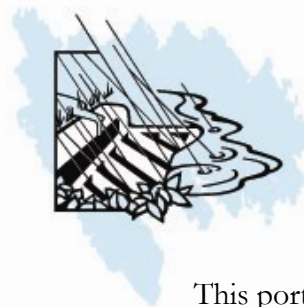


Maintenance of Stormwater Best Management Practices

By John S. Gulliver, Joohyon Kang and Peter T. Weiss



University of Minnesota

**Stormwater Management Practice
Assessment Project**

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the MPCA.



Acknowledgements



City of Albert Lea
City of Andover
City of Blaine
City of Bloomington
City of Buffalo
City of Burnsville
City of Chaska
City of Duluth
City of Faribault
City of Forest Lake
City of Hastings
City of Hermantown
City of Lake Ville
City of Lauderdale

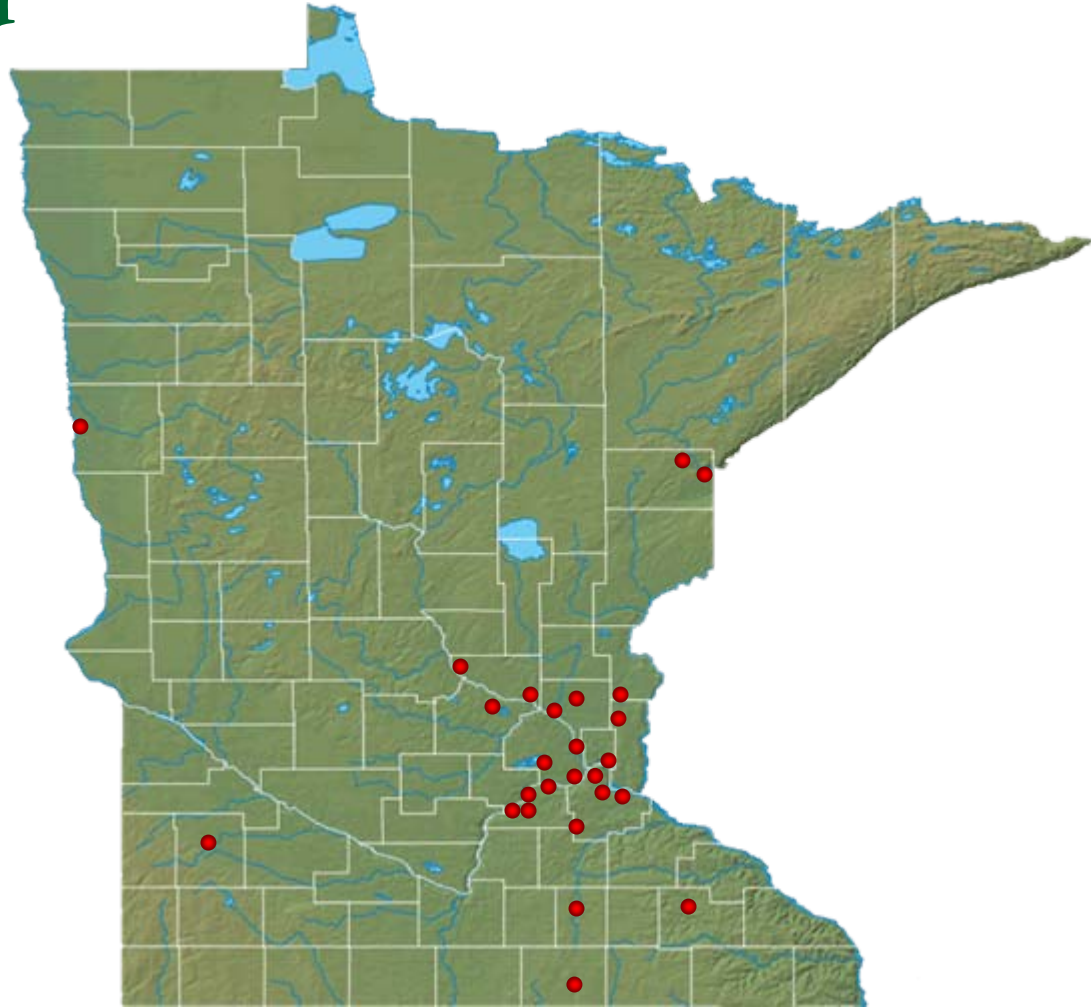
City of Little Canada
City of Marshall
City of Mendota Heights
City of Moorhead
City of North St. Paul
City of Plymouth
City of Prior Lake
City of Ramsey
City of Richfield
City of Rochester
City of Shakopee
City of St. Cloud
City of White Bear Lake

Statewide Survey



- Objectives
 - ❑ Investigate current status on BMPs and their maintenance in Minnesota
 - ❑ Identify maintenance components and corresponding costs
 - ❑ Obtain information to establish guidance for scheduling and budgeting maintenance of BMPs
- Sent to 106 cities in Minnesota
- 27 of them have responded

Spatial Distribution of the 27 Cities Surveyed



Components of BMP Maintenance



Routine

- Visual Inspection
- Remove debris and litter
- Mowing
- Vegetation management, etc.

Non-routine

- Remove accumulated sediment
- Structure maintenance
- Stabilize eroded bank
- Check dam replacement
- Repair mechanical components, etc.

Questionnaire

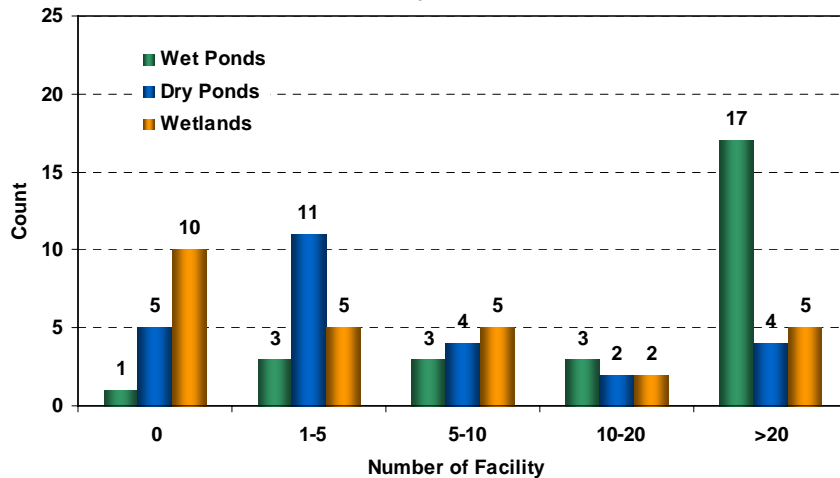


- Q1. Number of BMPs
- Q2. Frequency of regular inspection and maintenance
- Q3. Staff-hours for regular inspection and maintenance
- Q4. Complexity of maintenance
- Q5. Factors affecting performance of BMPs
- Q6. Costs of non-routine maintenance activities

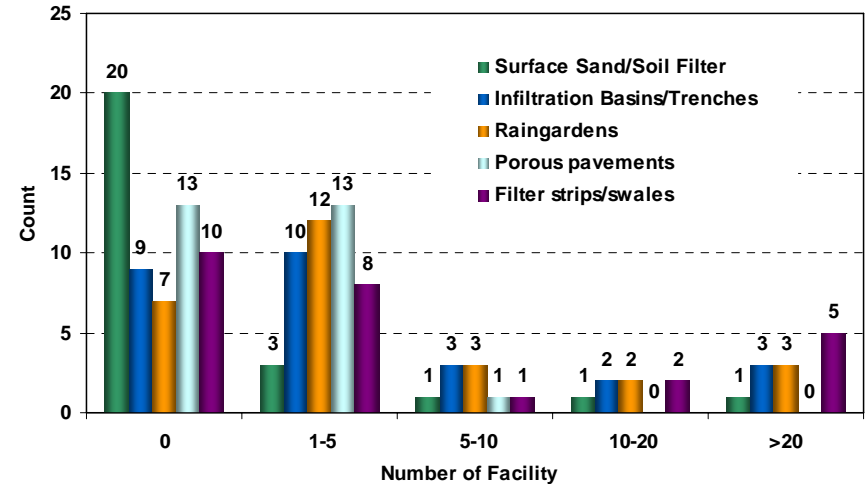
Q1. Number of BMPs



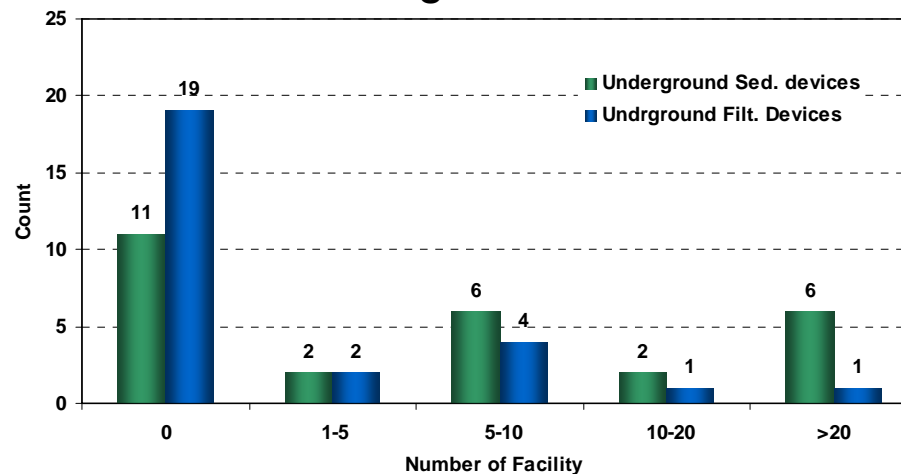
Pond type BMPs



Filtration/infiltration BMPs



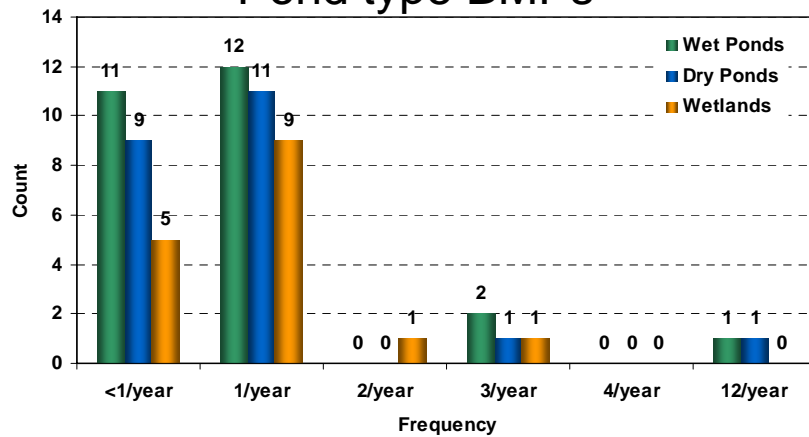
Underground devices



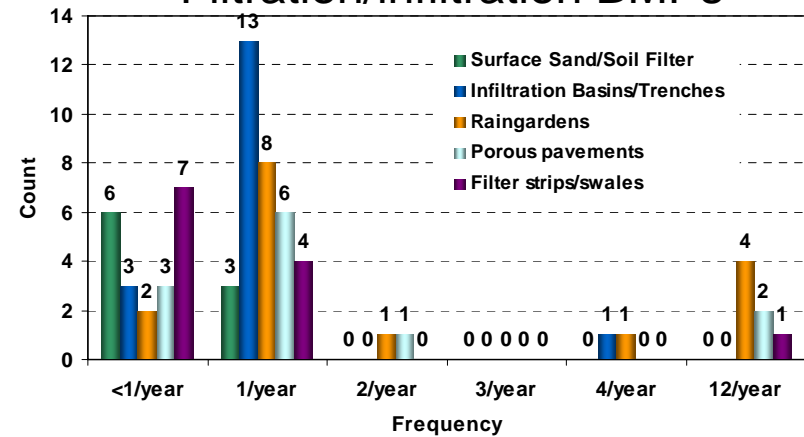
Q2. Frequency of regular inspection and maintenance



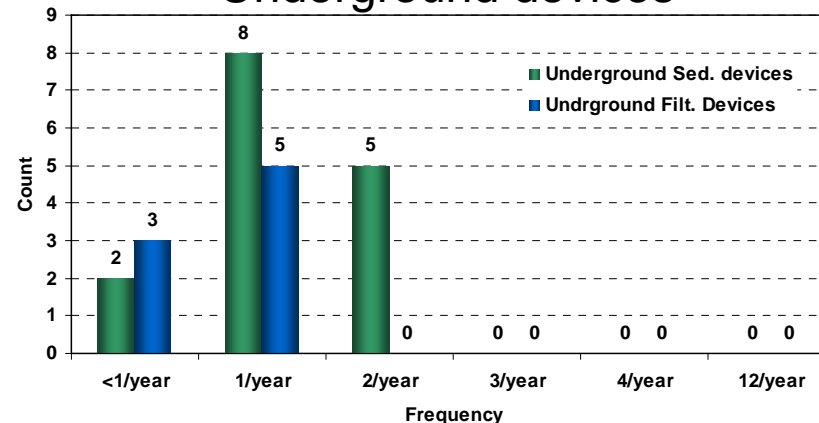
Pond type BMPs



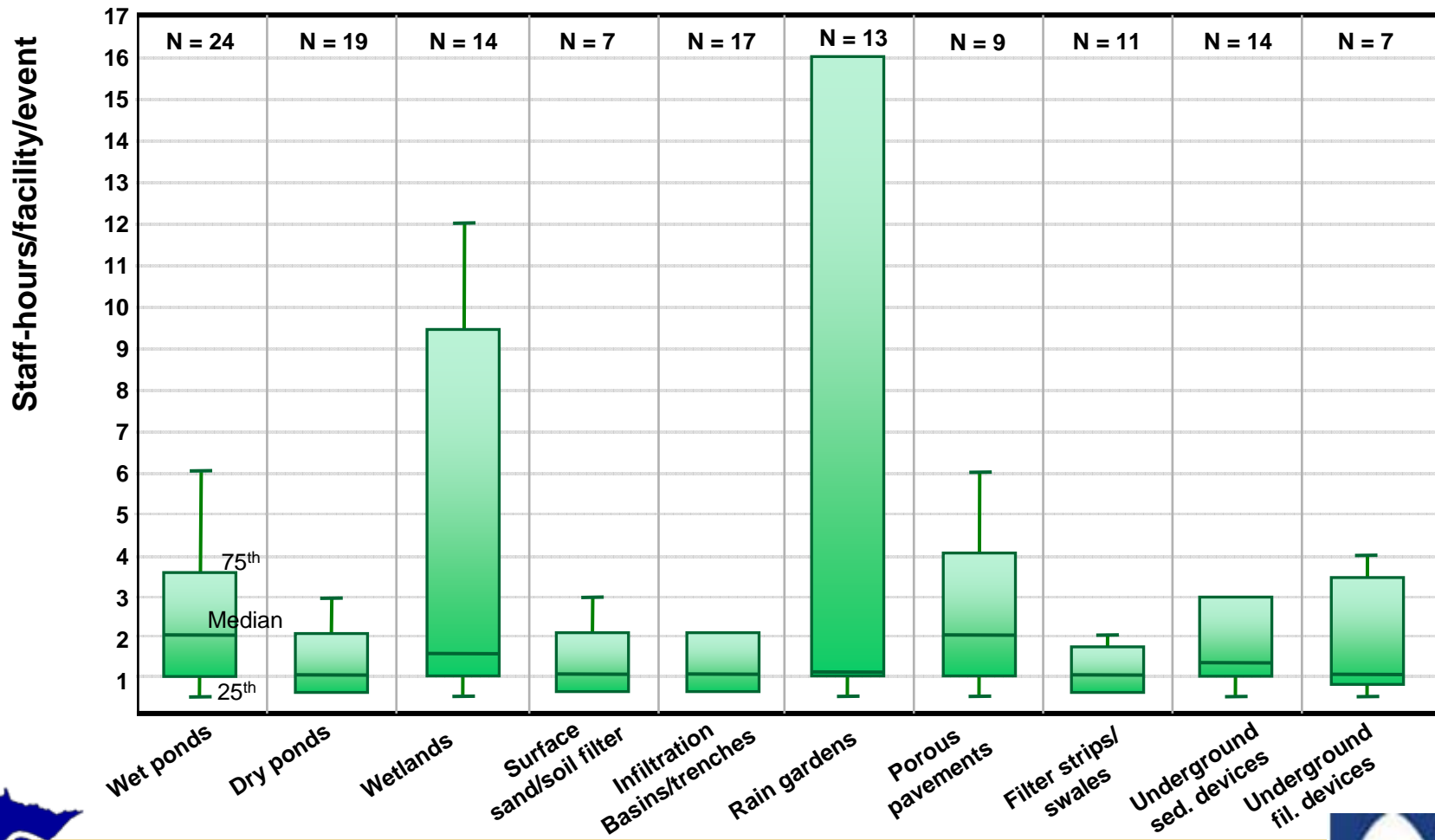
Filtration/infiltration BMPs



Underground devices



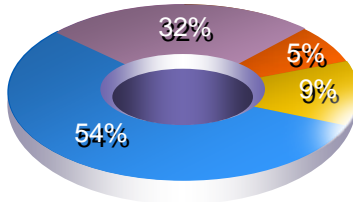
Q3. Staff-hours for regular inspection and maintenance



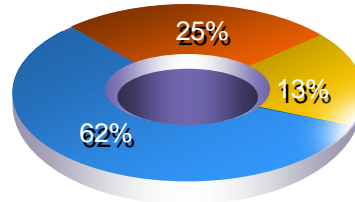
Q4. Maintenance complexity



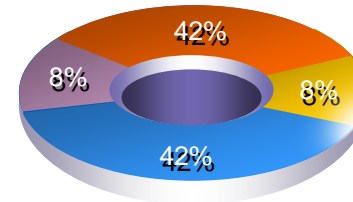
Wet Ponds



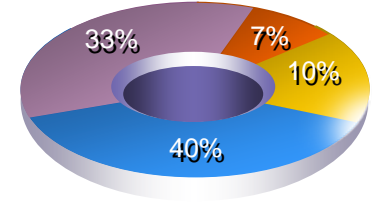
Surface Sand/Soil Filters



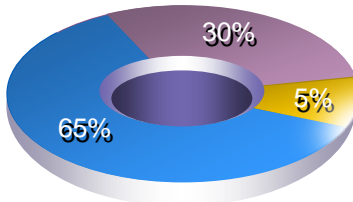
Porous Pavements



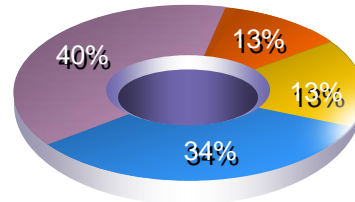
Underground Sed. Devices



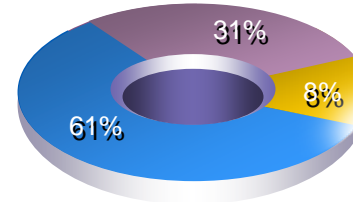
Dry Ponds



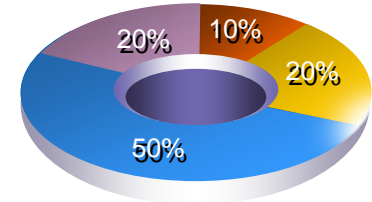
Filtration Basins/Trenches



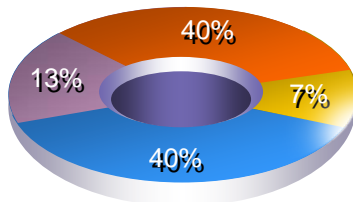
Filter Strips/Swales



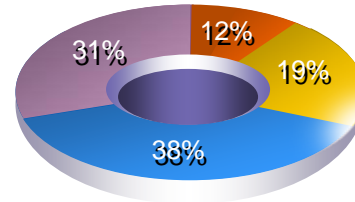
Underground Filtr. Devices



Wetlands

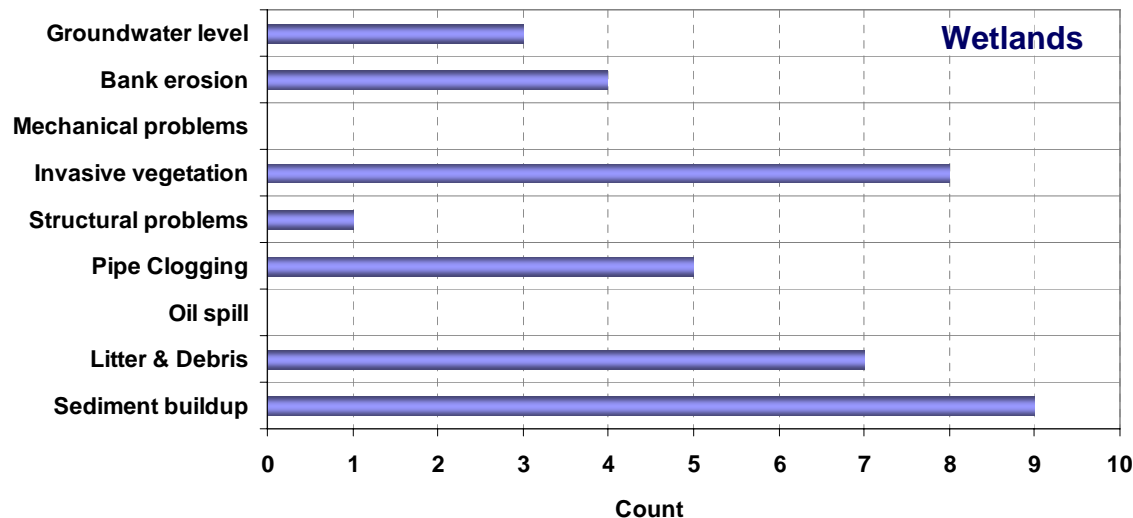
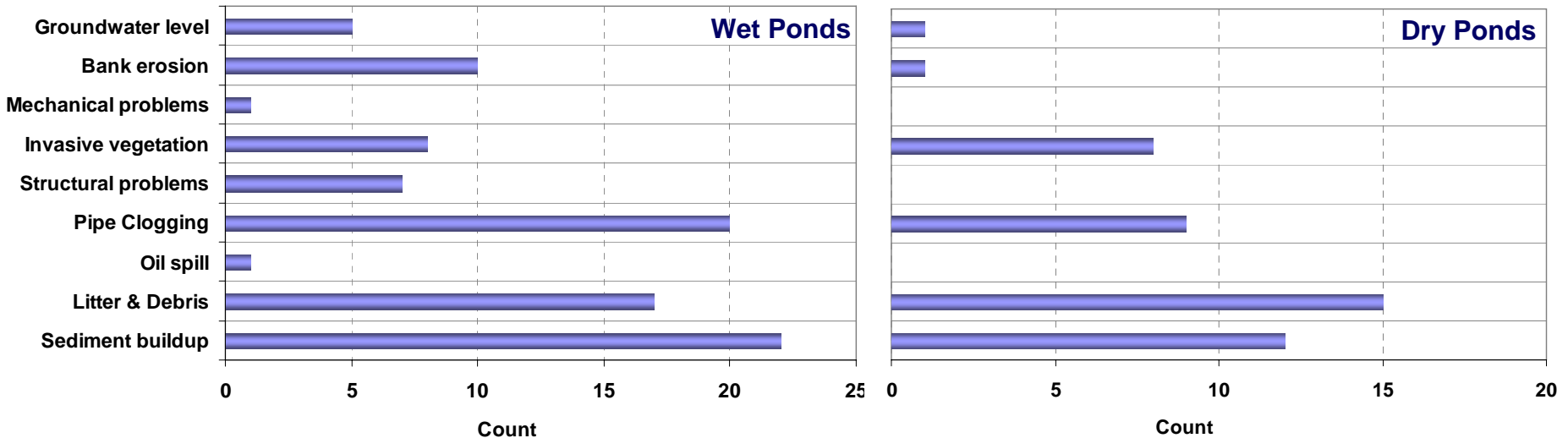


Rain Gardens

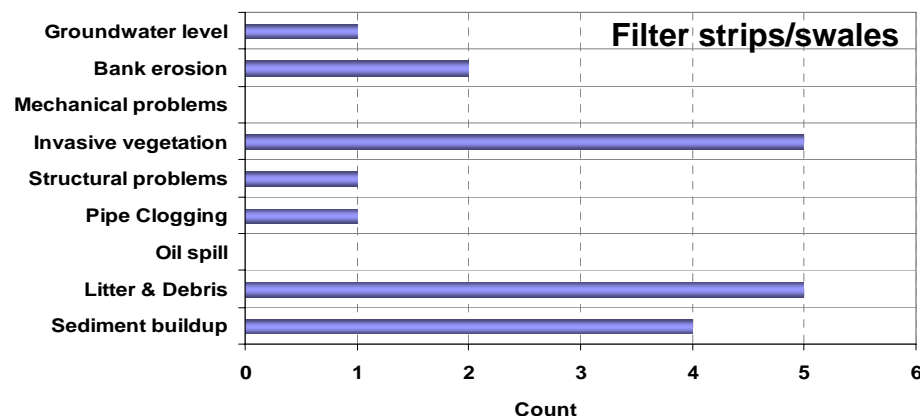
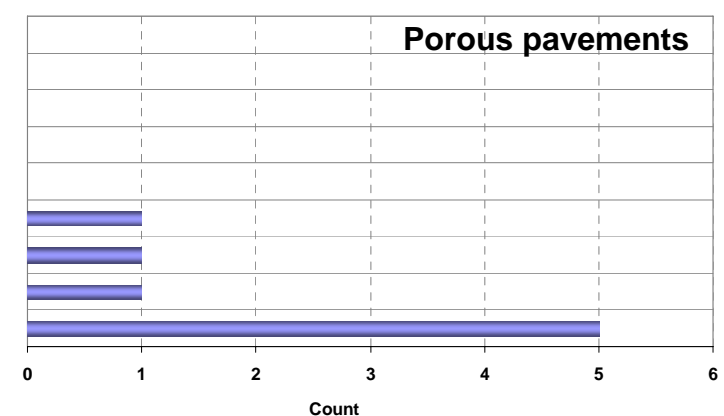
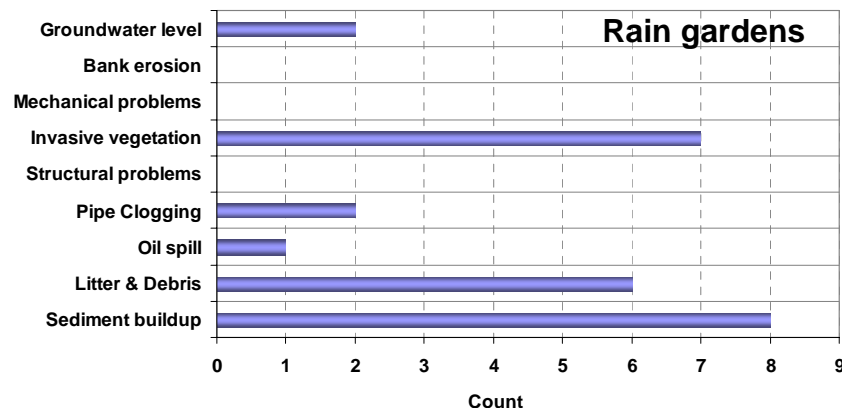
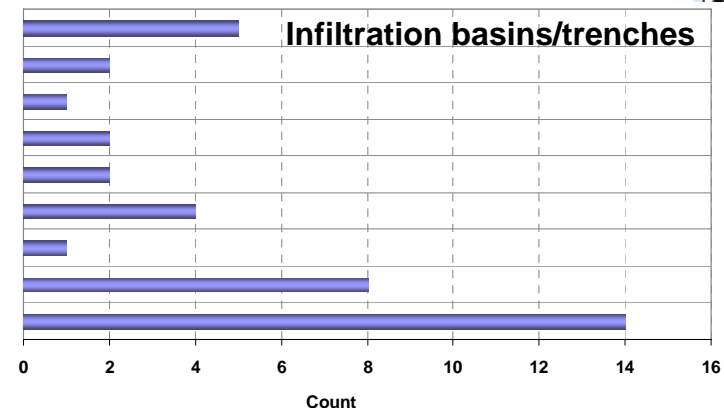
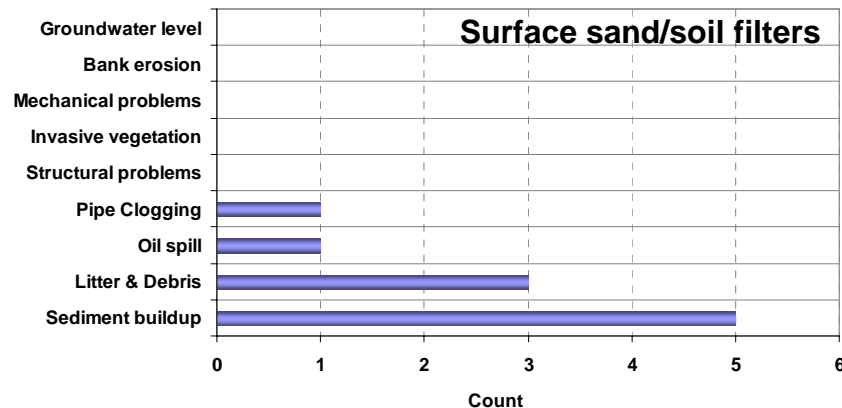


- **Minimal** (SW professional is seldom needed)
- **Simple** (SW professional is occasionally needed)
- **Moderate** (SW professional is needed half the time)
- **Complicated** (SW professional is always needed)

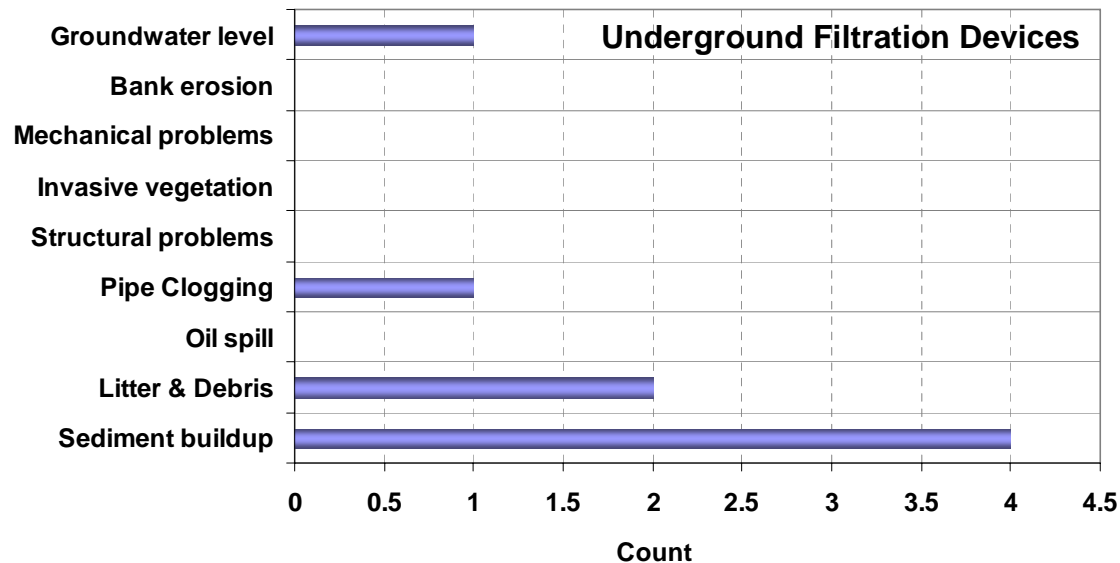
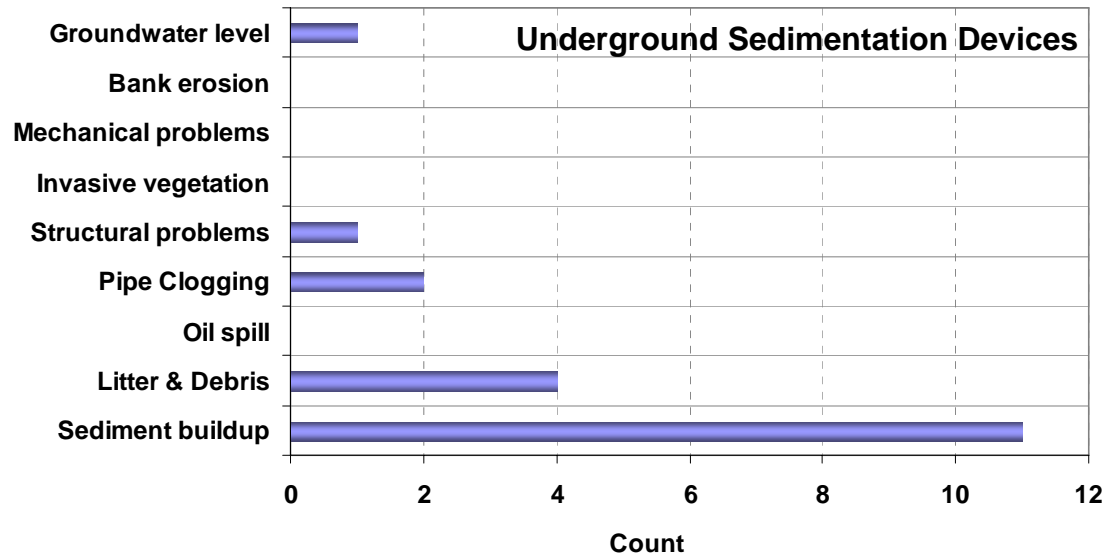
Q5. Factors affecting performance of BMPs (Multiple-answers allowed)



Q5. Factors affecting performance of BMPs, *Cont'd*



Q5. Factors affecting performance of BMPs, *Cont'd*

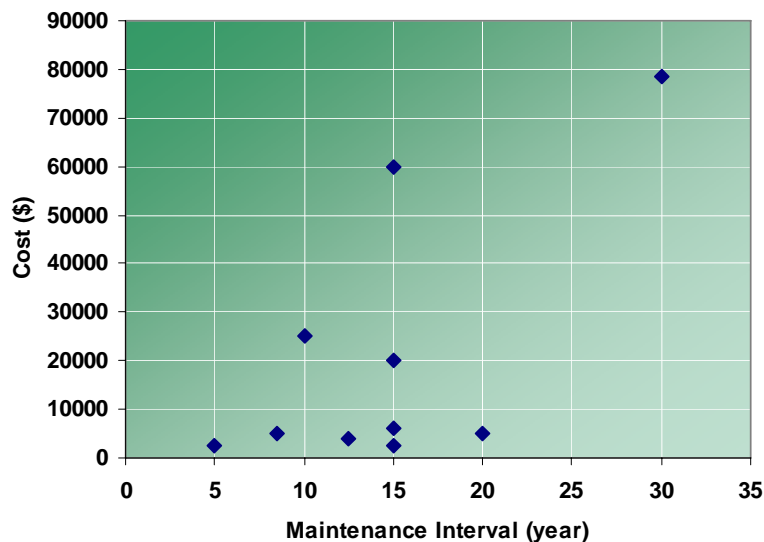


Q6. Costs for non-routine maintenance activities

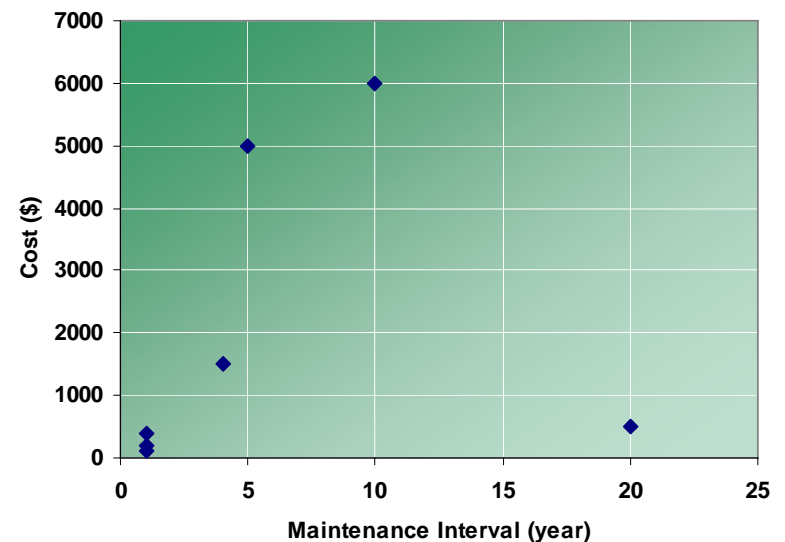


Wet Ponds

Sediment Removal



Inlet/Outlet Structure Maintenance

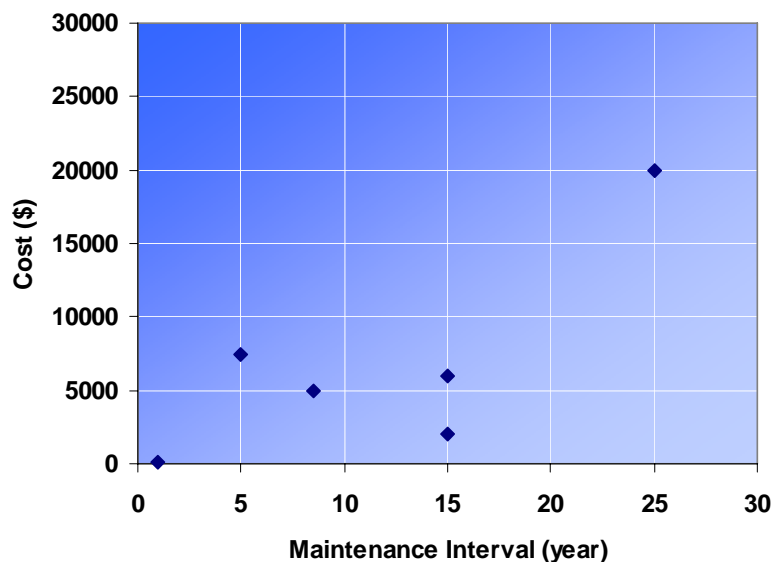


Q6. Costs for non-routine maintenance activities, *Cont'd*

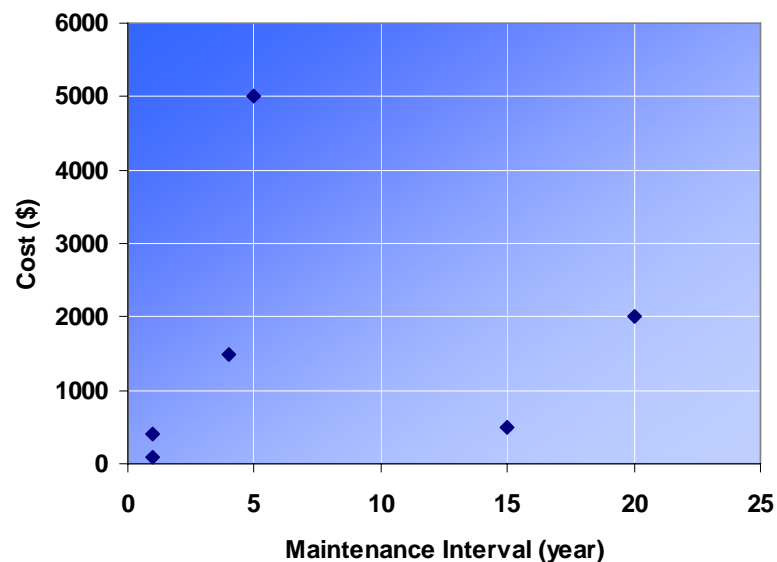


Dry Ponds

Sediment Removal



Inlet/Outlet Structure Maintenance



Polycyclic Aromatic Hydrocarbons and Pond Sediments



- Pond sediments are anaerobic
 - PAHs do not bio-degrade
- Minnesota changed their dredged sediment testing
 - Test for PAHs
 - Found PAHs > 10X hazardous waste limits
- Dredging of pond sediments has stopped in Minnesota
- Is this also a concern for:
 - Wetlands?
 - Soil and sand filters?
 - Rain gardens?

Concentration of PAHs in White Bear Lake



7 of 24 Benzo(a)pyrene (BaP) Equivalents

Chemical	Relative Potency Factor	Site Concentration (mg/kg)	BaP Equivalent
Benz[a]anthracene	0.1	8.300	0.830
Benzo[b]fluoranthene	0.1	9.600	0.960
Benzo[k]fluoranthene	0.1	8.800	0.880
Benzo[a]pyrene (1)	1	9.500	9.500
Chrysene	0.01	11.000	0.110
Indeno[1,2,3,-c,d]pyrene	0.1	2.000	0.200
5-Methylchrysene	1	11.000	11.000
Total BaP equivalents =			23.48
Residential usage BaP <			2
Industrial Use BaP <			3
Hazardous Waste BaP >			3

Our Approach to a Solution

=> Composting



- Add bulking agent
- Seed with bacteria and fungus
- Maintain aerobic conditions
- Maintain temperatures below 45° C



www.turnandscreen.com

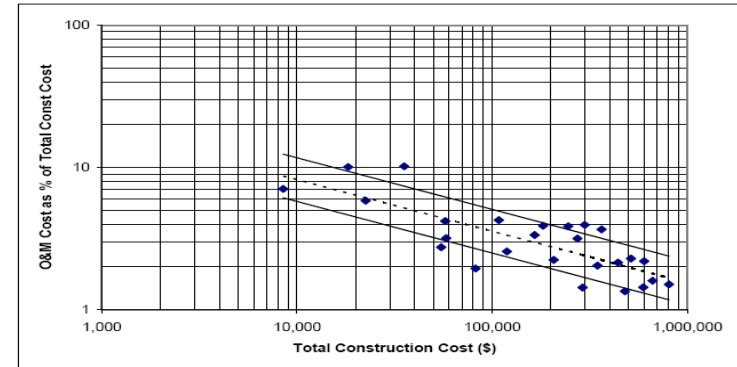
Annual O&M Costs for Stormwater Ponds (Weiss et al., 2005)



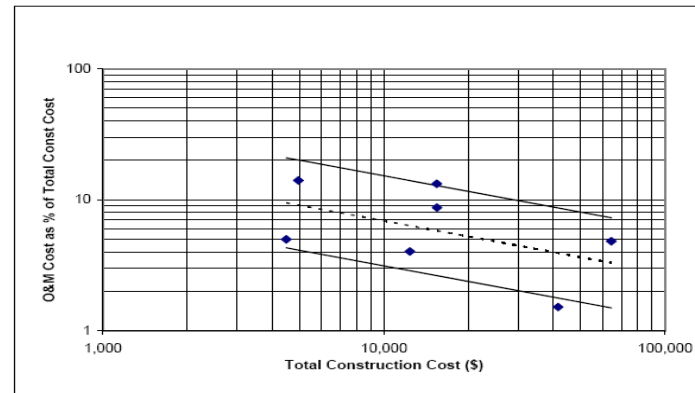
Dry Ponds



Wet Ponds



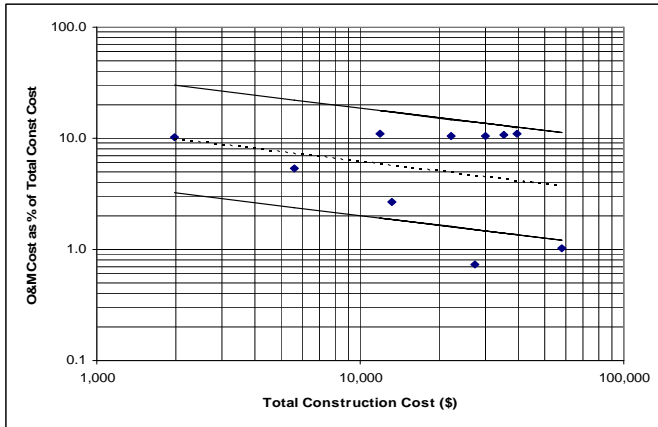
Wetlands



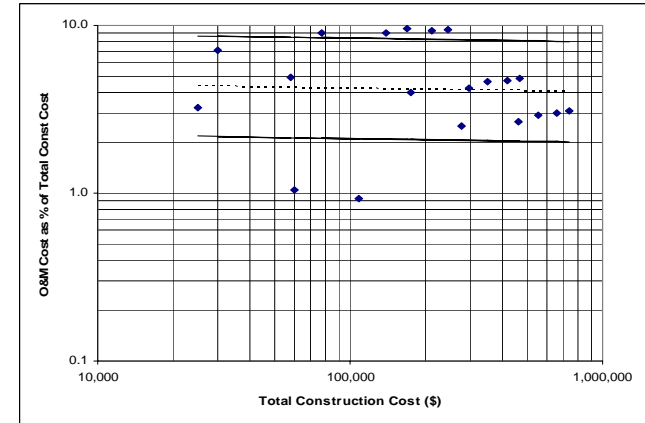
Annual O&M Costs for Stormwater Ponds (Weiss et al., 2005)



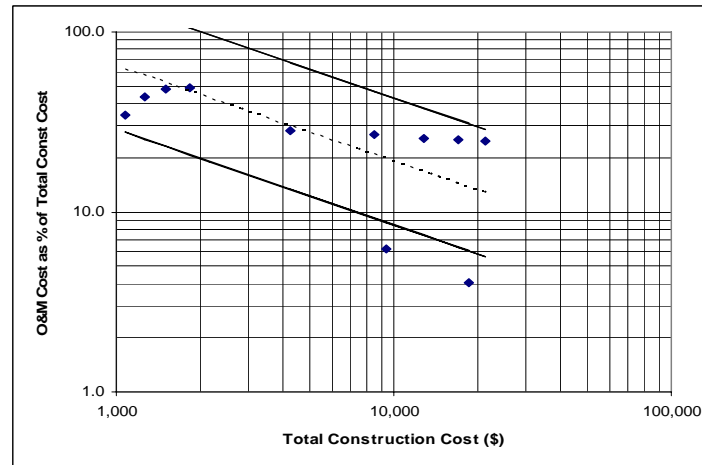
Bio-retention Practices



Sand Filters



Swales



Median O & M Costs (Weiss, et al., 2005)



Practice	Median Annual O&M Costs / Total Construction Costs
Dry Ponds	2%
Wet Ponds	3.5%
Wetlands	6%
Bio-retention	5%
Sand Filters	4%
Swales	20%

Summary



- Wetlands, surface filters and porous pavements are most difficult to maintain
- Staff-hours range from 1-4 except for wetlands and rain gardens
- Most of the BMPs are inspected once/year or less
- Sediment buildup, litter & debris accumulation, pipe clogging, and invasive vegetation are the major factors reducing the effectiveness of BMPs
- Generally sediment removal and repair of inlet/outlet structure are major activities accounting for a large portion of total maintenance costs
- Accurate estimation the sediment accumulation rate in a BMP is very important to establish the schedule and budget for maintenance
- Annual O&M Cost / Total Construction Cost
 - Dry ponds < Wet Ponds < Sand filters < Bio-retention < Wetlands < Swales

Questions?



Thank you for your attention!

