Programmatic Approaches to Ensuring Long-Term Performance of Stormwater Control Measures

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If it’s working, it’s going to need maintenance...
Longevity is a Design Decision

- For any SCM, increasing performance or hydraulic loading rate reduces longevity.
- Developers often prioritize capital cost reduction over life cycle cost reduction – especially when planning to transfer property ownership.
Can it be Maintained?
How Often Must it be Maintained?
Failure Mechanisms
Stormwater program resources are limited...

**Typical Stormwater Program Elements**

- Management and organization
- Monitoring and discharge characterization program
- Project planning and design
- Construction program permitting and compliance
- Roadway maintenance activities
- Facility operations
- Non-departmental activities
- Non-stormwater activities/discharges
- Training
- Public education and participation
- Location specific activities
- Program evaluation
- Measurable objectives
- Reporting

Source: AASHTO. 2009. Developing and Implementing a Stormwater Management Program in a Transportation Agency
# Typical Bioretention Maintenance Requirements

<table>
<thead>
<tr>
<th>Routine Maintenance Tasks</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>Remove trash and debris</td>
<td>As needed</td>
</tr>
<tr>
<td>Check and repair eroded areas</td>
<td>Annually</td>
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<tr>
<td>Inspect for and remove excess sediment</td>
<td>Annually</td>
</tr>
<tr>
<td>Mow grass filter strips and bioretention turf cover</td>
<td>At least four times per year</td>
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<tr>
<td>Weed and rake mulch</td>
<td>Twice during the growing season</td>
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<tr>
<td>Inspect plant composition for consistency with approved plans and correct any deficiencies</td>
<td>Annually</td>
</tr>
<tr>
<td>Remulch to maintain a three inch layer</td>
<td>Annually</td>
</tr>
<tr>
<td>Prune trees and shrubs</td>
<td>Annually</td>
</tr>
<tr>
<td>Inspect for clogging or ponding water in the filter bed</td>
<td>Annually</td>
</tr>
<tr>
<td>Remove invasive plants</td>
<td>As needed</td>
</tr>
<tr>
<td>Replace dead or damaged plant material</td>
<td>As needed</td>
</tr>
<tr>
<td>Repair broken pipes</td>
<td>As needed</td>
</tr>
<tr>
<td>Remove sediment in pretreatment cells and inflows</td>
<td>Every 2-3 years</td>
</tr>
<tr>
<td>Replace the mulch layer</td>
<td>Every 3 years</td>
</tr>
</tbody>
</table>

Source: Alexandria VA Bioretention Area Maintenance Schedule and Guidelines
Typical MTD Maintenance Requirements

- Hydrodynamic Separators – Vacuum once per 3-5 years
- Media Filters – Replace cartridges once per 1-3 years
- Biofiltration – Replace mulch annually
Typical Bioretention O&M Costs

![Graph showing average annual maintenance costs for bioretention systems with data values: Mean $0.88, Median $0.68, Min $0.13, Max $2.30.]

Figure 3-1. Range of Average Annual Bioretention Maintenance Costs (2015 dollars per square foot)

Source: Clary, Jane and Holly Piza. 2017. Cost of maintaining green infrastructure. ASCE. Reston, VA
Typical O&M Costs for MTDs

**Ballpark estimates:**

- Vac Tuck & Operator $260-$375/hour (4 Hour Minimum Typ)
- Disposal of Liquid/Solid mixtures $.40/Gallon - $1.10/Gallon
- Disposal of Dry/Damp Solids $60-$125/Ton
- “Special” or “Hazardous” materials significantly more
- Cost of replaceable parts varies widely
Private SCM Maintenance is a Public Agency Concern

- Private SCM maintenance is more complex to regulate vs. asset management plan approach for public infrastructure
- Unmaintained SCMs mean unmet water quality standards
- As TMDLs are incorporated into municipal MS4 permits, every pollution control opportunity must be maximized
Regulatory Framework for Adequate Inspection, Operation and Maintenance

Permits
- Set minimum standards for stormwater programs
- Enforceable regulation

Ordinances
- Give local programs authority to carry out actions required by the permit

Local Programs
- Implementation of program elements as required in permits and ordinances
Permit and Ordinance References

• 2010 EPA MS4 Permit Improvement Guide recommends permit language in all areas including:
  • Long term maintenance of post-construction SCMs
  • SCM inventory and tracking
  • Inspection and enforcement

• Model Ordinance Examples (not on EPA page)
  • State of Illinois Department of Natural Resources. 2015. Model Stormwater Management Ordinance
The permittee must require the owner or operator of any new development or redeveloped site subject to the performance standards in Part 5.2 to develop and implement a maintenance agreement addressing maintenance requirements for any structural control measures installed on site to meet the performance standards. The agreement must allow the permittee, or its designee, to conduct inspections of the structural stormwater control measures and also account for transfer of responsibility in leases and/or deeds. The agreement must also allow the permittee, or its designee, to perform necessary maintenance or corrective actions neglected by the property owner/operator, and bill or recoup costs from the property owner/operator when the owner/operator has not performed the necessary maintenance within thirty (30) days of notification by the permittee or its designee.

Enforceable Maintenance Contracts

• Between Owner and Permittee
• For a specific property and BMPs as described in an approved SWMP
• Require SCM construction according to SWMP
• Require maintenance according to O&M Plan
• Include relevant SWMP details and O&M Plan
• Grant Permittee permission to access site
• Contain a remedy for owner negligence
• Establish agreement as transferrable covenant
Enforceable Maintenance Contracts

• Include a path for site and plan modifications
• Require notarized signatures

References:


O&M by the Permittee

Permittees may elect to take on inspection and maintenance responsibility for private SCM

- Provides certainty on timing and quality of work
- Consistent reporting
- Economy of scale benefits
- Funded by the property owner

City of Gresham, OR. Stormdrain Cleaning Assistance Program (SCAP).
https://greshamoregon.gov/Stormdrain-Cleaning-Assistance-Program/
SCM Tracking and Inventory

- GIS integration recommended
- Should be integrated with inspection and maintenance records
- Facilitates enforcement
- Facilitates CIP project planning
- Enables crediting toward TMDL obligations
- Allows forensic investigations
SCM tracking and inventory

Example of a searchable GIS database containing stormwater infrastructure information from Gwinnett County, GA
SCM Database Content

(i) Municipal Project ID
(ii) State WDID No.
(iii) Project Acreage
(iv) BMP Type and Description
(v) BMP Location (coordinates)
(vi) Date of Acceptance
(vii) Date of Maintenance Agreement
(viii) Maintenance Records
(ix) Inspection Date and Summary
(x) Corrective Action
(xi) Date Certificate of Occupancy Issued
(xii) Replacement or Repair Date

Source: Los Angeles Region MS4 Permit
As-built Verification

**Necessary Elements:**

- Certification by Contractor and/or Engineer that as-built details conform to plans
- Completed installation checklist
- Photographs
- Documentation of proper plants and soils where applicable
- Construction plans
- Details of any deviations from plans
Post-Construction SCM Inspection

Must assess SCM design characteristics
- Infiltration rate or filter media capacity
- Detention volume
- Vegetation health, mulch distribution
- Diameter, material, inverts of all pipes
- Elevation of inlets, curbs, bypass structures
- Scour protection
- Flow distribution structures

Checklist examples:
DNREC Post-Construction Verification Document (PCVD) Checklists:
http://www.dnrec.delaware.gov/swc/Drainage/Pages/PCVD-Checklists.aspx
SD1: SD1 BMP Installation Checklist
http://sd1.org/Resources.aspx?cid=3
Routine, Ongoing SCM Inspection

- Inspection interval should either:
  - Match the most frequent maintenance element interval if quarterly or less, or;
  - Be set at half the interval of the typical routine maintenance event

- More frequent inspection during initial operation can help set long term inspection/maintenance intervals

- Some permits set minimum inspection and reporting frequencies
  - SCMs may have maintenance intervals shorter than the permitted inspection frequency interval

- Severe events can trigger inspections
  - WA Phase I permit requires spot checks of SCMs after 10-yr, 24-hr event or greater (S5.9.C.c.ii)
Progressive Enforcement

At each step, the owner/operator can stop escalation by submitting an inspection and maintenance report.
Conclusions

• EPA MS4 Permit improvement guide remains a valuable resource for updating permit language
• Local ordinances give permittees authority to hold private landowners accountable for inspection and maintenance
• As-built and routine inspections must address fundamental design elements
• Require binding maintenance contracts prior to approval
• Strong, progressive enforcement provides critical motivation
• Resources abound – There is no excuse for negligence!
Questions?

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Sometimes, even if I stand in the middle of the room, no one acknowledges me.