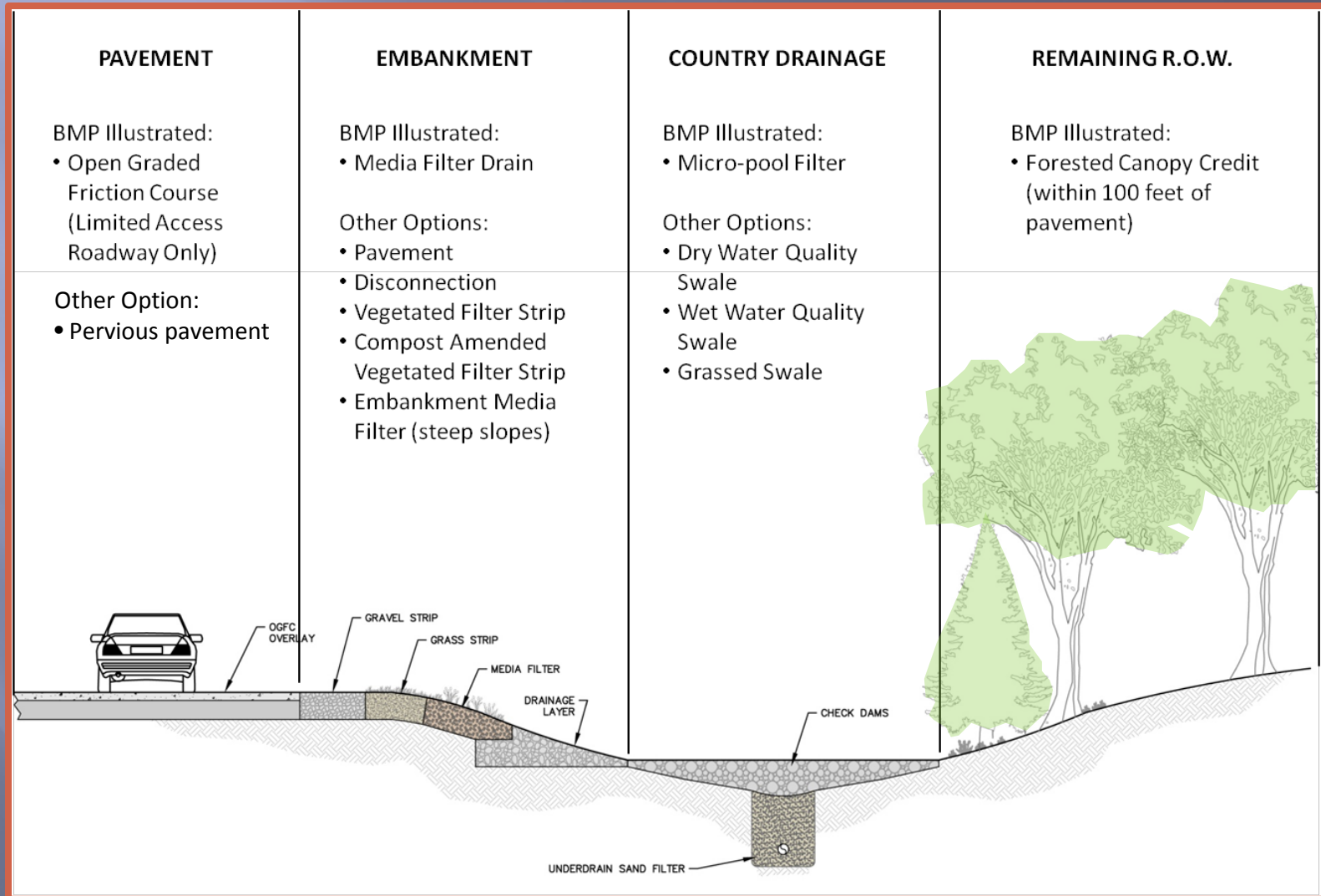
Roadways consist of

- ▣ Paved surfaces
- ▣ Graded side slopes
- ▣ Drainage conveyance systems
- ▣ Managed rights-of-way

Develop a design approach to integrate runoff reduction and pollutant attenuation functions into these features.

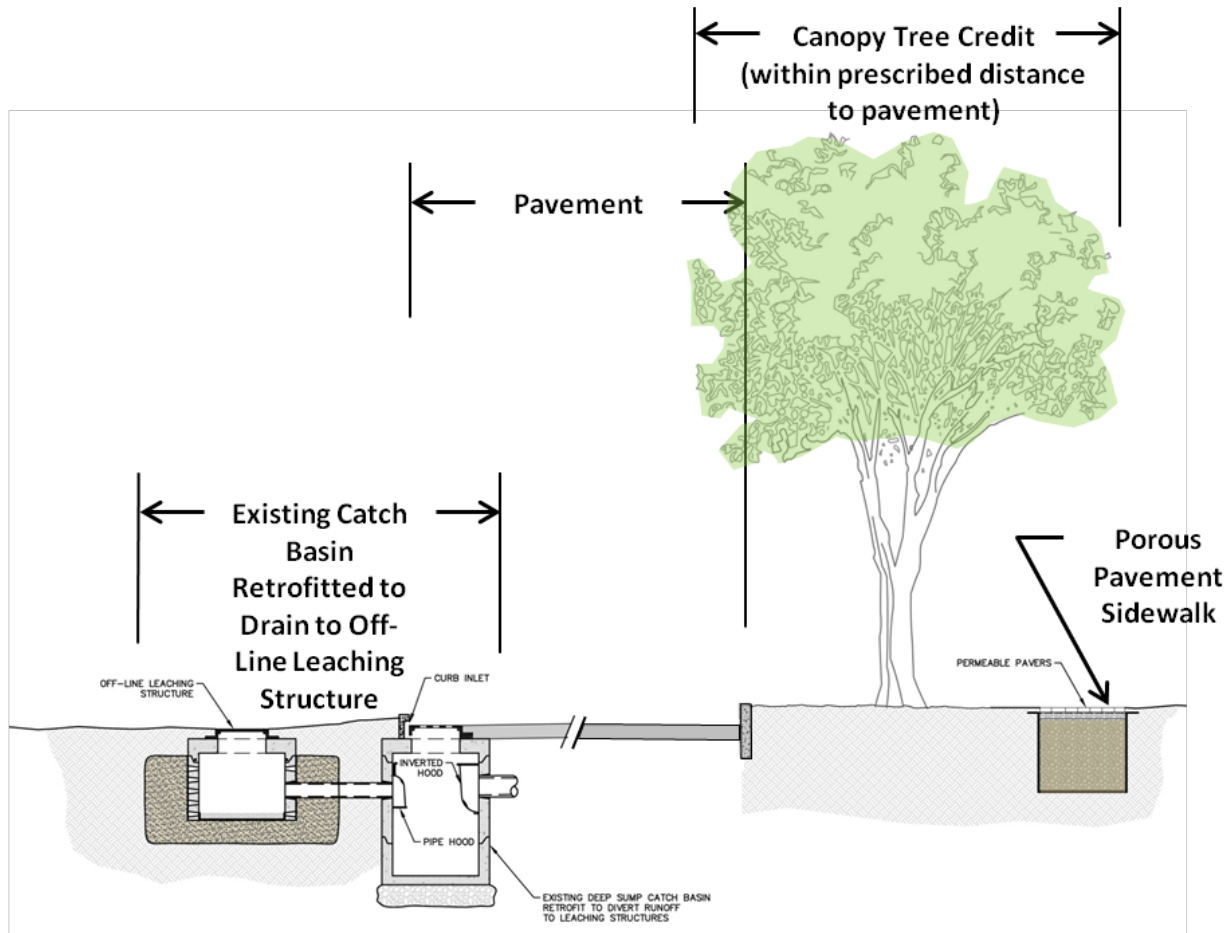
Roads as BMPs

Rural Roadways



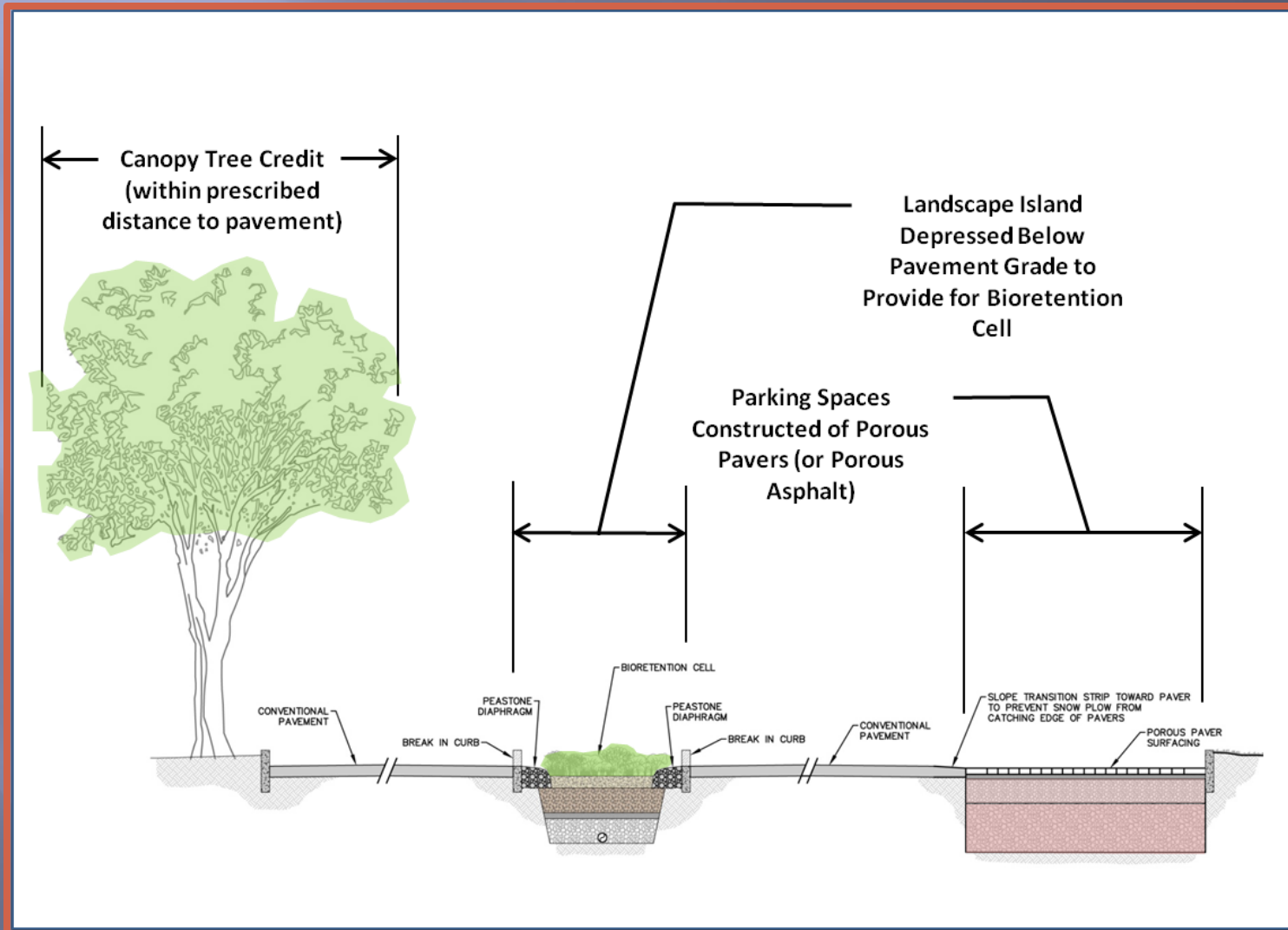
Roads as BMPs

Urban Streets



Roads as BMPs

Parking and Service Facilities



Design Roads as BMPs

Consider roadway elements as potential BMPs:

- ▣ Pavement stormwater practices
- ▣ Embankment stormwater practices
- ▣ Conveyance stormwater practices
- ▣ Roadway landscape stormwater practices

Pavement Options: Pervious Pavements



deeproot.com



Raleighnc.gov



co.jefferson.wa.us

Pavement Options: Pervious Pavements

Maine Mall Road, South Portland, ME

~16750 AADT within Project Limits



Maine Mall Road - Construction 7/27/2009



Maine Mall Parking Lot 1/17/2013



Maine Mall Road - Same Day

Source: Maine DOT

Pavement Options:

Open Graded Friction Course (OGFC)



Conventional Pavement



Open Graded Friction Course

Source: Barrett, M. and C. Shaw. 2006.
Stormwater Quality Benefits of a Porous Asphalt Overlay.

Pavement Options:

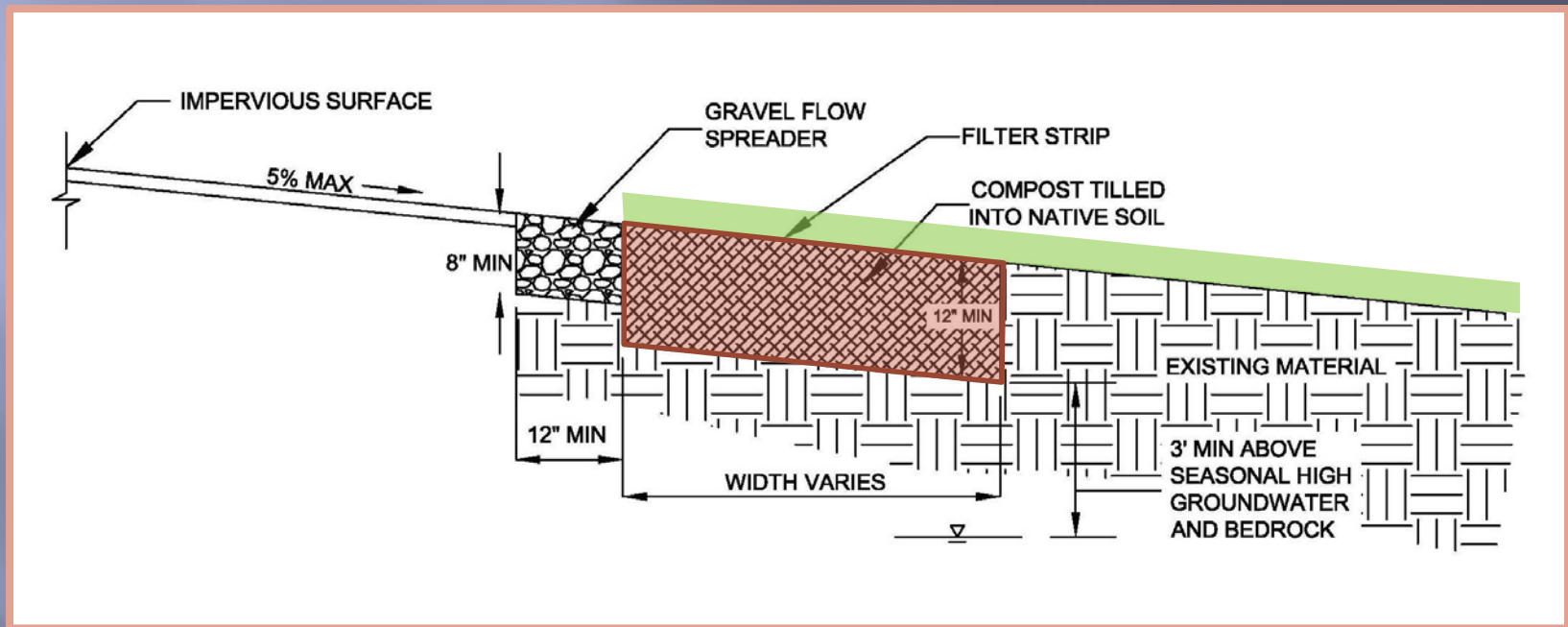
Open Graded Friction Course (OGFC)

OGFC Pollutant Reduction Relative to Conventional Pavements

Study	Pollutant (Relative % Reduction)				
	TSS	Total P	Total Cu	Total Pb	Total Zn
Berbee, et.al., 1999	91	-	67	92	90
Pagotto, et.al., 2000	90	-	35	78	66
Barrett, et.al., 2005	93	-	79	95	73
Barrett & Shaw, 2006	91	35	-	90	75
Barrett, et.al., 2006	94	-	75	93	76
Stannard, et.al., 2008	88-92	51-64	51-58	88-91	81-84
Eck, et.al., 2011	91-96	66-78	56-69	>90 - >96	87-90

Eck, et.al., 2011 also shows relative reduction does not deteriorate over time.

Embankment Options: Compost Amended Vegetated Filter Strips (CAVFS)



2/3 loamy sand and 1/3 compost

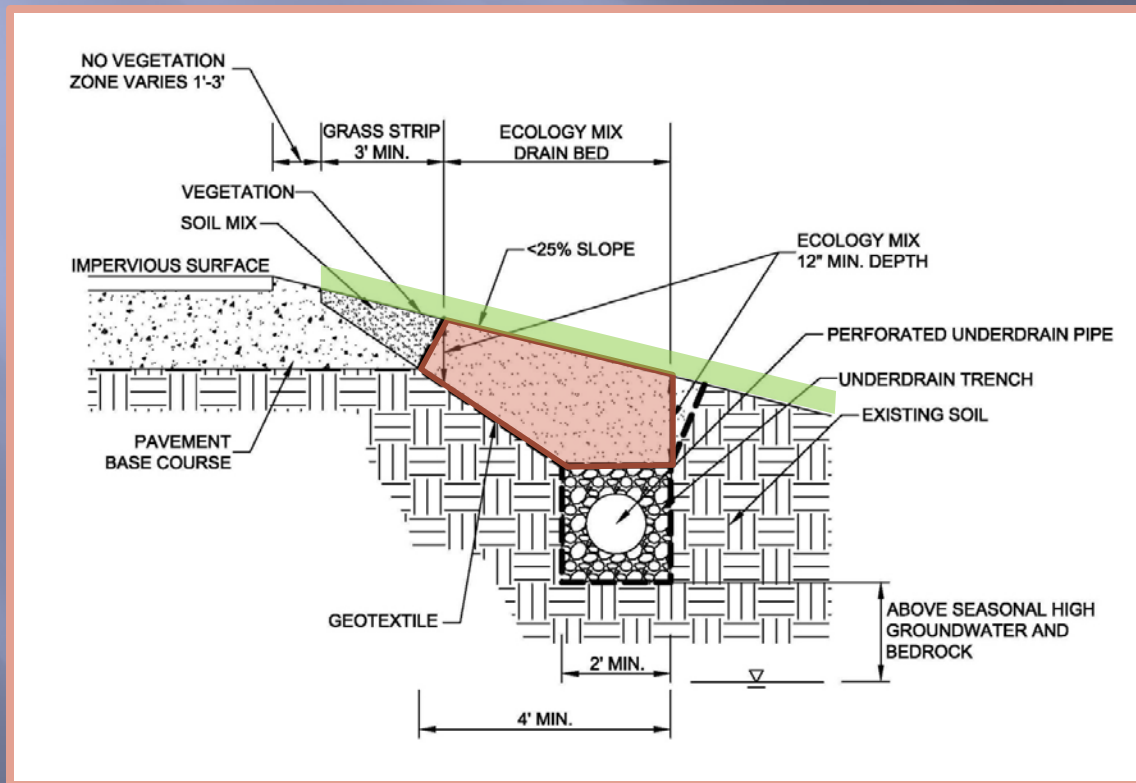
Adapted from Washington Department of Transportation

Embankment Options: Compost Amended Vegetated Filter Strips (CAVFS)

CAVS Pollutant Removal

Study	Pollutant			
	TSS	Total P	Total Cu	Total Zn
WSDOT, 2005 (% Removal, conc.)	84	-17	79	67
Herrara, 2007 (% Removal, conc.)	94	77-84	80-84	87-90
Herrara, 2007 (% Load Reduction)	98-99	96-99	96-100	97-100

Embankment Options: Media Filter Drain (MFD)



Ecology Mix:

crushed stone aggregate
perlite
dolomite
gypsum

Adapted from Washington Department of Transportation

Embankment Options: Media Filter Drain (MFD)

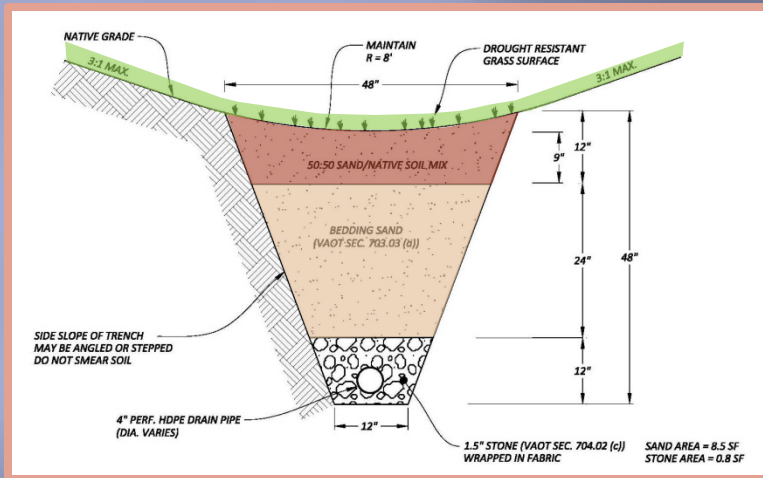
Media Filter Drain Pollutant Removal

Study	Pollutant (% Removal)						
	TSS	Total P	Total N	Total Cu	Total Pb	Total Zn	Turbidity
WSDOT, 2005	95	84		82		89	
Wright Water Eng'rs, et.al., 2011				57	67-85	59-83	
Geosyntec, et.al., 2010		47	42				
Geosyntec, et. al., 2011							80

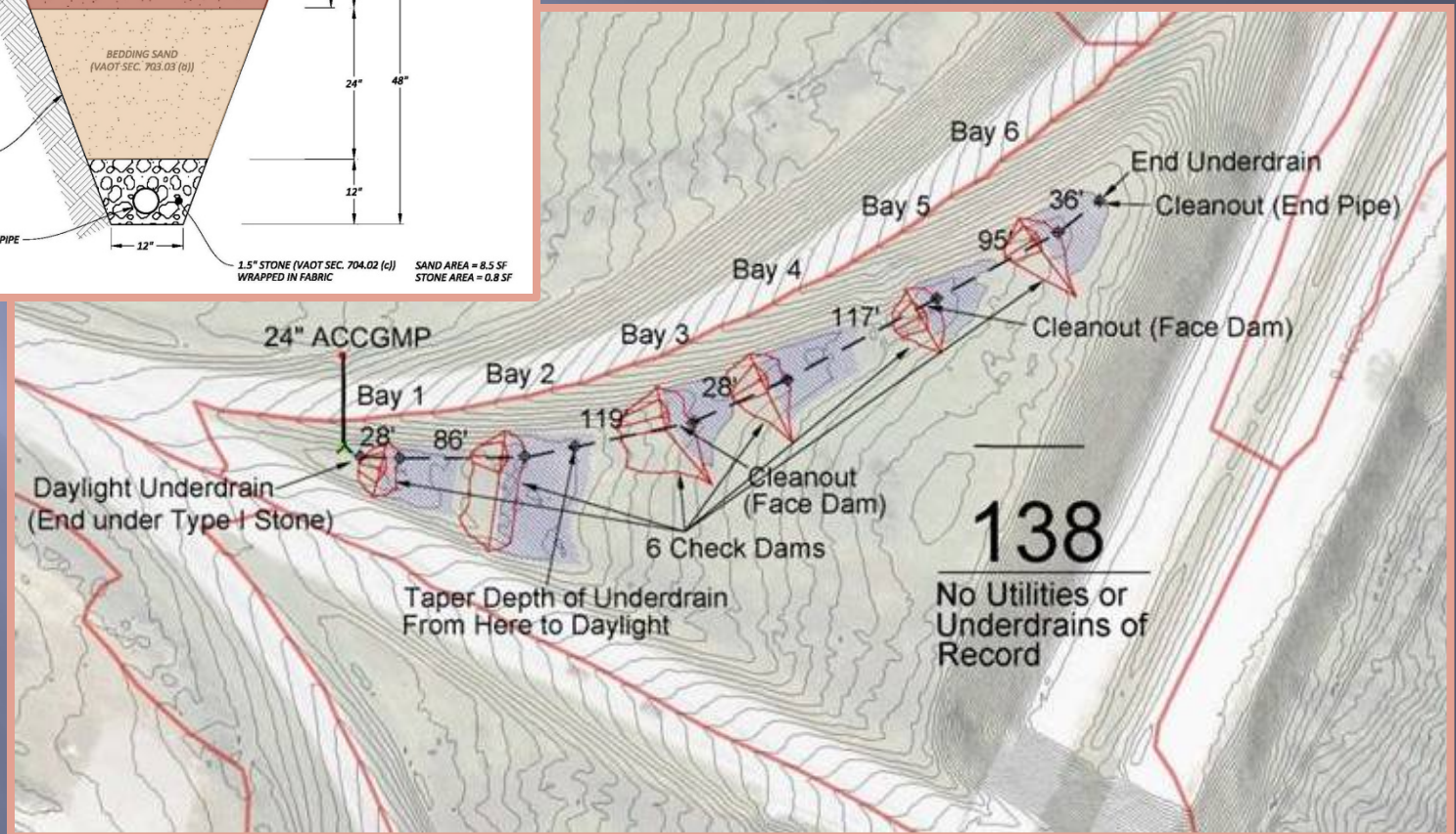
Conveyance System Options

- ▣ Accessible, maintainable systems based on use of natural materials
- ▣ Linear conveyance systems that provide treatment; examples:
 - Water Quality Swales
 - Linear Bioretention Swales
 - Variations: think outside the box:
VTrans Micro-Pool Filter

Conveyance System Options: Micro-Pool Filter



Source: Vermont Agency of Transportation

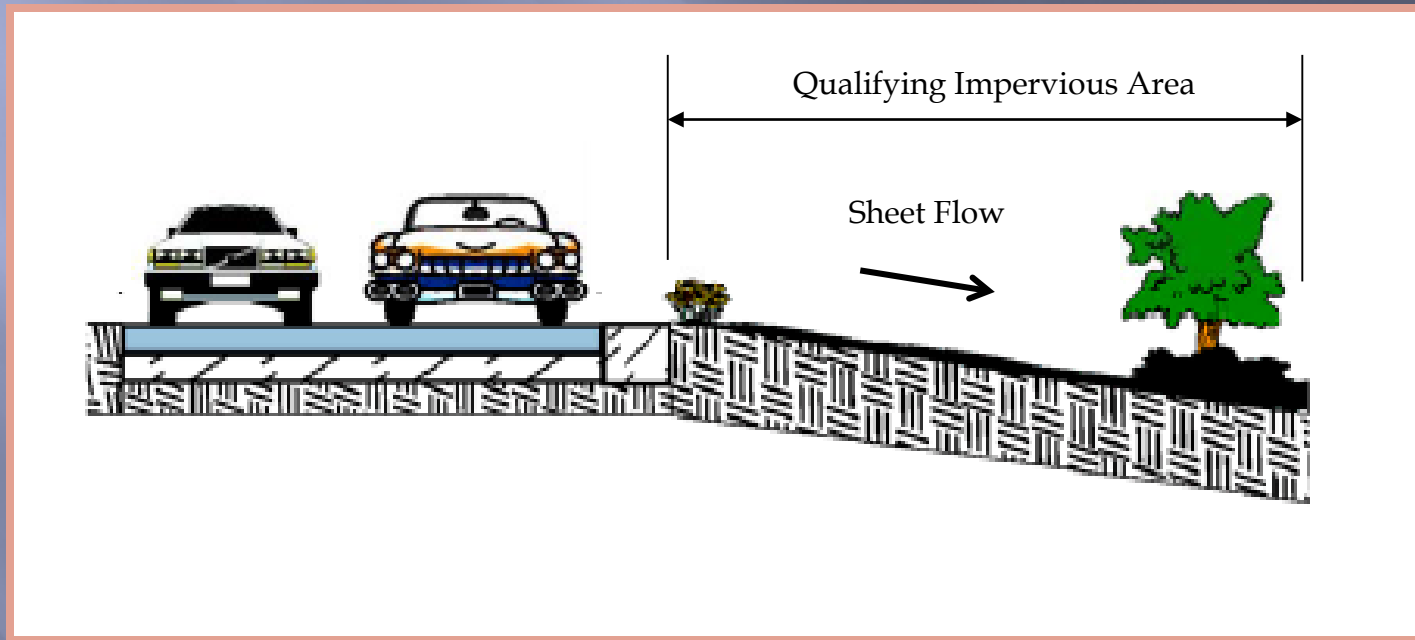


Conveyance System Options: Micro-Pool Filter

Estimated Micro-Pool Pollutant Removal

Source	Pollutant (% Removal)			
	TSS	Total P	Total N	Cu, Pb, Zn, Cd
MassDEP, 2008 Data for Sand Filters	80	10-50	20-40	50-90
Plus:	Channel Protection Enhanced treatment by settling pools, vegetated filter layer			

Landscape Management Options: Pavement Disconnection

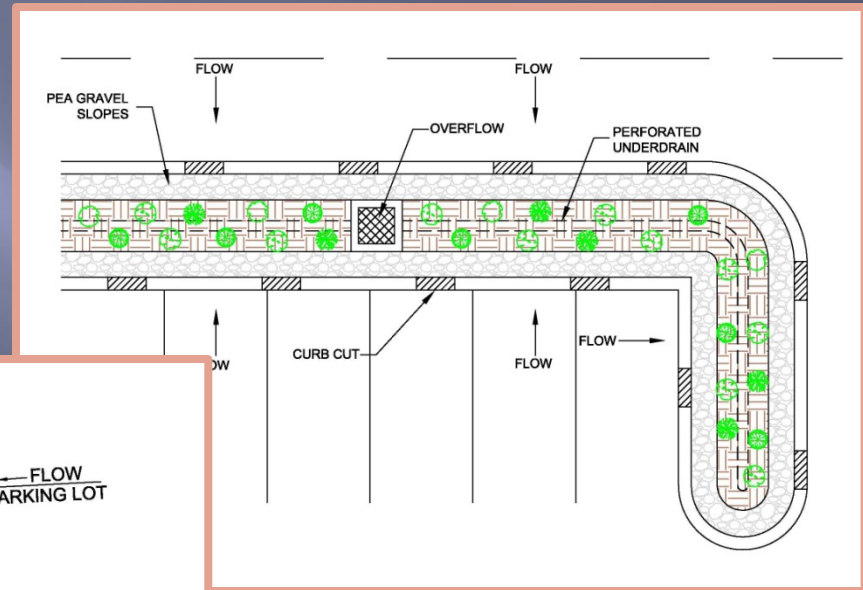
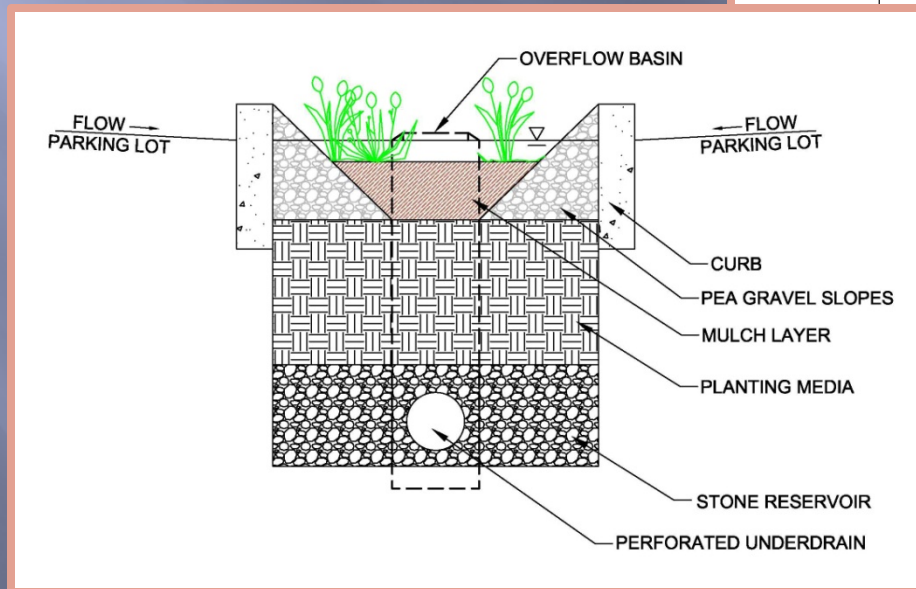


Adapted from Maryland Stormwater Design Manual

Landscape Options: “Micro” treatment systems

Scale BMPs to fit the
design context; example:

Micro-Bioretention Cell



Adapted from Maryland
Stormwater Design Manual

Landscape Options: Trees in the Roadway Landscape

Trees *as* BMPs

- ▣ Urban street trees (individual trees)
- ▣ Wooded landscape



(carsmoveus.com)



CUFR 2007

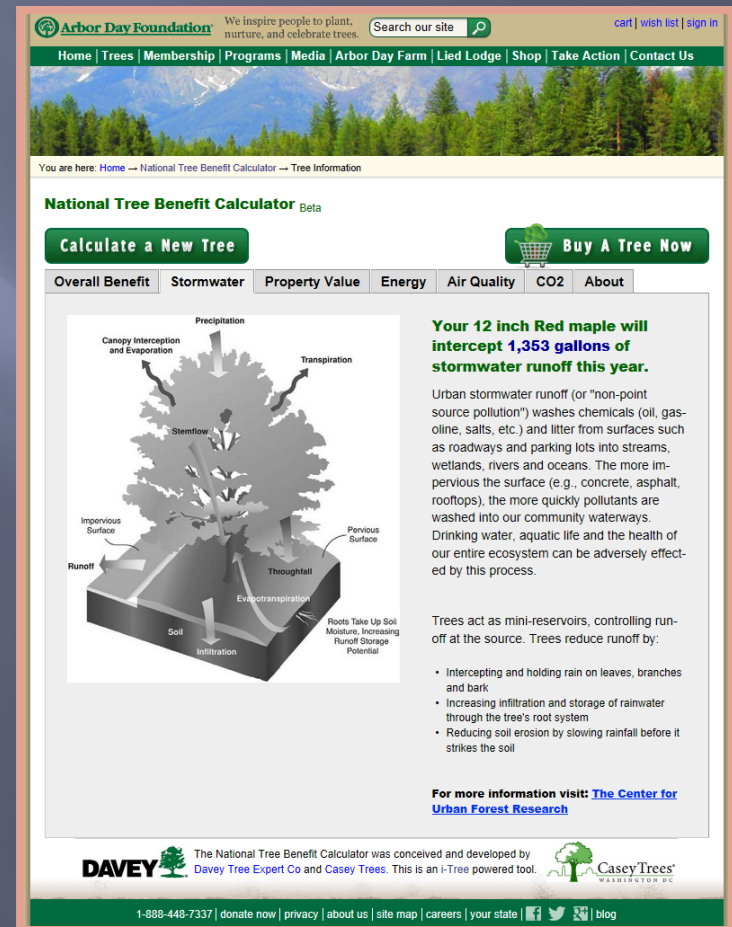
Landscape Options: Trees in the Roadway Landscape

In Central Massachusetts,
a 12-inch Red Maple...

- ▣ Intercepts 1353 gallons of water per year;
- ▣ Equals 3.8 inches of runoff reduction over the area of the tree's canopy
- ▣ **Significant "Runoff Reduction" potential**

National Tree Benefit Calculator

<https://www.arboday.org/calculator/index.cfm>

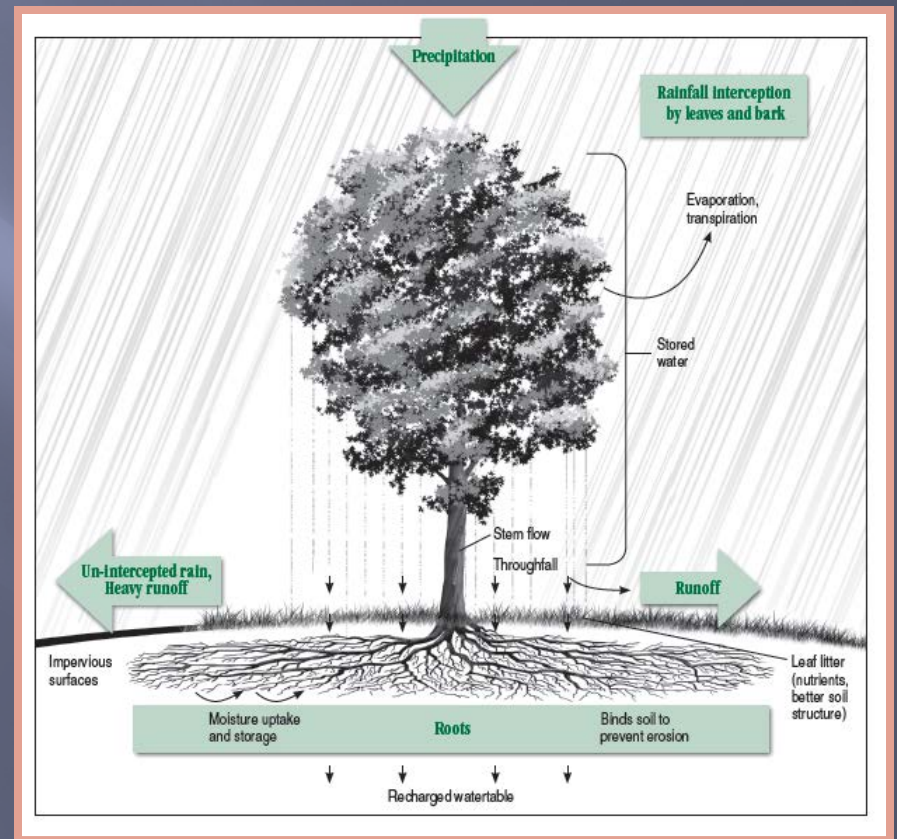


The screenshot shows the website for the National Tree Benefit Calculator. At the top, there is a navigation bar with links for Home, Trees, Membership, Programs, Media, Arbor Day Farm, Lied Lodge, Shop, Take Action, and Contact Us. Below the navigation bar is a search bar and a "Buy A Tree Now" button. The main content area features a "National Tree Benefit Calculator" section with a "Calculate a New Tree" button and a "Buy A Tree Now" button. A diagram illustrates the water cycle around a tree, showing precipitation, transpiration, stemflow, throughfall, evapotranspiration, runoff, and infiltration. A text box states: "Your 12 inch Red maple will intercept 1,353 gallons of stormwater runoff this year." Below this, there is a list of benefits: "Trees act as mini-reservoirs, controlling runoff at the source. Trees reduce runoff by: • Intercepting and holding rain on leaves, branches and bark • Increasing infiltration and storage of rainwater through the tree's root system • Reducing soil erosion by slowing rainfall before it strikes the soil". At the bottom, there is a footer with the Davey logo and the text: "The National Tree Benefit Calculator was conceived and developed by Davey Tree Expert Co and Casey Trees. This is an i-Tree powered tool." and the Casey Trees logo.

Landscape Options: Trees in the Roadway Landscape

In addition to interception/evaporation, trees reduce runoff by:

- Uptake and transpiration from the ground
- Enhancing infiltration into the ground
- Roots binding soil, preventing erosion and associated accelerated runoff



Source: Tree City USA Bulletin No. 55
Arbor Day Foundation

Landscape Options: Trees in the Roadway Landscape

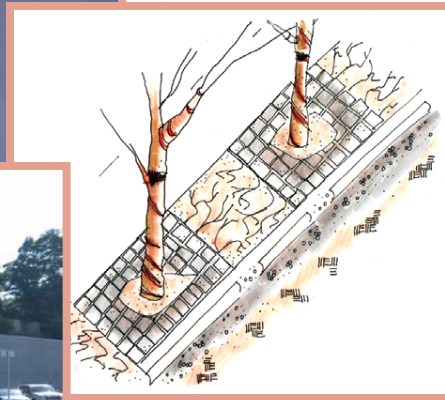
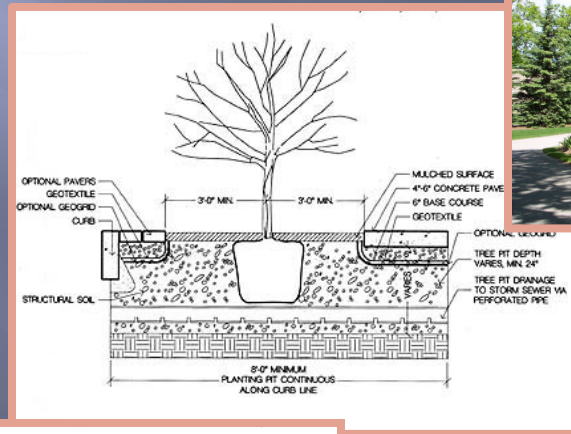
Use trees for runoff reduction:

- ▣ Introduction, restoration, or preservation of individual canopy trees
- ▣ Preservation/restoration of forested landscape
- ▣ Incentives for implementation of these measures

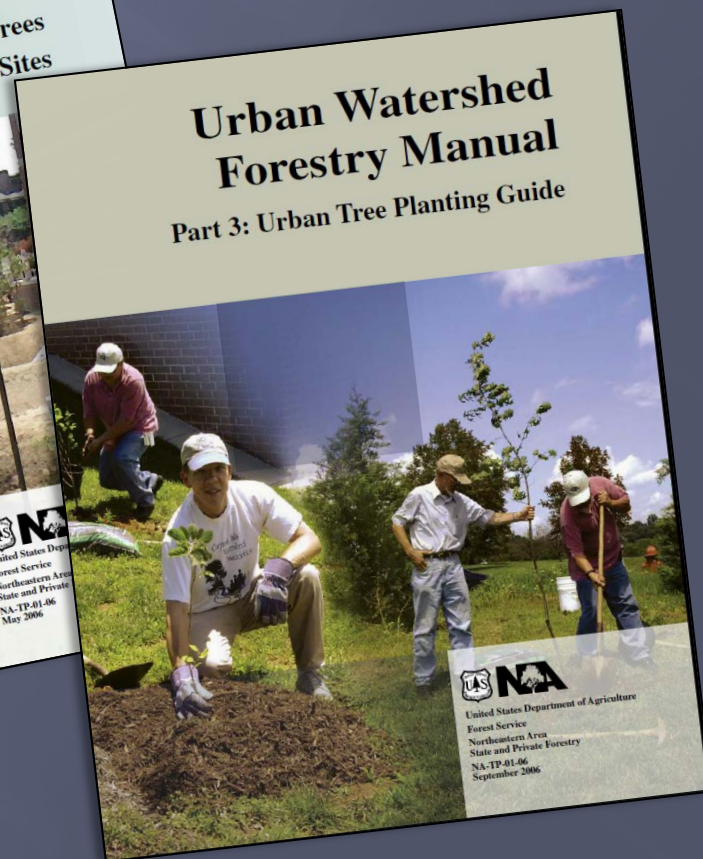
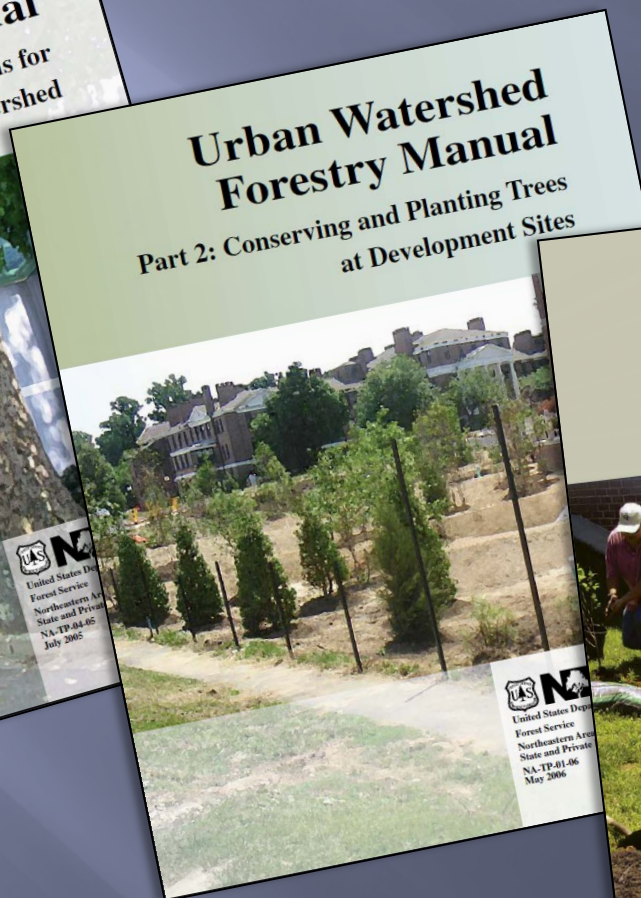
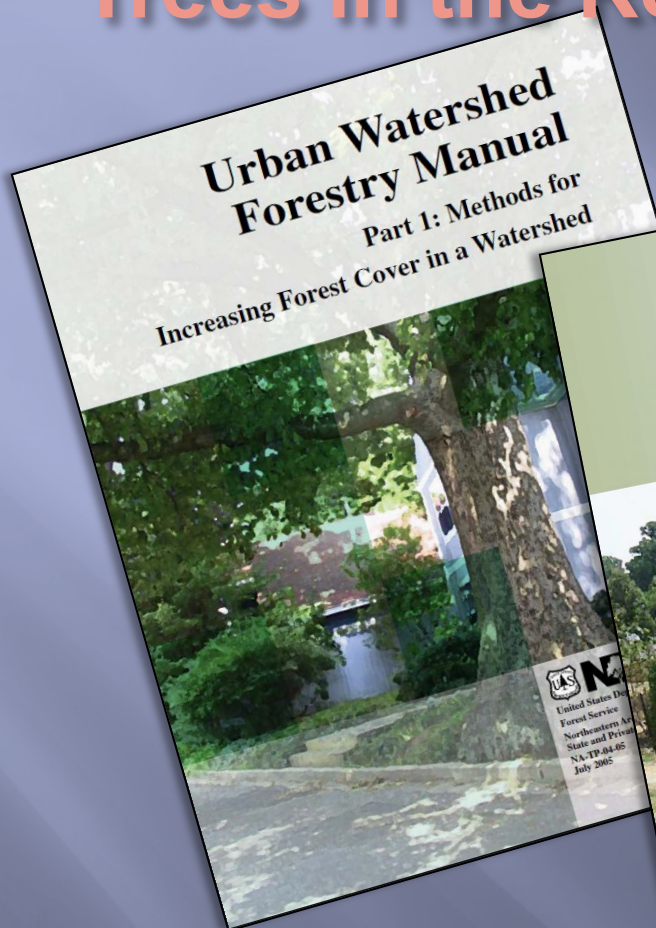
Landscape Options: Credits for Trees

- ▣ City of Philadelphia, PA stormwater program:
 - Water Quality Volume reduction for individual trees
 - Existing tree preservation (canopy within 20 feet)
 - New tree installation (canopy within 10 feet)
 - Must comply with specified standards
- ▣ Pennsylvania (State) Stormwater BMP Manual
 - Individual tree credits
 - Forested area credits (within 100 feet)
- ▣ Portland, OR
 - Comparable practices to Philadelphia

Landscape Options: Trees in the Roadway Landscape



Landscape Options: Trees in the Roadway Landscape



[http://www.na.fs.fed.us/pubs/uf/watershed1/
urban_watershed_forestry_manual_part1.pdf](http://www.na.fs.fed.us/pubs/uf/watershed1/urban_watershed_forestry_manual_part1.pdf)

Is Your Road a BMP?

Tree Canopy
Preservation?

Enhanced
Conveyance
System?



Pavement
Disconnection?

Media Filter
Drain?

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