



LID Changes Everything!

*The New Stormwater  
Maintenance Paradigm*

# Welcome to the Webcast

- To Ask a Question
  - Submit your question in the chat box located to the left of the slides. We will answer as many as possible during Q&A.
- To Answer a Poll Question
  - Simply select the preferred option. For those viewing this session alongside several colleagues, respond in a manner that represents your organization as a whole.
- We ARE Recording this Session
  - All comments and questions will be recorded and included in the archives.
- We Appreciate Your Feedback
  - Fill out our evaluations - our funders need to hear it!  
[http://www.surveymonkey.com/s/SW-LID-Maintenance\\_webcast11](http://www.surveymonkey.com/s/SW-LID-Maintenance_webcast11)

# Session Resources

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Today's presentation and resources will be posted at  
[http://www.mawaterquality.org/capacity\\_building/swmanagement.htm](http://www.mawaterquality.org/capacity_building/swmanagement.htm)

- R1. Pond and Maintenance Guidebook
- R2. Pdf of this presentation

# Speaker Info



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# Webcast Agenda

- LID and Maintenance: A practitioner's perspective...Ted Scott
- The Changing Local Maintenance Paradigm.
- Bioretention Case Study
- Managing Your Existing BMP Inventory to Maximize Performance



# Webcast Caveats & Ground Rules

- The opinions in this webcast are exclusively those of CSN and Ted Scott
- Things are evolving rapidly as localities adopt new state stormwater regulations
- While there are many uncertainties, please no whining or hand-wringing
- Based on feedback, the webcast info will be expanded in a CSN Technical Bulletin

# Poll Question 1

I work for \_\_\_\_\_?

- Local government DPW or stormwater agency
- State or federal agency
- Local planning agency
- Engineering firm
- Other
- Peanuts



# Ted's Presentation

# Questions and Answers





## POLL Question 2

What impact will LID practices have on the future maintenance burden in your community?

- Minor impact
- Moderate impact
- Huge impact
- Don't know

**ADD 25% TO YOUR BUDGET**

**Maintenance**

**GET JACKED**  
SEE RESULTS IN 15 DAYS!  
FOODS, MOVES & TIPS

**ESD**

**Vegetation management**

**SEDIMENT CLEANOUTS**

**849**  
**WAYS TO REDUCE YOUR MAINTENANCE BURDEN in 6 WEEKS**

**NEW EVERY MONTH!**  
**ESD**  
**THAT WORK**

**CENTER FOR WATERSHED PROTECTION**

Toward a  
New  
Maintenance  
Model

## Technical Bulletin # 10

# Maintenance of LID Practices: Guidance for Designers Inspectors, and Local Stormwater Managers

- Design criteria to reduce future maintenance burden
- New roles for ESC inspectors and landscape contractors
- Construction sequencing and inspection
- Performance bonding
- Certifying LID performance
- LID maintenance inspections and work triggers
- Local LID tracking systems

\* *Draft to be released later this Fall*

# Why Stormwater Maintenance?

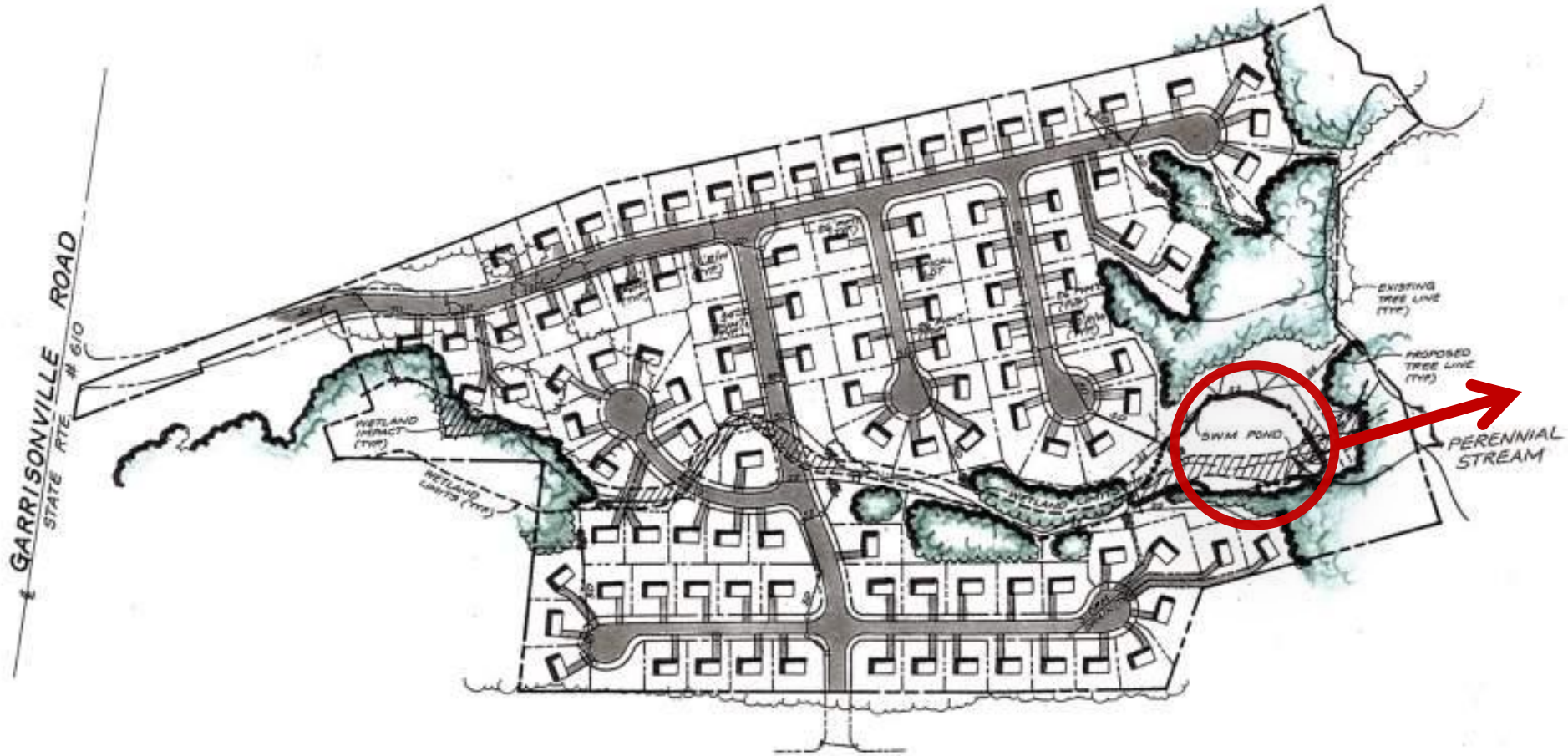


- Protects water quality
- Improves longevity of stormwater BMPs
- Maintains BMP pollutant removal rates over time
- Physically transfers trapped stormwater pollutants to safe upland areas
- Ensures facilities are safe, attractive and functional



# The Old Pond Maintenance Model

One big pond







# Stormwater Manager Survey

- **50%** not sure how to document LID compliance
- **70%** report concerns about LID maintenance and longevity
- **90%** report that it will have a **moderate to major** impact on their maintenance programs



# The Changing Maintenance Paradigm

	Conventional Practices	LID Practices
Example of Practice	Pond	Disconnects/rain garden
Number of practices?	A few at each site	Dozens
Size of practices?	Large drainage area	Micro-drainage area
When to construct?	During site construction	After site is stabilized
Who is responsible?	Homeowner association	Homeowner
Who does inspection?	Public sector engineer	Trained contractor
Who does maintenance	Specialized contractor	Landscape contractor
How long does it take?	Hour or more	10 minutes
What is the goal?	Prevent dam failure and and public nuisances	Maintain hydrologic function and landscaping
Sediment cleanouts?	On a 30 to 50 year cycle (if ever)	Annual cleanouts at pretreatment devices
Maintenance Triggers	After catastrophic failure	When it looks like crap

# The Dirty Little Secrets of the Old Maintenance Model:

- Apart from cutting the grass, we only maintain to prevent catastrophic failure
- No triggers for pollutant cleanouts, and no money to pay for it if we did
- We do have fancy inspection checklists



How will the shift to LID  
reshape local stormwater maintenance  
programs ?



# Increased Role for Erosion and Sediment Control Inspectors During LID construction

- Protect areas during site construction
- Authorize LID construction
- Inspect and Accept LID credits
- Certify Vegetative Stability and Soil Amendments
- Others ?





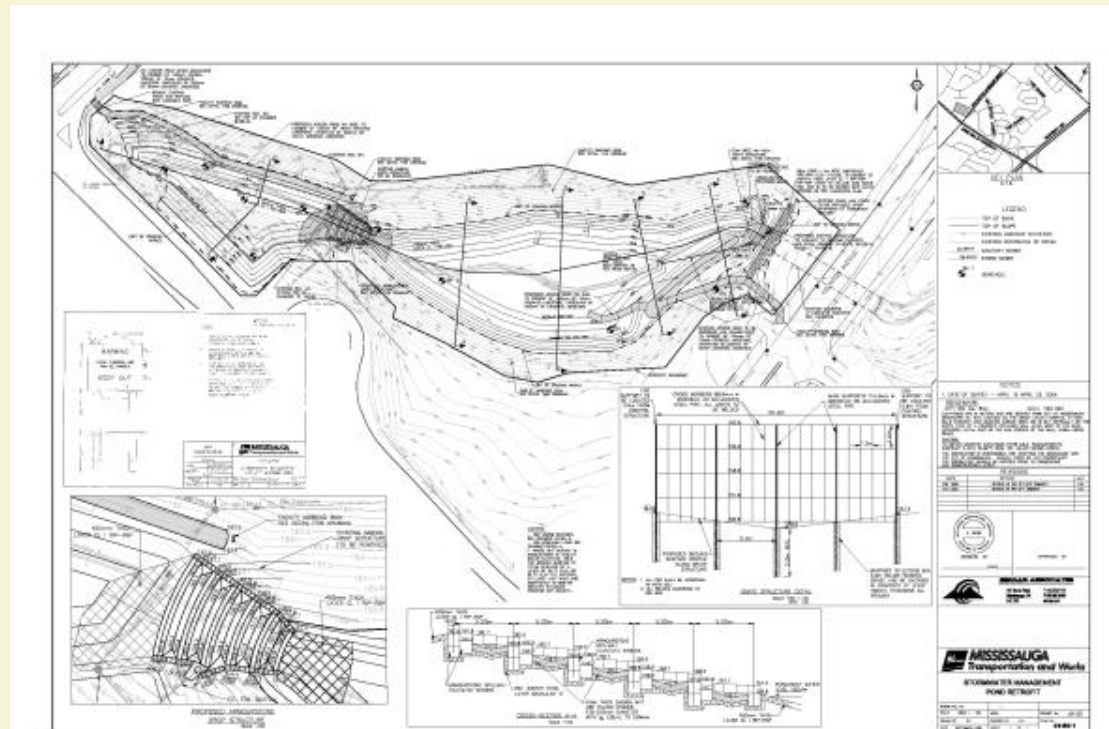
# At what point is a LID practice ready for final inspection and acceptance ?



- Perform final inspection at end of establishment phase
- Usually 6 to 12 months after installation for most vegetative LID practices
- Developer or builder responsible for this first year of maintenance

# What exactly does an LID as-built look like?

- Engineered surveys ?
- Digital photo and GPS coordinates ?
- Depends on type and scale of LID practices



# Verifying Disconnection and Buffer Credits

- Look for signs of concentrated flow
- Verify distance
- Vegetative density
- Screwdriver test
- Exposed soil
- Digital photo





# As-builts for micro LID practices (CDA less than 5000 sf)

- Digital photo and GPS coordinates
- Vegetative cover and stability
- Confirm ponding elevation and flow paths
- No survey work



# Larger LID Practices (CDA more than 5000 sf)



- Limited survey work to confirm inlet and outlet elevations, flow paths and ponding depths
- Confirm underdrain depth and outflow
- Ensure landscaping meets design objectives
- Verify boundaries of stormwater easement
- Check overflow to downstream conveyance system
- Digital photo after establishment phase

# Maintaining On-lot Practices



Disconnections and dry wells are OK

Rain gardens OK if there is a homeowner association that can enforce private maintenance

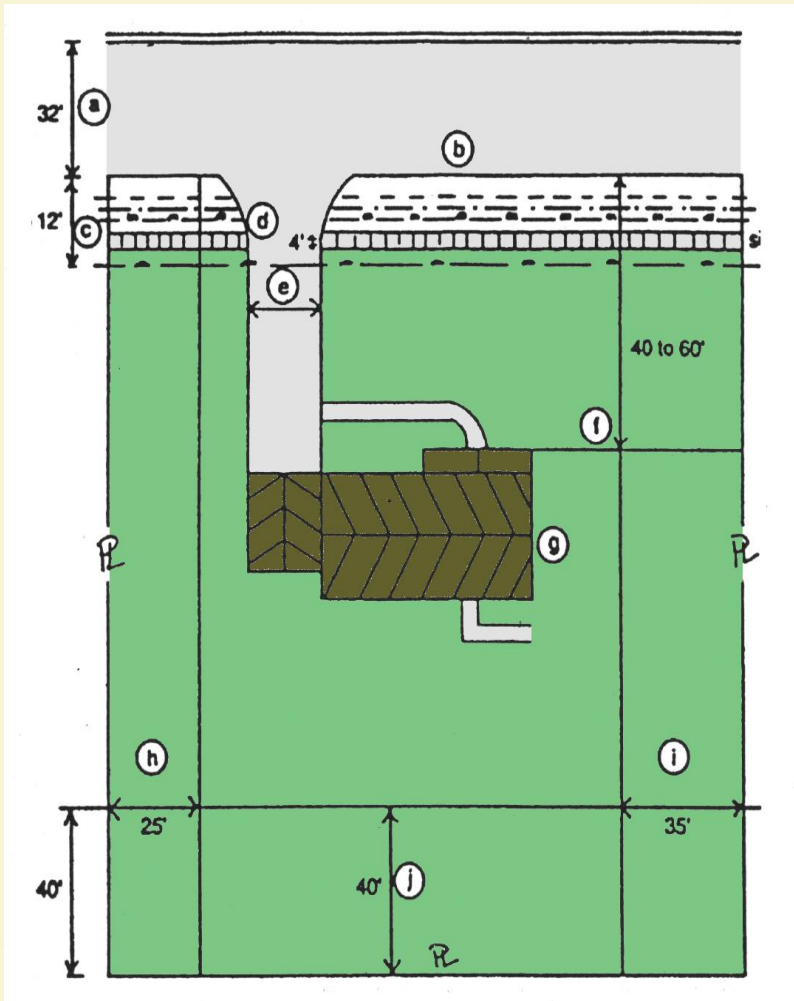


May want to shift them to expanded street right of way

May want to avoid use in side and backyards



# Where to Locate Residential LID Practices



## On - lot

- Front yard
- Back yard ?
- Side yard ?

## Off - lot

- In expanded street right of way
- HOA open space

Localities should clearly define the appropriate conditions under which LID practices can be located within a residential lot.

Is there a superior legal instrument to compel maintenance of smaller LID practices that an owner can really understand ?


- Depends on whether it is to be maintained by homeowner, HOA or property manager
- Key is an owners maintenance guide w/ LID map with digital photo of installed practices



# Key Issues in Maintenance Agreements

- Identify specific parties responsible for maintenance
- Identify landscape contractor or other party to perform maintenance
- Require annual self-inspection
- Reference the specific annual maintenance tasks that must be performed
- Provide LID locator map to find practices
- Provide photos of the established LID practices

## Stormwater Operation and Maintenance Model Ordinance

 *This Operation and Maintenance ordinance language is not "stand-alone." Operation and maintenance language would be a part of a more comprehensive stormwater ordinance.*

### Definitions

Best Management Practice (BMP) - Device, measure, facility or activity that helps to achieve stormwater management objectives at a designated site.


Non-Routine Maintenance - Maintenance activities that are expensive but infrequent, such as pond dredging or major repairs to stormwater structures.


Plan - A document approved at the site design phase that outlines the measures and practices used to control stormwater runoff at a site.

Stormwater Treatment Practice (STP) - A structural or non-structural Best Management Practice (BMP) specifically designed to remove pollutants in rainfall runoff from developed areas.


### Section I. Design

- A. All STPs shall be designed in a manner to minimize the need for maintenance, and reduce the chances of failure. Design guidelines are outlined in the most recent version of \_\_\_\_\_ (*Local or State Stormwater Manual*).

 *Rather than incorporate specific stormwater design or maintenance standards into the ordinance itself, it is best to reference "the most recent edition" of a stormwater manual. In this way, technical information can remain up to date without making legal changes to the ordinance.*

 *The Maryland Stormwater Design Manual, is one example of an up-to-date stormwater design manual that explicitly defines design and regular maintenance measures. For more information, go to [www.mde.state.md.us](http://www.mde.state.md.us). Under topics, choose "Stormwater Design Manual."*

- B. Stormwater easements and covenants shall be provided by the property owner for access for facility inspections and maintenance. Easements and covenants shall be recorded with \_\_\_\_\_ (*Stormwater Agency*) prior to the issuance of a permit.

 *For an example of a stormwater easement, see [Maintenance Easements](#)*

- C. Final design shall be approved by \_\_\_\_\_ (*Stormwater Agency*)

### Section II. Routine Maintenance

- A. All STPs shall be maintained according to the measures outlined in the most recent

# Moving beyond Checklists to Punchlists

## STORMWATER POND / STORMWATER WETLAND CONSTRUCTION INSPECTION CHECKLIST

Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Project: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Site Status (active, inactive, completed): \_\_\_\_\_  
 Inspector(s): \_\_\_\_\_

### Type of Practice:

- |   |  |
|---|--|
| <input type="checkbox"/> Micropool ED Pond    | <input type="checkbox"/> Shallow Wetland       |
| <input type="checkbox"/> Wet Pond             | <input type="checkbox"/> Shallow ED Wetland    |
| <input type="checkbox"/> Multiple Pond System | <input type="checkbox"/> Pond / Wetland System |
| <input type="checkbox"/> Pocket Pond          | <input type="checkbox"/> Pocket Wetland        |

Construction Sequence	Satisfactory	Unsatisfactory	Comments
<b>I. Pre-Construction / Materials and Equipment</b>			
Pre-construction meeting			
Pipe and appurtenances on-site prior to construction and dimensions checked			
1. Material (including protective coating, if specified)			
2. Diameter			
3. Dimensions of metal or pre-cast concrete riser			
4. Required dimensions between water control structures (orifices, weirs, etc.) are in accordance with approved plans			
5. Barrel stub for prefabricated pipe structures at proper angle for design barrel slope			
6. Number and dimensions of prefabricated anti-seep collars			
7. Watertight connectors and gaskets			
8. Outlet drain valve			
Project benchmark near pond site			
Equipment for temporary de-watering / sediment and erosion control			
<b>II. Subgrade Preparation</b>			
Area beneath embankment stripped of all vegetation, topsoil, and organic matter			
Core trench excavated and backfilled			
<b>III. Pipe Spillway Installation</b>			
Method of installation detailed on plans			
<b>A. Bed preparation</b>			
Installation trench excavated with specified side slopes			
Stable, uniform, dry subgrade of relatively impervious material (If subgrade is wet, contractor shall have defined steps before proceeding with installation)			
Invert at proper elevation and grade			

Adapted from WMI, 1997

Page 1 of 5

## Maintenance Task Order

- Clean out curb cuts and inlets for accumulated grit, leaves, and debris that are blocking inflow
- Spot weeding, trash removal, and mulch raking
- Prune trees at SE corner
- Add reinforcement planting to cell 3
- Remove invasive plants and dead yellow poplar at point B
- Stabilize and reseed the exposed soils on bioretention buffer at point D
- Supplement mulch in devoid areas to maintain a 3 inch layer
- Prune trees and shrubs
- Remove sediment in pre-treatment cell

# Clear "triggers" to compel maintenance tasks

# How Does LID Change Performance Bonds?

- ESC and SWM Bonds ensure the design is properly installed
- Price bonds for LID practices and credits based on landscape contractor
- Front end load the ESC Bonds
- On-lot LID (builder) Off-lot LID (developer)





# Training Landscaping Contractors on LID

Many crews may not realize the stormwater objectives of the landscaping areas they are maintaining



# How do we do visual inspections to rapidly assess LID performance?



5 or 10 minutes max

Schedule within 24 hours after a decent storm

Visual indicators

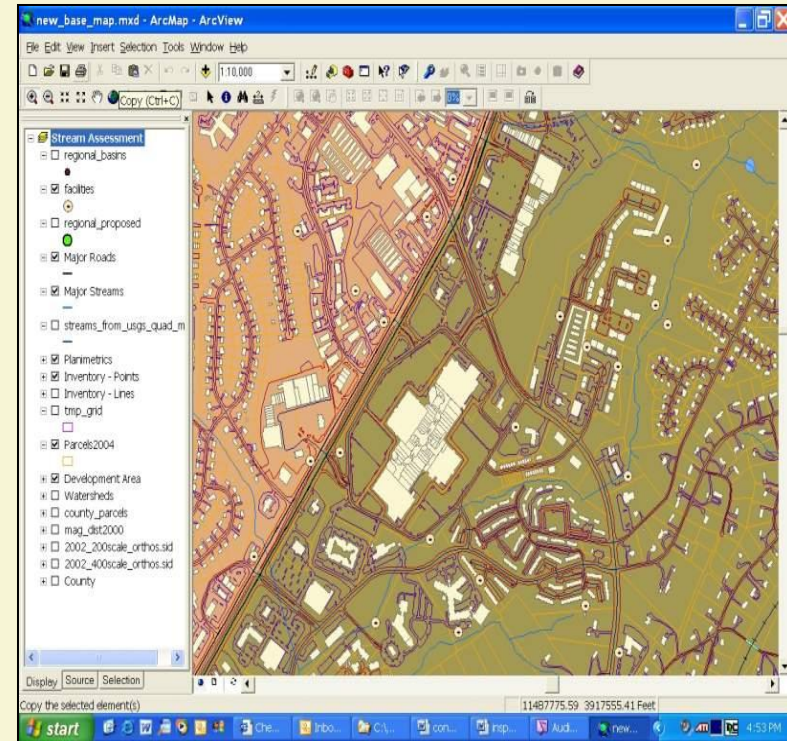
# CBSTP Training in 2012

- LID inspection training for stormwater and ESC inspectors
- Field and classroom training at local BMP campuses in the watershed
- Certificates of proficiency
- Video training materials for landscape contractors

# How do we track LID in our local database ?

Each site would provide data to store in the system:

- Site map with LID Locator
- Responsible party for maintenance
- BMP design info for larger LID practices
- Maintenance and inspection reports
- Digital photos of accepted LID practices
- Nutrient and runoff reduction credit



# Linking Maintenance Inspections to state permit and TMDL tracking

- Maintain a project file for each LID project installed.
- The file should be maintained for the lifetime for which the nutrient removal credit will be claimed.
- The typical duration for the credit will be approximately **25** years
- Locality required to conduct a performance inspection at least once every **five** years to verify that the system is being adequately maintained and operating as designed.

The screenshot shows a Microsoft Access database form titled "Stormwater BMP Master Database" for Stafford County, Virginia. The form is for a record with ID "RG388" and a date of "11/2/2004". The "General BMP Type" is "Ponds". The inspector is "Gouganthula". The PDF file is "RG388-1.PDF". The location is "Regional Pond 4A". The status is "Complete". The form includes various input fields for coordinates, location, and maintenance details. A photo of a pond is displayed. The form also has a list of "Photo Filename" and a grid of checkboxes for various inspection criteria such as "Pond Type", "Accessibility", "Emergency Spillway", "Outfall Structure", etc. The bottom of the form shows "Records: 14 of 658" and "Form View".



# Certification of Hydrologic Performance



Post-construction field evaluation of LID practices to ensure they are operating properly and are achieving nutrient reduction

Local BMP Reporting to state for Bay-wide TMDL and MS4 Permits

Bay BMP credits are tied to periodic recertification (5 years)

# Questions?



## Poll Question 3

How would you characterize the stormwater maintenance program in your community ?

- Don't have a clue
- Getting started, but don't have a lot of BMPs yet
- Some experience, but lack staff for inspections
- Experienced, but have a lot of problem BMPs
- Very experienced, looking for a few new tips

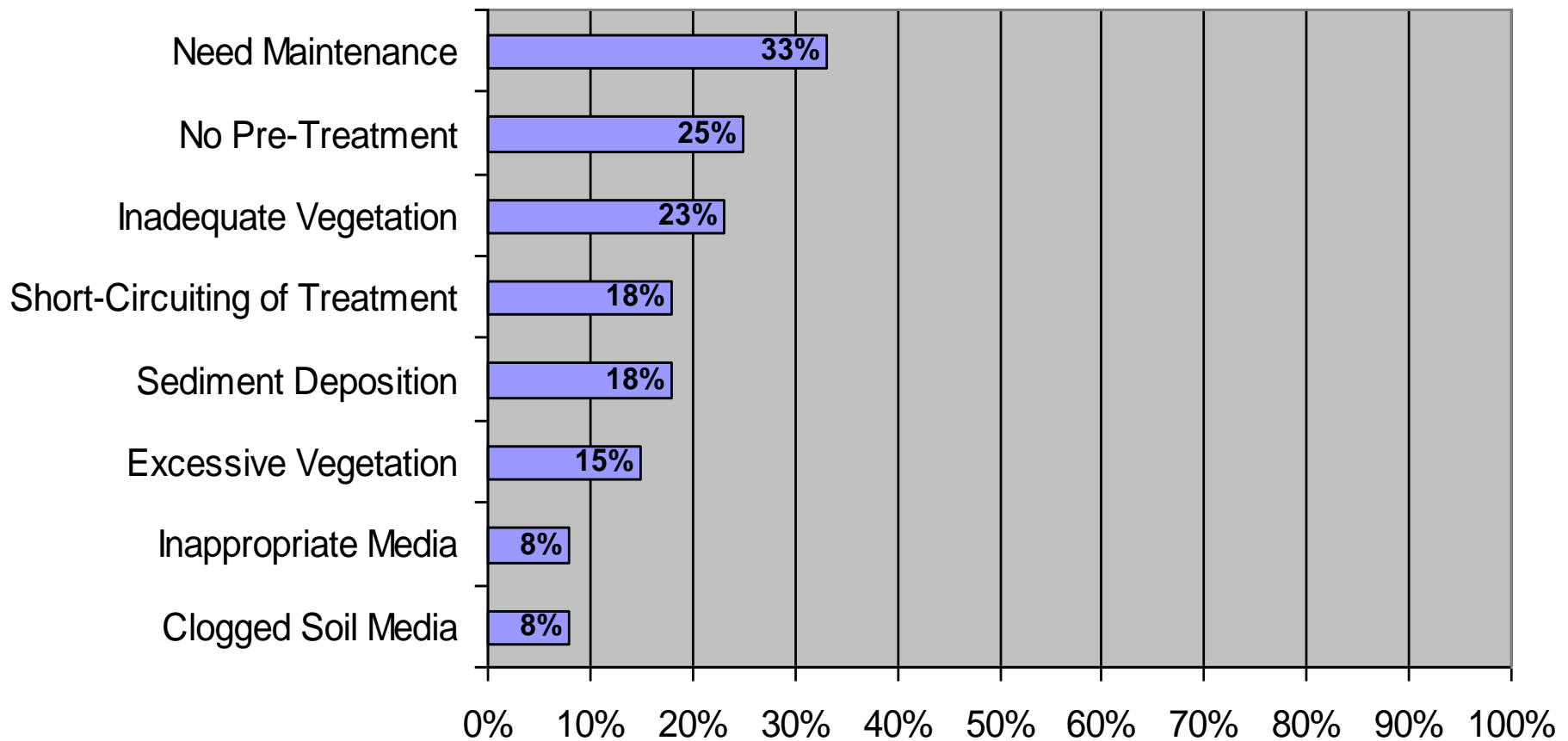


# Bioretention Maintenance



# Performance Issues Observed in Field

**General Performance Problems with Bioretention (n = 40)**





# Maintaining the "Bio" in Bioretention



- Prune woody matter, remove invasive plants, and manage vegetative growth to maintain landscape.
- Add reinforcement planting to maintain desired vegetation density.



2000



**Vegetation  
Management  
Is Key  
Maintenance  
Task**

2003



# Many Future Maintenance Problems are Rooted in Poor Design

- Lose the filter fabric on the bottom
- Max 12 inch ponding depth
- Flat slope
- Max Contributing Drainage Area (CDA)
- Maximize Flow Path and Length to Width Ratio
- Turf cover



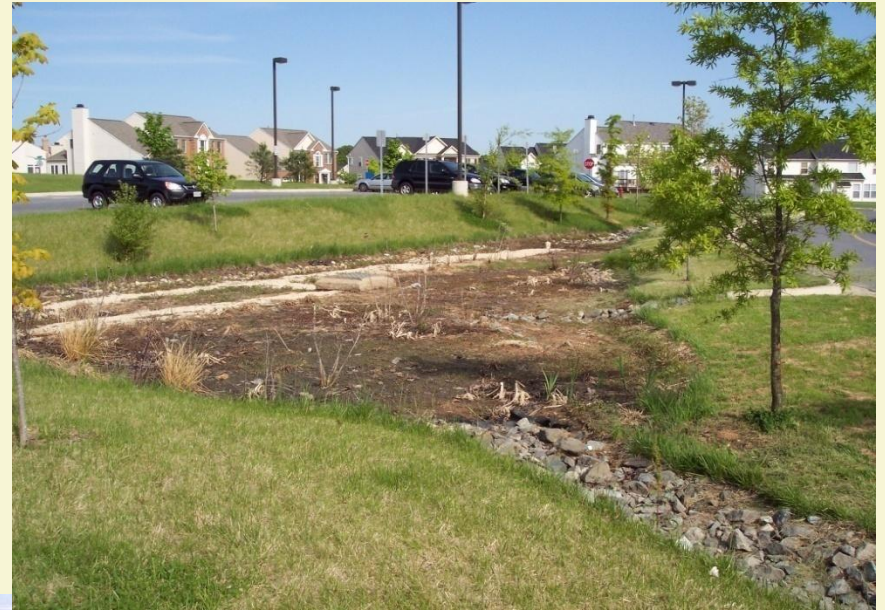


# Provide Pretreatment

- Nature of pretreatment depends on size of bioretention area and type of flow it experiences
  - **Concentrated flow:** two cell design with a small trapping "forebay" and level spreader
  - **Sheet flow:** grass filter strip, stone diaphragm, stone ring berm



# No Pre-treatment: Maintenance Problem





# Maintenance Considerations During Installation



- Protect bioretention during site construction
- Don't install until site is stabilized
- Make sure the original design still works
- Excavate from the side
- Make sure ponding depth meets design
- Water and maintain plantings

# Construction Inspection



- Under drain and stone sump installation
- Verify the actual contributing drainage area boundaries
- Confirm inlet and outlet elevations
- Side-slope stabilization

\* Subtle changes in grading, paving and drainage can really screw up an otherwise fine design



# The establishment phase through first growing season



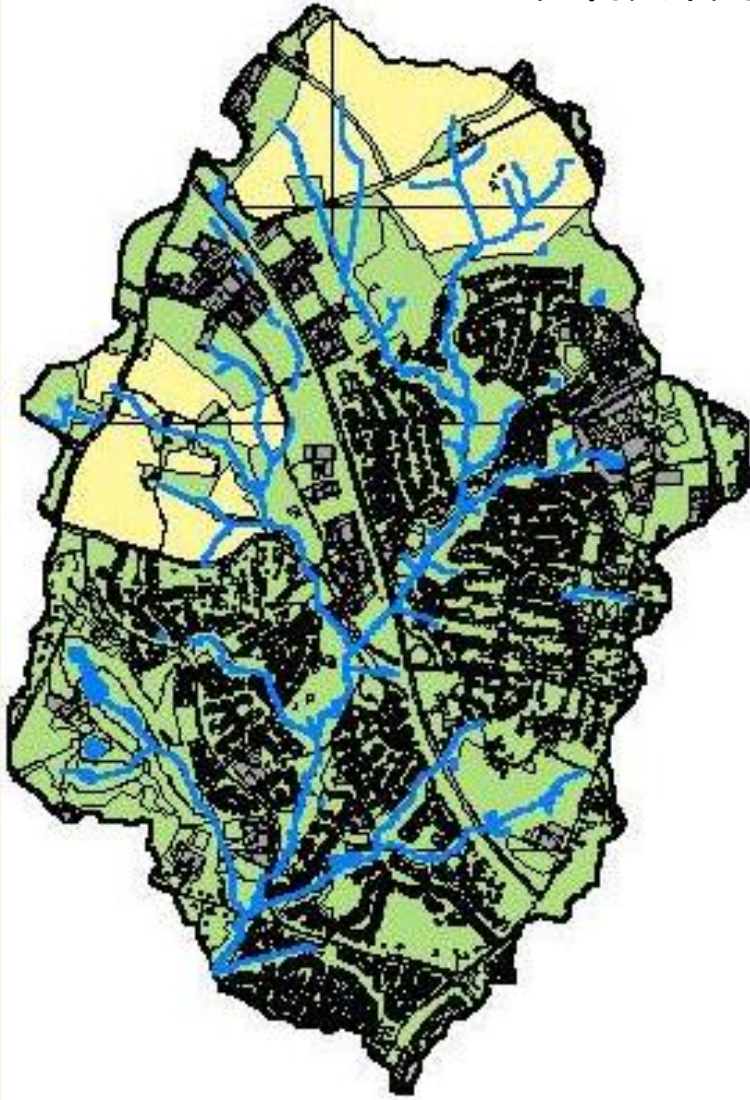
Landscaping contract covers first year after installation  
Regular watering first few months  
Spot re-seeding and remove/replace dead plants  
Remove sediment accumulation at inlets  
Repair erosion on side-slopes



# Maintenance Considerations

Maintenance Tasks	Frequency
<ul style="list-style-type: none"> <li>▪ Mow grass filter strips and bioretention with turf cover</li> <li>▪ Check curb cuts and inlets for accumulated grit, leaves, and debris that may block inflow</li> </ul>	At least 4 times a year
<ul style="list-style-type: none"> <li>▪ Spot weeding, trash removal, and mulch raking</li> </ul>	Twice during growing season
<ul style="list-style-type: none"> <li>▪ Add reinforcement planting to maintain desired the vegetation density</li> <li>▪ Remove invasive plants using recommended control methods</li> <li>▪ Remove any dead or diseased plants</li> <li>▪ Stabilize the contributing drainage area to prevent erosion</li> </ul>	As needed
<ul style="list-style-type: none"> <li>▪ Conduct a maintenance inspection</li> <li>▪ Supplement mulch in devoid areas to maintain a 3 inch layer</li> <li>▪ Prune trees and shrubs</li> <li>▪ Remove sediment in pre-treatment cells and inflow points</li> </ul>	Annually
<ul style="list-style-type: none"> <li>▪ Remove sediment in pre-treatment cells and inflow points</li> <li>▪ Remove and replace the mulch layer</li> </ul>	Once every 2 to 3 years

# Maintaining Your Traditional BMPs



- Inventory BMPs
- Perform Stage 1 BMP triage inspection to categorize problems
  - Safety issues
  - Dysfunctional
  - Out-dated technology, not worth fixing
  - Needs routine maintenance ASAP

# Dealing with the Local BMP Legacy

Thirty Years of BMPs. The BMP Inventory in a Maryland County (2006)			
<i>Potentially High Performers</i>		<i>Known Low Performers</i>	
Bioretention/Dry Swales	49	Underground Detention	270
Sand Filters	279	Dry Ponds	528
Wet pond	212	Oil Grit Separators	805
Pond Wetland	98	Proprietary Practices	239
Infiltration Basin	58	Flow Splitter	321
Infiltration Trench	459	Other (plunge pools)	30
Grand Total			<b>3350</b>

# Developing a Preventative Maintenance Program

Identify maintenance levels:

- **Routine maintenance** - garbage pickup, underground cleanouts, weeding, mulch replacement, exercising valves on pond drains, etc.
- **Minor maintenance** - removal of top layer of medium, forebay dredging, etc.
- **Major maintenance** - total medium replacement; total dredge, replacement of failed risers, etc.
- **Retrofit or replacement**

# Triage Condition 1: Reconstructive BMP Surgery



**Failed infiltration basin to Wet Swale**



**Failed infiltration basin to Extended Detention with Micro-pools**



# BMP Triage System

**Condition 2:  
Major Repair/Functional  
Enhancement**



**Condition 3:  
Notify Owner to Perform  
Routine Maintenance**



# Thanks !

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[http://www.surveymonkey.com/s/SW-LID-Maintenance\\_webcast11](http://www.surveymonkey.com/s/SW-LID-Maintenance_webcast11)

Or e-mail your comments directly to [watershedguy@hotmail.com](mailto:watershedguy@hotmail.com)



United States Department of Agriculture  
National Institute of Food and Agriculture

# Upcoming Webcasts - for 2011

- **August 18 Stormwater Retrofits to Maximize Nutrient Reduction**
- **September 15 Increasing the Delivery of Residential Stewardship Practices**

# Questions and Answers

