Urban Stormwater Runoff
Phosphorus Loading & BMP Treatment Capability

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Imbrium Systems
Co-authors:
Brian Lee & Joel Garbon

October 22, 2009
Overview

- Phosphorus Basics
- Urban Sources & Loads
- BMP performance
- Advanced Removal Mechanism
- Applications
- Things to Avoid
Phosphorus

- Essential nutrient for life
- Cyclic between Land & Water
- Limiting nutrient in fresh water
- Identified in Stormwater as:
  - Particulate-bound phosphorus
  - Dissolved phosphorus (DP)
Millions of Years
Problem:

- Excess Phosphorus in fresh water causes *Eutrophication* (over enrichment):
  - Algal blooms
    - Micro-toxins ... **Toxic Cyanobacteria**
  - Hypoxia --- depletion of Dissolved Oxygen
    - Fish kills
    - Invasive species

Hampton Roads Bridge Tunnel - AUG. 18, 2009
Photo – The Virginia-Pilot / Ryan Henriksen
Additional Eutrophication Issues:

- Taste & odor problems
- Water clarity
- Fish & aquatic community
- Recreational quality
- Property values

York River near Gloucester Point, VA - Sept. 9, 2005

Photo by Bill Portlock – Chesapeake Bay Foundation
Canadian Experimental Lakes Area # 226:

- Curtain divided lake
- Carbon & Nitrogen added to both sides
- Phosphorus added to lower half
Qingdao, Eastern China`s Shandong province
July, 2008
It'll be clean some day...

Fertilizer

Chesapeake Bay

Sync together or sink separately.
Chesapeake Bay Watershed

Relative Responsibility for Pollution Loads to the bay

Nitrogen: Agriculture 42%, Urban Suburban 32%, Wastewater 20%, Atmospheric 22%

Phosphorus: Agriculture 46%, Wastewater 22%, Urban Suburban 32%

Sediment: Agriculture 76%, Urban Suburban 24%
Typical Urban Stormwater
Phosphorus Sources

- Fertilizers
- Waste Water (CSO / Septic)
- Animal Waste
- Development ... Sediment Loss & exposure
- Airborne Fallout: Dust, Pollen, Fossil Fuels
- Vegetation / Leaves
- Detergents
- Hydrocarbons & Lubricants
Chesapeake Bay
Pollen Load from
Outfalls APR09
Total Phosphorus
Stormwater Loading by Land Use

Pounds / Acre / Year

Total Phosphorus

Commercial
Industry
High Density Residential
Highways
Parking Lot
Shopping Center
Med. Density Residential
Parks
Low Density Residential

EPA Stormwater BMP Design Guide, 2004
Total Phosphorus Load with Increasing % Tree Canopy
Stormwater

Total Phosphorus (TP) Partitioning

1. Particulate-Bound (PB) Phosphorus

2. Dissolved Phosphorus (DP)
   - less than 0.45-micron
     - Soluble Reactive Phosphorus (SRP) / Bio-available
     - “QUICK SUGAR” for Algal Blooms
### Stormwater Runoff

#### Phosphorus Partitioning by Land Use

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Open Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. TP EMC (mg/L)</td>
<td>0.41</td>
<td>0.34</td>
<td>0.45</td>
<td>0.59</td>
</tr>
<tr>
<td>Ave. DP EMC (mg/L)</td>
<td>0.20</td>
<td>0.18</td>
<td>0.16</td>
<td>0.16</td>
</tr>
</tbody>
</table>

- **TP = Particulate-bound phosphorus & Dissolved Phosphorus**
- **DP = Dissolved Phosphorus**
- **PB = Particulate-bound Phosphorus**

New York State DEC, 2008
Total Phosphorus (TP) Removal

BMP Efficiencies

- Dry Ponds
- Wet Ponds
- Wetland
- Filtering Practices
- Bioretention
- Infiltration Practices
- Open Channels

Center for Watershed Protection, National Pollutant Performance Removal Database version3, Sept. 2007
Typical Urban Stormwater BMPs designed to captures 80% TSS:

80% TSS capture X 50% (particulate-bound phosphorus) = 40% (TP) Removal
Natural factors impacting Phosphorus Fate in Stormwater Runoff & BMPs

- Water chemistry conditions
  - pH
  - Alkalinity
  - Temperature
  - Redox potential
  - Particle charge
  - Concentration
- Time / maintenance frequency
Phosphorus Fate

- Phosphorus speciation will shift
  - Sediments release Phosphorus
    - Particulate-bound (PB) shifts into Dissolved Phosphorus (DP)

- Examples
  - Impact of acid rain (pH of 7.0 versus 4.5)
  - Runoff detained versus diluted (pH & time)
    - Denitrification - Anaerobic activity / decaying organics
Stormwater TP Removal
Mechanisms & Generalized Capability

<table>
<thead>
<tr>
<th>Primary Unit Process / Removal Mechanism</th>
<th>Total Phosphorus (TP)</th>
<th>Particulate-bound Phosphorus (PB)</th>
<th>Dissolved Phosphorus (DP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedimentation</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Filtration</td>
<td>Yes</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Biological Uptake</td>
<td>Limited</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>*assuming vegetative harvesting</td>
<td></td>
<td>*assuming vegetative harvesting</td>
<td></td>
</tr>
<tr>
<td>Sorption</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Sorption

- Combination of complex physiochemical interactions;
  - Adsorption - surface attachment
  - Absorption - internal attachment (sponge)
  - Ion Exchange - displacement of ions (Ca, Mg, Na)

- **Sorption Capacity --- mg/g**

Compared to soils ...

- **Ion Exchange Capacity --- meq/100g**
Ways to increase TP removal & reduce performance variance?

1. **↑ TSS Removal**  
   (particulate-bound P Removal)  
   - Focus on Filtration & Infiltration  
   - ↑ Volume treated

2. **Prevent Phosphorus Speciation Shift**  
   - Better BMP Design Consideration / Engineering  
   - ↑ Maintenance frequency

3. **Amend BMPs to Capture Dissolved Phosphorus**  
   - Sorption
Quantifying Sorption Capability for Dissolved Pollutant Removal

- **Isotherm** —
  - How much can it hold?

- **Kinetics** —
  - How fast can it go in?

- **Breakthrough** —
  - How much before it is full? (maintenance)

- **Desorption** —
  - Retaining DP ... is the bond strong enough?
# Dissolved Phosphorus (DP) Sorption Performance

(T. Wu et al, Stormwater Phosphorus Adsorption on Oxide Coated Media, WEFTEC, 2008)

<table>
<thead>
<tr>
<th>Media Type</th>
<th>Isotherm $K_f$ (mg/g)</th>
<th>Kinetics $q_e$ (mg/g)</th>
<th>Breakthrough Exhaustion (BVs)</th>
<th>Desorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-oxide Pumice</td>
<td>0.40</td>
<td>1.19</td>
<td>1,800 – 2,700</td>
<td>No</td>
</tr>
<tr>
<td>Al-oxide Waste Aggregate</td>
<td>1.3</td>
<td>0.51</td>
<td>1,450 – 3,600</td>
<td>No</td>
</tr>
<tr>
<td>Mod. Activated Alumina</td>
<td>5.7</td>
<td>0.40</td>
<td>&lt; 1</td>
<td>No</td>
</tr>
<tr>
<td>Zeolite / Perlite / Carbon (ZPG)</td>
<td>0.05</td>
<td>None</td>
<td>5</td>
<td>Yes</td>
</tr>
<tr>
<td>Perlite</td>
<td>0.002</td>
<td>1.37</td>
<td>&lt; 10</td>
<td>No</td>
</tr>
<tr>
<td>Recycled Tire</td>
<td>0.003</td>
<td>None</td>
<td>&lt; 45</td>
<td>Yes</td>
</tr>
<tr>
<td>Expanded Shale</td>
<td>0.14</td>
<td>0.98</td>
<td>9 - 50</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Media Type</th>
<th>Isotherm $K_f$ (mg/g)</th>
<th>Kinetics $q_e$ (mg/g)</th>
<th>Breakthrough Exhaustion (BVs)</th>
<th>Desorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention Soil</td>
<td>0.18</td>
<td>4.67</td>
<td>50</td>
<td>No</td>
</tr>
<tr>
<td>Concrete Sand</td>
<td>&lt; 0.01</td>
<td>&lt; 0.001</td>
<td>&lt; 5</td>
<td>No</td>
</tr>
</tbody>
</table>

Very Finely Graded Medias (< 0.5 mm) with low hydraulic conductivity
Amended Sand Filters & Filtration Trenches

Applications

Use Sorption based Media or Material
- displace part of Sand bed
Amended Pervious Pavements

- Interlocking Pavers
- Pervious Pavements

Applications
- In Joints
- Bedding Course
- Polishing System

Under Drain PVC
Things to Avoid with “Sorption” Based Materials

- Limit use of materials prone to desorption
  - Organics / Compost / Soils
    - Test P-index & use as an indicator
  - Evaluate Materials upfront
    - Expanded Shale, Recycled Tires, ZPG

- Prevent leaching of other Toxics
  - i.e - Heavy Metals
    - Slag, Iron-based materials, other waste by-products
Summary

To address Algal Blooms & Eutrophication

- Look beyond Total Phosphorus (TP) & account for **Dissolved Phosphorus (DP)**
- **Amend** BMPs to be “Best Management Practices” and address DP removal
Questions?

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sperry@imbriumsystems.com
The Road Ahead:
Implementing Environmental Site Design in Maryland

Tom Schueler
Chesapeake Stormwater Network

October 22, 2009
Key Themes

- About Chesapeake Stormwater Network
- The Future of Stormwater: Tommy the Swammi
- Baywide Stormwater Design Specifications
- MD Runoff Reduction Spreadsheet
- Special Stormwater Technical Bulletins
- Baywide Stormwater Training
- Master Stormwater Engineers
Chesapeake Stormwater Network

Nonprofit organized to align the local, state, federal and private sectors to solve the Bay stormwater problem through an independent network of concerned stormwater professionals

[Logo]

www.chesapeakestormwater.net
Growing the Network & Bringing the Sectors together

CSN

- Reviewers
- Designers
- Practitioners
- Environmental Advocates
- Researchers
- Policy Makers
Innovatiion and Adopter Categories

Figure 7-3. Adopter Categorization on the Basis of Innovativeness

The innovativeness dimension, as measured by the time at which an individual adopts an innovation or innovations, is continuous. The innovativeness variable is partitioned into five adopter categories by laying off standard deviations (sd) from the average time of adoption ($\bar{x}$).

Source: Diffusion of Innovation, 5th Edition, Everett M. Rogers
The Future of Stormwater in MD

Tommy the Swammi
Some Future Predictions

Uneven local implementation of new ESD regulations

Rapid changes in practices, technology and compliance tools

More stringent EPA stormwater rules for Chesapeake Bay (or nationally)

More numeric municipal, industrial and construction NPDES permits, with more accountability and enforcement

Local nutrient reduction requirements from Bay TMDL
We have Reached the Clipping Point

Distribution of Turf Grass in the Chesapeake Bay Watershed (yr. 2000)

Legend
- US_DetailedStates
- Chesapeake Bay

Counties/ cities
- Turf grass (acres)
  - 0 - 30,000
  - 30,001 - 60,000
  - 60,001 - 90,000
  - 90,001 - 120,000
  - 120,001 - 150,000

Map showing distribution of turf grass across the Chesapeake Bay Watershed with different color intensities for various acreage ranges.
The Clipping Point: Emergence of Turf Cover As a Major Bay Ecosystem

TURF COVER, BAY WATERSHED 2000

Method 1: 3.82 million acres
Method 2: 3.79 million acres

TURF As PERCENT OF BAY LAND AREA

Method 1: 9.5%
Method 2: 9.5%

COMPARISON TO OTHER BAY LAND USES

Row Crops: 9.2% of watershed
Pasture: 7.7%
Hay and Alfalfa: 7.4%
Wetlands: 3.8%
First Annual
Bay-wide
Stormwater Performance Scorecard
2009
Ten Core Implementation Tools Graded

1. Stormwater Permits: Larger Communities
2. Stormwater Permits: Smaller Communities
3. Updated State Stormwater Regulations
5. State Outreach to Localities
6. Public Stormwater Outreach
7. Industrial Stormwater Permits
8. Construction Stormwater Permits
9. Permit Compliance and Enforcement
10. State and Local Stormwater Financing
<table>
<thead>
<tr>
<th>Core Programs</th>
<th>DC</th>
<th>MD</th>
<th>PA</th>
<th>VA</th>
<th>WV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large MS4 Permits</td>
<td>A-</td>
<td>C-</td>
<td>-</td>
<td>D</td>
<td>-</td>
</tr>
<tr>
<td>Small MS4 Permits</td>
<td>-</td>
<td>F</td>
<td>D</td>
<td>C+</td>
<td>A</td>
</tr>
<tr>
<td>Stormwater Regs</td>
<td>I</td>
<td>B+</td>
<td>I</td>
<td>I</td>
<td>B+</td>
</tr>
<tr>
<td>Stormwater Manual</td>
<td>I</td>
<td>C-</td>
<td>B</td>
<td>A-</td>
<td>I</td>
</tr>
<tr>
<td>MS4 Outreach</td>
<td>B</td>
<td>D</td>
<td>D</td>
<td>B-</td>
<td>B</td>
</tr>
<tr>
<td>Public Outreach</td>
<td>A</td>
<td>D+</td>
<td>F</td>
<td>B</td>
<td>I</td>
</tr>
<tr>
<td>Industrial Permits</td>
<td>D</td>
<td>D</td>
<td>D-</td>
<td>B-</td>
<td>D</td>
</tr>
<tr>
<td>Construction Permits</td>
<td>B+</td>
<td>C-</td>
<td>D+</td>
<td>C-</td>
<td>D</td>
</tr>
<tr>
<td>Permit Enforcement</td>
<td>B+</td>
<td>D</td>
<td>D-</td>
<td>D</td>
<td>D-</td>
</tr>
<tr>
<td>Local/ State Financing</td>
<td>A-</td>
<td>C-</td>
<td>F</td>
<td>C+</td>
<td>D+</td>
</tr>
<tr>
<td><strong>OVERALL GRADE</strong></td>
<td><strong>B+</strong></td>
<td><strong>D+</strong></td>
<td><strong>D</strong></td>
<td><strong>C+</strong></td>
<td><strong>C</strong></td>
</tr>
</tbody>
</table>
NPDES Permitting: The gap between wastewater and stormwater
Runoff reduction (RR) is defined as the total volume reduced through canopy interception, soil infiltration, evaporation, rainfall harvesting, engineered infiltration, extended filtration or evapotranspiration at small sites.
# MD Runoff Reduction Spreadsheet

## 1. Post-Development Project & Land Cover Information

### Constants

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Annual Rainfall (inches)</td>
<td>43</td>
</tr>
<tr>
<td>Target Rainfall Event (inches)</td>
<td>1.00</td>
</tr>
<tr>
<td>Phosphorus EMC (mg/L)</td>
<td>0.28</td>
</tr>
<tr>
<td>Target Phosphorus Load (lb/acre/yr)</td>
<td>0.28</td>
</tr>
<tr>
<td>P</td>
<td>0.90</td>
</tr>
</tbody>
</table>

### Land Cover (acres)

<table>
<thead>
<tr>
<th>Land Cover (acres)</th>
<th>A Soils</th>
<th>B Soils</th>
<th>C Soils</th>
<th>D Soils</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest/Open Space -- undisturbed, protected forest/open space or</td>
<td>0.0</td>
<td>2.0</td>
<td>4.0</td>
<td></td>
<td>6.0</td>
</tr>
<tr>
<td>Managed Turf -- disturbed, graded for yards or other turf to be</td>
<td></td>
<td>6.0</td>
<td>14.0</td>
<td></td>
<td>20.0</td>
</tr>
<tr>
<td>Impervious Cover (all soil types)</td>
<td>14.0</td>
<td></td>
<td></td>
<td></td>
<td>14.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40.0</td>
</tr>
</tbody>
</table>

### Rv Coefficients

<table>
<thead>
<tr>
<th>Rv Coefficients</th>
<th>A Soils</th>
<th>B Soils</th>
<th>C Soils</th>
<th>D Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest/Open Space</td>
<td>0.02</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Managed Turf</td>
<td>0.15</td>
<td>0.20</td>
<td>0.22</td>
<td>0.25</td>
</tr>
<tr>
<td>Impervious Cover</td>
<td></td>
<td></td>
<td></td>
<td>0.95</td>
</tr>
</tbody>
</table>

Adapted from VA, but Modified to Conform to MD ESD regs
VA Runoff Reduction Spreadsheet

The VA DCR spreadsheet developed to simplify compliance and has been tested (and revised) on dozens of sites by hundreds of engineers

☑ Based on New Science on Runoff Coefficients and Runoff Reduction of Practices

☑ Compliance Tool for Early Concepts and Final Design (although individual practice design still required)

☑ Excellent Tool for Training and Plan Review

☑ Truly Integrates all Practices Together and Rewards a Treatment Train
Step 1
Conserve Natural Areas and Soils
- Soil Amendments
- Forest Conservation
- Site Design to Minimize Impervious Area
- Reduce Soil Disturbance

Step 2
Apply ESD Reduction Practices
- Roof Disconnects
- Sheetflow to Cons
- Reforestation
- Soil Amendments
- Permeable pavers

Step 3
Apply Engineered Runoff Reduction Practices
- Bioretention
- Dry Swales
- Green Roofs
- Infiltration
- Traditional STPs

Step 4
Apply Standard Treatment Practices
- Adjust Site loads for Phosphorus treatment

Step 5
Mitigation Fee for balance of unmet P Load

A step by step approach to comply at a development site

Tv: Treatment Volume for Site
ESD: Environmental Site Design
STP: Stormwater Treatment Practices
Annual Runoff Reduction Rates (%)

- Infiltration: 50 to 90
- Bioretention: 40 to 80
- Pervious Pavers: 45 to 75
- Green Roof: 45 to 60
- Dry Swale: 40 to 60
- Rain Tanks/Cisterns: 40 +
- Roof Disconnection: 25 to 50
- Grass Channel: 15 to 30
- Dry ED Pond: 0 to 15
- Wet Pond: 0
- Sand Filter: 0

Source: CWP and CSN (2008)
<table>
<thead>
<tr>
<th>LEVEL 1 DESIGN</th>
<th>LEVEL 2 DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV = (Rv)(A)</td>
<td>TV = 1.25 (Rv)(A)</td>
</tr>
<tr>
<td>Filter media at least 24” deep</td>
<td>Filter media at least 36” deep</td>
</tr>
<tr>
<td>One form of accepted pretreatment</td>
<td>Two or more forms of accepted pretreatment</td>
</tr>
<tr>
<td>At least 75% plant cover</td>
<td>At least 90% plant cover, including trees.</td>
</tr>
<tr>
<td>One cell design</td>
<td>Two cell design</td>
</tr>
<tr>
<td>Underdrain</td>
<td>Infiltration design or underground stone sump</td>
</tr>
</tbody>
</table>
CSN and CWP expect to release MD version by end of 2009

Will initially calculate ESD treatment volume using MDE woods in good conditions “look up” table.

The spreadsheet then accounts for progressive runoff reduction by different ESD practices from up to five different sub-drainage areas at the site.

Allows plan reviewers that ESD to the MEP has been achieved or not, and quickly test alternative combinations

Also computes curve number reductions for larger storms
Need for New Design Tools

- CSN/CWP released 14 new design specs
- Focus on better design, installation and maintenance
Draft Bay-wide Design Specifications

- Rooftop Disconnection
- Filter Strips
- Grass Channels
- Soil Amendments
- Green Roofs
- Rain Tanks/Rainwater Harvesting
- Permeable Pavement
- Infiltration

- Bioretention
  - Urban Bioretention
- Dry Swales
- Filtering Practices
- Constructed Wetlands
  - Wet Swales
- Wet Ponds
- Extended Detention Ponds

Drafts available at CSN website: www.chesapeakestormwater.net
BAY WIDE DESIGN SPEC NO. 6

RAIN TANKS AND CISTERNS
CSN TECHNICAL BULLETIN No. 1

STORMWATER DESIGN GUIDELINES FOR KARST TERRAIN IN THE CHESAPEAKE BAY WATERSHED VERSION 2.0
CSN TECHNICAL BULLETIN No. 2

STORMWATER DESIGN GUIDELINES
FOR COASTAL PLAIN TERRAIN IN THE
CHESAPEAKE BAY WATERSHED
VERSION 2.0
# BMP Selection in Coastal Plain

<table>
<thead>
<tr>
<th>Preferred</th>
<th>Accepted</th>
<th>Discouraged</th>
<th>Prohibited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructed Wetland</td>
<td>Sand Filter</td>
<td>Wet ponds</td>
<td>NONE</td>
</tr>
<tr>
<td>Shallow Bioretention</td>
<td>Small-scale Infiltration</td>
<td>Dry ED ponds</td>
<td></td>
</tr>
<tr>
<td>Wet Swale</td>
<td>Green Roofs</td>
<td>Grass Channel</td>
<td></td>
</tr>
<tr>
<td>Rain Tanks/Cisterns</td>
<td>Soil Compost Amendments</td>
<td>Large Scale Infiltration</td>
<td></td>
</tr>
<tr>
<td>Shallow Dry Swale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof Disconnection &amp; Filter Strips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permeable Pavers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
New and Innovative Sustainable Stormwater Practices for the City

1. Green Roofs
2. Cisterns and Rain Tanks
3. Foundation Planters
4. Permeable Pavers
5. Expanded Tree Pits
6. Regular Bioretention
7. Street Bioretention
8. Soil Restoration
9. Reforestation
10. Sand Filters
Designating Stormwater Hotspots

Future status of development determines how much treatment is required, whether runoff can be infiltrated or what on-site pollution prevention practices are needed.
# A Lot of Change Going On in the Bay States

<table>
<thead>
<tr>
<th>STATE</th>
<th>Runoff Reduction</th>
<th>Channel Protection</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>Reduce Runoff 1st Inch of Rainfall</td>
<td>No</td>
<td>New Regs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>New Manual</td>
</tr>
<tr>
<td>DE</td>
<td>Reduce Runoff from 2.4 inches of rainfall</td>
<td>YES</td>
<td>New Regs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>New Manual</td>
</tr>
<tr>
<td>MD</td>
<td>Reduce Runoff from 1.0 to 2.4 inches of rainfall</td>
<td>YES</td>
<td>New Regs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>New Manual?</td>
</tr>
<tr>
<td>PA</td>
<td>Reduce Runoff from 1.0 to 2.4 inches of rainfall</td>
<td>YES</td>
<td>2005 Manual</td>
</tr>
<tr>
<td>VA</td>
<td>Reduce Runoff from 1.0 to 2.4 inches of rainfall</td>
<td>YES</td>
<td>New Regs</td>
</tr>
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<td></td>
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<td></td>
<td>New Manual</td>
</tr>
<tr>
<td>WV</td>
<td>Reduce runoff from 1st Inch of rainfall</td>
<td>No</td>
<td>New Permit</td>
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<td></td>
<td>New Manual</td>
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</tbody>
</table>
Bay-wide Stormwater Training Partnership

• Collaborative Stormwater Training in MD, VA, DC and WV w/ focus on local designers and plan reviewers

• $500,000 NFWF Grant over next 30 months (+ $600,000 match)

• MD and DC training coordinated by Chesapeake Stormwater Network

• VA and WV training coordinated by Center for Watershed Protection

• Certificates are awarded for participation (but not certification)
Bay-wide Stormwater Training Partners

- Maryland Assoc. of Floodplain and Stormwater Managers
- American Society of Civil Engineers, Maryland Chapter
- Maryland Association of Soil Conservation Districts
- District of Columbia Dept of Environment
- American Society of Civil Engineers, Virginia Chapter
- Virginia Assoc. of Soil & Water Conservation Districts
- Virginia Department of Conservation Resources
- West Virginia Department of Environmental Protection

Piggyback training, resources, and MSEs
Three Levels of Training for Designers and Plan Reviewers

**Basic:** Participate in several webcasts on new regulations and practices

**Advanced:** One-day design charette to apply new tools to real world development and redevelopment sites

**Master:** Two day training session on special topics and teaching others
Other CSN Priorities in 2010

• Create MS4 Stormwater Managers Exchange

• Technical Bulletins for Stormwater Design in Trout Waters and Ultra-urban Watersheds

• Technical Assistance for MD Critical Area Commission Staff on Stormwater Compliance

• Second Annual Bay-wide Stormwater Partners Retreat and Bay-wide Stormwater Institute

• Stormwater Research Updates
Master Stormwater Engineers

- Up-front two day voluntary training commitment
- Get paid $1,500 for each local design training workshops
- Be eligible to be paid as a local stormwater circuit rider
- Become a Jedi-master to use the force in your own empire
- Marketing and professional development
Webcast Topics

• Implementing Your State’s Stormwater Regs
• Utilizing the Runoff Reduction Spreadsheet
• Design of Innovative Practices
  • Bioretention
  • Rainwater harvesting
  • Permeable paver
  • Rooftop disconenctions/soil amendments
  • Others
• Stormwater Design for Special Terrain and Receiving Waters
• Construction Inspection and Maintenance

• OTHER TOPICS DEPENDING ON INPUT/SURVEY
Work Between Now and the End of 2009

- Baseline Survey of Current Design and Review Practices
- Training Needs and Preference Survey
- Initial Class of Master Stormwater Engineers (10 in MD)
- Coordination with States and Professional Societies
- On-line training calendar and registration system
Training During 2010 and 2011

• 10 stormwater webcasts

• 60 one-day stormwater design charettes to teach new methods

• 4 intensive workshops to create 40 master stormwater engineer trainers

• 500 hours of direct on-site technical assistance to requesting local governments

• 20 self-guided, web-based stormwater training modules
Questions ?