

INSPECTION & MAINTENANCE OF BMPs: PROGRAM COMPONENTS & ASSET MANAGEMENT

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Outline

Stormwater Best Management Practices (BMPs)

- Types of BMPs and how they work
- An asset management approach to maintenance

Inspection and Maintenance of BMPs

- Why do BMPs need to be maintained
- Elements of a maintenance program
- Routine and non-routine maintenance needs



Types of stormwater BMPs

Stormwater Asset Category	Example Types of Assets	
Basins	 Dry basins Cisterns and rain barrels Wetlands 	 Wet basins Vaults and swirl concentrators Forebays
Swales and Strips	SwalesLevel spreaders	 Vegetated strips
Filters	 Surface and subsurface sand filters Landscaped / vegetated roofs Manufactured filters (boxes) 	 Bioretention Drain inlet inserts Subsurface gravel wetlands
Infiltrators	Infiltration basinsDry wells	 Infiltration trenches and vaults Permeable pavement
Gross Pollutant Traps and Mechanical Operations	ScreensBasketsHoods	NetsRacks

Adapted from "Design of Urban Stormwater Controls" (WEF Press, McGraw Hill, 2012)



How BMPs work: pollutant removal mechanisms

- Storage •
- Settling •
- Filtering •
- **Biological and chemical** • processes
- Evapotranspiration •
- Soil infiltration •







How BMPs work: factors in BMP design

- Volume (runoff inflow and outflow)
- Velocity
- Resuspension (consideration of by-pass flows)
- Pollutant concentration
- Dissolved or suspended pollutants
- Pre-treatment areas/devices



BMP design and maintenance criteria need to be improved

- Routine maintenance is not being performed consistently and proactively in may cases
- Some BMPs are failing
- Performance feedback is needed to address design and maintenance needs







Asset Management Approach to Maintenance



Asset Management definition – adapted from USEPA

Asset Management is a body of management practices that

- Is applied to the *entire portfolio of infrastructure assets* • at all levels of the organization
- Seeks to *minimize total costs* of acquiring, operating, maintaining, ۲ and renewing assets
- Works within an environment of *limited resources* •
- Delivers service levels customers desire and • regulators require
- Targets acceptable level of risk to the organization •



There is more to Asset Management than **Data Collection**





A well-defined AM structure is critical

ASSET GROUP	Outfalls/ Pipes	Junctions/ Chambers	Pumps
ASSET TYPE	PipePipe InletPipe Outlet	 Manhole Catch basin Junction box Drop inlet 	PumpGateValve
ASSET COMPONENT	 Manhole Catch basin Headwall Flume 	WallsChimneyLid	 Motor (if <100 HP pump)

Good AM Protocols for Traditional Assets



A well-defined AM structure is critical

ASSET GROUP	Open Linear Systems	BMPs/GI	
ASSET TYPE	DitchChannelSwale	 Rain gardens Bioswales Wet ponds Dry ponds 	 Constructed wetlands Manufactured devices
ASSET COMPONENT	Check damsVegetation	 Forebay Overflow / riser Channel 	VegetationStructure protection

Need Better AM Protocols for Stormwater Assets



A key focus of the Asset Management process is Risk-Based Evaluations

Risk Is a Simple Equation: Probability * Consequence





Condition assessment helps determine probability of failure

Condition Type	Failure Mode	Description	Assessment Method
	Capacity	Does not meet demand (flow, loading, storage volume, etc.)	Test or Desktop
Performance	Level of Service	Does not meet functional needs (regulatory permits, customer commitments)	Desktop
	Efficiency	Not lowest cost alternative (labor, maintenance, obsolescence)	Desktop
Physical	Mortality	Current state of repair and operation as influenced by age, historical maintenance and operating environment	Test, Visual, Desktop, Modeling



Physical condition examples

Condition Score 1



Condition Score 5





Multiple stormwater assets example

Stormwater Assets:

- Detention basins 6
- Retention basins 4
- Storm filters 3
- Underground pipe 1 •
- Filterra 23
- Streams/Channels 2







Condition ratings for all stormwater asset types

					Condition Assessment Rating				
Object	Location		Technology/	Structure	Structural	Erosion/		Clogging	Pretreatment
ID	ID	Asset ID	Туре	Number	Problem	Sedimentation	Vegetation	Trash	Device
1	278	1363	Detention	-	3	2	4	4	
2	3278	1598	Detention	WCVE	5	2	3	2	
3	3298	1614	Retention	Home Depot		2	4	4	3
4	8162	1469	Detention	-		1	4		
			Extended						
5	8555	1221	Detention	# 1	2	3	4	2	1
			Extended						
6	8559	1222	Detention	#2	2	4	5	2	1
7	8561	899	Filterra	F1	2	2	3	2	1
8	8566	1070	Storm Filter	17	2	1	1	4	1
9	8568	1466	Detention	-	4	5	5	5	1
10	8580	1173	Retention	#1	2	2	2	2	
11	8580	1630	Retention	#2	2	2	3	3	



Which assets to repair/retrofit?

Total Score	No. of Assets	Percent	Repair Priority
1-6	39	74%	None
7-9	12	23%	Low
10-12	2	4%	Medium
13-15	0	0	High
Total	53	100%	



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Benefits of Asset Management

- Informed asset investment decisions
- ✓ Managed risk
- Demonstrated compliance
- Improved organizational sustainability
- Improved efficiency and effectiveness
- Improved services and outputs
- Demonstrated social responsibility

= Real organizational savings (reduced borrowing costs, right-timed asset replacement, reduced asset failures)







Maintenance of BMPs?

- No BMP is maintenance free
- A properly cared for stormwater management facility can work effectively for years without major maintenance costs
- Neglected, a stormwater BMP can potentially be a continual financial drain





Maintenance requirements will change as **BMPs** age





Maintenance requirements will change as **BMPs** age





Maintenance requirements will change as **BMPs** age





Outflow impacts on maintenance requirements





Downstream impacts on maintenance requirements





Ponds – specs and debris management





Retrofitted pond to facilitate maintenance







Establish a Maintenance Program



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Identify BMP characteristics and maintenance needs



Dry Pond



Wet Pond



Infiltration Trench



Bioretention Facility



Vegetated Rooftop



Vegetated Swale



Underground Detention



Permeable Paving



Manufactured Device

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Define maintenance tasks and costs

- **Regular Inspections** •
- Vegetation Management •
- Embankment and Outlet Stabilization •
- Debris and Litter Control •
- **Mechanical Components** • Maintenance
- Insect Control •
- Access Maintenance
- **Overall Pond Maintenance**
- Sediment/Pollutant Removal •
- **Components Replacement**







Perform routine inspections

- Detect issues early
- First line of defense to ensure optimal operation
- Helps avoid long term problems

Sample Self Inspection Chec	: klist
STRUCTURAL INTEGRITY	OTHER INSPECTION ITEMS
Yes No N/A Does the facility show signs of settling, oracking, bulgin misalignment, or other structural deterioration?	Yes No N/A g, Is there evidence of encroachments or improper use o impounded areas?
Yes No N/A Do embankments, emergency spillways, side slopes, o inlet/outlet structures show signs of excessive erosion o slumping?	Yes No N/A or Are there signs of vandalism? or Yes No N/A Do the force acts lack as other sofety design and
Yes No N/A Is the outlet pipe damaged or otherwise not functionin properly?	repair? 19 Yes No N/A
Yes No N/A Do impoundment and inlet areas show erosion, low spot or lack of stabilization?	Is there excessive algae growth, or has one type o vegetation taken over the facility? s, Yes No N/A
Yes No N/A Are trees or saplings present on the embankment?	Is there evidence of oil, grease, or other automotive fluid entering and clogging the facility?
Yes No N/A Are animal burrows present?	Yes No N/A In rain gardens, is there evidence of soil erosion, does muld oover the entire area, are specified number and types o
Yes No N/A Are contributing areas unstabilized with evidence of erosion?	plants still in place, on's there evidence or disease or plan stress from inadequate or too much watering?
Yes No N/A Do grassed areas require moving and/or are olipping building up?	OTHER OBSERVATIONS
WORKING CONDITIONS	
Yes No N/A Does the depth of sediment or other factors suggest a lo of storage volume?	
Yes No N/A Is there standing water in inappropriate areas, such as o filters or oartridges after a dry period?	A yes answer to any of these items should result in corrective action or a call to a professional inspector.
Yes No N/A Is there an accumulation of floating debris and/or trash?	
	Source: Northern Virginia Regional Commission



Regular inspections reduce maintenance costs

Inspection Checklist

- Remove obstructions of the inlet or outlet devices by trash and debris \checkmark
- Look for excessive erosion, scouring, or sedimentation in the pond perimeter, \checkmark inlets, outlets, and energy dissipaters
- Look for cracking or settling in the embankment, dam, inlet and outlet \checkmark structures
- Look for animal burrows, nests, or lodges \checkmark
- Look for permanently ponded areas in the bottom of an extended-detention dry \checkmark pond or bioretention facility
- Look for sluggishly draining infiltration devices \checkmark
- Look for algae growth, stagnant pools, or noxious odors \checkmark
- Look for poor or distressed stands of grass \checkmark



Regular inspections reduce maintenance costs

Inspection Checklist (continued)

- Look for distressed aquatic vegetation
- Look for deterioration of pipes and conduits
- Look for piping along the outlet barrel
- Look for deterioration in the emergency spillway (grass should not be cut to less than 8 inches in height)
- Look for washouts, bulges or slumps, and woody growth in the embankment
- Identify seepage at the toe of wet ponds or constructed treatment wetlands
- Identify unstable side slopes and embankments
- Document deterioration of downstream channels \checkmark
- Document signs of vandalism



Provide proper/consistent training

- Provide guidance on proper maintenance techniques for different BMPs
- Keep staff up-to-date on changes in BMP technology
- Provide instruction on use of maintenance equipment







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Keep records of maintenance

- Identifying persistent problems by asset type
- "Calibrate" your crews
- Identify chronic maintenance problems by location
- Aid in future budget preparation

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Don't forget to involve the public!

- Educating and involving the community is a cost-effective way to prolong the life of the stormwater **BMPs**
- Activities can range from organized clean-up days to a community-wide education program
- Supplies, resources, and technical support should be provided to businesses and communities







Provide routine maintenance

- Costs are relatively consistent and can usually be predicted for an annual budget
- Typical range is 1 to 10% of original capital construction costs per year depending on BMP type and size





Considerations for routine maintenance

- Visibility of the Facility/ **Aesthetics**
- Landscaping
- Upstream Conditions
- Safety
- Need for Professional Judgement
- Financing







Plan for non-routine maintenance

- Non-routine maintenance is highly specific and varies depending on different factors
- Costs can be substantial over the long run, especially when considering the possibility of eventual BMP replacement
- Having a dedicated BMP • maintenance fund account to cover these costs is highly recommended







Non-routine maintenance items

- Major sediment removal
- Inflow and outflow pipes •
- Trash racks and anti-vortex devices
- Valves, orifices, and aerators
- Concrete structures (riser structures in • ponds, etc.)
- Pumps and switches ٠
- Manhole covers and access hatches •
- Earthworks such as embankments and side slopes
- Mulch and vegetation •







Summary

Old Problems

- Reactive response to BMP maintenance
- Limited funding

New Solutions

- Proactive response to BMP maintenance
- Take an asset management approach
- Establish a maintenance program
- Provide routine and non-routine maintenance



Improving quality of life.

Thank you!





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