Stormwater BMP Maintenance and Operations

CEE by AASHTO Stormwater Community of Practice
October 18, 2018
Center for Environmental Excellence

- Promotes environmental stewardship and encourages innovative ways to streamline the transportation delivery process.

- Provides technical assistance, training, information exchange, partnership-building opportunities, and quick and easy access to environmental tools.

- Provides a variety of products and services to assist transportation agencies in achieving environmental excellence, including:
  - Peer Exchanges
  - Practitioner’s Handbooks
  - Communities of Practice
  - Webinars
  - Databases

https://environment.transportation.org/
AASHTO and FHWA

Melissa Savage
AASHTO Center for Environmental Excellence

Susan Jones, P.E.
Federal Highway Administration
Community of Practice Presenters

William Fletcher
Oregon Department of Transportation

Andy McDaniel
North Carolina Department of Transportation

Richard Heineman
Pennsylvania Department of Transportation

Kiona Leah
Maryland Department of Transportation

Scott McGowen (Moderator)
Michael Baker International
Community of Practice Forum Overview

- Overview: State of the Practice Report
  - William Fletcher, Oregon DOT

- PennDOT Stormwater Control Measure Maintenance
  - Richard Heineman, Pennsylvania DOT

- NCDOT’s BMP Inspection & Maintenance Program: Past, Present, and Future
  - Andy McDaniel, North Carolina DOT

- Managing Maryland’s Stormwater – One Road at a Time
  - Kiona Leah, Maryland DOT

- Community of Practice Forum
  - Scott McGowen, Michael Baker International

- Closing
Overview: State of the Practice Report

William Fletcher
Water Resources Program Coordinator
Oregon Department of Transportation
State of the Practice
Stormwater BMP Maintenance and Operations
William Fletcher
Oregon Department of Transportation
Purpose and Goals

- Provide an overview of how DOTs manage and implement their programs for maintaining stormwater treatment facilities.
- Identify issues that deserve research and need additional information
- Develop recommendations and suggestions on actions to assist and improve stormwater BMP maintenance programs
The Survey and Analysis

27 DOTs responded!

- 44 questions in 8 categories
  - General Criteria, Training, Tracking, Inspection, BMP Design, BMP Maintenance, Funding, and Asset Management
- Analyzed in 4 groups: Basics, Training and Personnel, Tracking and Reporting, and Program Administration
  - Each group’s answers were discussed, summarized, and recommendations developed.
- Conclude with Future Research Needs
BMP Maintenance Basics

- Wide range in the number of maintained facilities: 0 to 6000!
- Inspection results trigger maintenance
- Guidance or criteria for identifying maintenance triggers
- BMP inspection and maintenance usually separate workflows
Training and Personnel

Common (but not universal) elements:

- Dedicated staff for BMP inspection and maintenance
- Formal BMP maintenance training
- Design documentation provided to Maintenance
- Maintenance and designers communicate about failures
- Formal handoffs between inspection and maintenance
Tools for Tracking and Reporting

- Use of software for tracking inspection and maintenance very common
- Asset management programs for stormwater infrastructure also common
- Cost tracking common, but not always used for budgeting
- The full strength of these tools for tracking and budgeting is not often fully utilized
Program Administration

- Stormwater maintenance costs not separated out from the total operation and maintenance budget
- Rare to have dedicated stormwater maintenance funding, or specific appropriation requests for it
- Outsourcing some or all BMP inspection and maintenance is common
Selected Recommendations and Suggestions

- Refine inspection frequency based on results
- Automate/streamline maintenance need identification and action implementation
- Internal audits to assure inspection and maintenance
- Break out BMP maintenance budget from the total Maintenance budget
- Track individual BMP maintenance costs and include in the asset management program
Selected Research and Information Needs

- Inspections: Developing criteria to optimize inspection schedules
- Training: Developing metrics for tying BMP performance to maintenance training
- Program Admin and Asset Management: Determining cost estimates for long term maintenance of BMPs
Summing Up

- BMP maintenance is important, but comes in second to maintaining the roadways, so
- Efficiencies are important to reduce the strain on maintenance resources
- Good use of information technology and asset management can support efficiency, improve budgeting, and provide information for better BMP selection and design and documenting regulatory compliance
PennDOT Stormwater Control
Measure Maintenance

Richard Heineman
Stormwater Section Manager
Pennsylvania Department of Transportation
PennDOT’s SCM Maintenance Program

- Pennsylvania Department of Transportation (PennDOT) is responsible for maintaining over 40,000 miles of state-owned roadway

- PennDOT’s MS4 Permit Stormwater Control Measure (SCM) Operation and Maintenance Requirement
  
  • **PENNDOT shall take necessary steps to ensure proper operation and function of the post construction stormwater management BMPs (SCMs) pursuant to 25 Pa. Code §102.**

- SCM maintenance program is taking shape to address current and future long-term Operation and Maintenance commitments
  
  • New manual for personnel responsible for SCM maintenance
  
  *PennDOT Pub. 888 – Stormwater Control Measure Maintenance Manual*
SCM Maintenance Program


- **Inventory procedures**
  - IDs, adding/modifying data

- **Inspections**
  - Types and frequencies
  - Forms, report templates
  - Submitting and viewing results

- **Maintenance**
  - SCM specific procedures
  - Common SCM components

- **Charging, recording, reporting**
  - Assemblies and charge codes
  - Creating work notifications
SCM Inventory

Stormwater Control Measure (SCM) Inventory

- Development
  - No statewide inventory pre-2012
  - Some basins in 2012
  - Other SCMs 2015-2016
  - Protocol for inventory after construction

- Inventory Access
  - Maintenance-IQ
  - PennDOT local area network
SCM Inventory

- The SCM inventory contains 40+ separate fields: type and location, discharge location, maintenance access, inspection frequencies, etc.
- Unique 10-digit SCM ID assigned by BOMO

<table>
<thead>
<tr>
<th>SCM_ID</th>
<th>SCM_TYPE_CODE</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
<th>DISTRICT_NO</th>
<th>COUNTY_NAME</th>
<th>ST_RT_NO</th>
<th>SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0110 IBE 001</td>
<td>IBE</td>
<td>41.65071</td>
<td>-79.65443</td>
<td>01</td>
<td>Crawford</td>
<td>0089</td>
<td>A02</td>
</tr>
<tr>
<td>0110 IBE 002</td>
<td>IBE</td>
<td>41.65116</td>
<td>-79.65465</td>
<td>01</td>
<td>Crawford</td>
<td>0089</td>
<td>A02</td>
</tr>
</tbody>
</table>

0110  
county code  
Erie

IBE  
SCM type  
infiltration berm

001  
sequential #  
first assigned
Current SCM Inventory

- SCMs in inventory as of Spring 2018

<table>
<thead>
<tr>
<th>District</th>
<th># of SCMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>110</td>
</tr>
<tr>
<td>2</td>
<td>164</td>
</tr>
<tr>
<td>3</td>
<td>138</td>
</tr>
<tr>
<td>4</td>
<td>260</td>
</tr>
<tr>
<td>5</td>
<td>254</td>
</tr>
<tr>
<td>6</td>
<td>582</td>
</tr>
<tr>
<td>8</td>
<td>254</td>
</tr>
<tr>
<td>9</td>
<td>251</td>
</tr>
<tr>
<td>10</td>
<td>85</td>
</tr>
<tr>
<td>11</td>
<td>57</td>
</tr>
<tr>
<td>12</td>
<td>84</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2239</strong></td>
</tr>
</tbody>
</table>
## Current SCM Inventory

- Breakdown of most common SCM types

<table>
<thead>
<tr>
<th>General SCM Type</th>
<th>SCM Type Codes</th>
<th>Number of SCMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Detention Basins</td>
<td>BDD, BED, BUD, BND, BOT</td>
<td>499</td>
</tr>
<tr>
<td>Infiltration Basins</td>
<td>BID</td>
<td>211</td>
</tr>
<tr>
<td>Wet Basins</td>
<td>BWD</td>
<td>103</td>
</tr>
<tr>
<td>Bioretention</td>
<td>BRE,BRU</td>
<td>211</td>
</tr>
<tr>
<td>Infiltration Trenches</td>
<td>SIT</td>
<td>194</td>
</tr>
<tr>
<td>Infiltration Berms</td>
<td>IBE</td>
<td>87</td>
</tr>
<tr>
<td>Vegetated Swales</td>
<td>VSW, VSC</td>
<td>589</td>
</tr>
<tr>
<td>Vegetated Filter Strips</td>
<td>VSF, VSS</td>
<td>21</td>
</tr>
<tr>
<td>Manuf. Treat. Devices</td>
<td>MTD</td>
<td>123</td>
</tr>
<tr>
<td>Media Filter Drains</td>
<td>MFD</td>
<td>13</td>
</tr>
<tr>
<td>Stormwater Wetlands</td>
<td>SWE</td>
<td>11</td>
</tr>
</tbody>
</table>
SCM Inspection Types

- **Visual screening**
  - Every 3 years for most SCM types
  - Walk-around observations
  - Identify common problems
  - Inspector training
  - One form used for all SCM types
  - Effort = 1-2 hours

- **Condition assessment**
  - Initial and every 10 years
  - Hands-on observations (e.g., opening manholes, soil sampling)
  - Measurements and sketches
  - Inspector training
  - Report certified by a licensed professional
  - Effort = 1-3 days
SCM Maintenance

**Routine**
- Regularly scheduled
- Minimally invasive preventative tasks
- Categories: grass, vegetation, litter control, sediment

**Corrective**
- Scheduled as-needed
- Correct problems and restore functionality of SCM
- Tiers: 6-month, 4-week, immediate response
## Preventative SCM Maintenance

### Table 4.2.1: Routine Maintenance Frequency by SCM Category

<table>
<thead>
<tr>
<th>SCM</th>
<th>Grass Maint.</th>
<th>Vegetation Mgmt.</th>
<th>Litter Control</th>
<th>Sediment Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin (BDD, BED, BUD, BOT, BND, BWD)</td>
<td></td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Bioretention (BRE, BRU)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Filter (CSF, MFD)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Infiltration (BID, IBE, SIT)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Manuf. Treatment Device (MTD)</td>
<td>X</td>
<td>X</td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Permeable Pavement (PPA, PPC, PPP)</td>
<td></td>
<td>X</td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Riparian Buffer (RBE, RBO)</td>
<td>X</td>
<td>○</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Stormwater Wetland (SWE)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Subsurface Detention (SDS)</td>
<td>X</td>
<td>X</td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Vegetated Filter Strip (VFS, VSS)</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Vegetated Swale (VSW, VSC)</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key:</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>N/A</td>
<td>As Needed</td>
<td>Annual</td>
<td>Semi-annual</td>
</tr>
</tbody>
</table>
Visual Screening Inspection

- **Visual Screening Ratings – SCM Component Condition**
  - 0 = No Action
  - 1 = Routine (per maintenance schedule)
  - 2 = Corrective (6-month response)
  - 3 = Corrective (4-week response)
  - 4 = Emergency (immediate response)
  - 5 = Environmental/Engineering Evaluation

- **Environmental/Engineering (E/E) Evaluation** – Used when SCM problems are difficult to rate or cannot be corrected through normal corrective maintenance
Visual Screening Inspection

- Problem Categories
  - Debris/Trash
  - Erosion
  - Ponding
  - Vegetation
  - Miscellaneous

<table>
<thead>
<tr>
<th>Catg.</th>
<th>Location/Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A. Anti-skid material accumulation</td>
</tr>
<tr>
<td></td>
<td>B. Inflow channel(s)</td>
</tr>
<tr>
<td></td>
<td>C. Side slopes</td>
</tr>
<tr>
<td></td>
<td>D. Sediment forebay or micropool</td>
</tr>
<tr>
<td></td>
<td>E. SCM floor/surface or within SCM</td>
</tr>
<tr>
<td></td>
<td>F. Outlet/dewatering structure</td>
</tr>
<tr>
<td></td>
<td>G. Other (describe)</td>
</tr>
<tr>
<td>2</td>
<td>A. Inflow channel(s)</td>
</tr>
<tr>
<td></td>
<td>B. SCM bottom or side slopes</td>
</tr>
<tr>
<td></td>
<td>C. Outlet/outfall</td>
</tr>
<tr>
<td></td>
<td>D. Emergency spillway</td>
</tr>
<tr>
<td>3</td>
<td>A. Standing water</td>
</tr>
<tr>
<td></td>
<td>B. Subsurface storage not draining</td>
</tr>
<tr>
<td></td>
<td>C. Permanent pool water level very low or dry</td>
</tr>
<tr>
<td></td>
<td>D. Other signs of poor drainage (describe)</td>
</tr>
<tr>
<td>4</td>
<td>A. Growth impeding inflow or outflow</td>
</tr>
<tr>
<td></td>
<td>B. Significant plant mortality</td>
</tr>
<tr>
<td></td>
<td>C. Non-uniform grass coverage (bare areas)</td>
</tr>
<tr>
<td></td>
<td>D. Woody vegetation in embankment</td>
</tr>
<tr>
<td></td>
<td>E. Presence of hydrophytic vegetation</td>
</tr>
<tr>
<td></td>
<td>F. Vegetation impeding access to SCM</td>
</tr>
<tr>
<td>5</td>
<td>A. Temporary ESPC measures present</td>
</tr>
<tr>
<td></td>
<td>B. Structural damage or deterioration</td>
</tr>
<tr>
<td></td>
<td>C. Sediment build-up in or on SCM surface</td>
</tr>
<tr>
<td></td>
<td>D. Signs of ground compaction/settlement</td>
</tr>
<tr>
<td></td>
<td>E. Evidence of sinkhole activity</td>
</tr>
<tr>
<td></td>
<td>F. Contamination (e.g. gas, oil, pet waste)</td>
</tr>
<tr>
<td></td>
<td>G. Evidence of burrowing animals</td>
</tr>
<tr>
<td></td>
<td>H. Other (describe)</td>
</tr>
</tbody>
</table>
## Inspection Results

- 650 inspections as of July 2018

<table>
<thead>
<tr>
<th>General SCM Type</th>
<th># of SCMs Inspected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin</td>
<td>309</td>
</tr>
<tr>
<td>Bioretention</td>
<td>33</td>
</tr>
<tr>
<td>Infiltration</td>
<td>125</td>
</tr>
<tr>
<td>Restoration</td>
<td>8</td>
</tr>
<tr>
<td>Riparian Buffer</td>
<td>1</td>
</tr>
<tr>
<td>Stormwater Wetland</td>
<td>9</td>
</tr>
<tr>
<td>Vegetated Filter Strip</td>
<td>7</td>
</tr>
<tr>
<td>Vegetated Swale</td>
<td>127</td>
</tr>
<tr>
<td>Filter</td>
<td>5</td>
</tr>
<tr>
<td>Manuf. Treat. Device</td>
<td>16</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
</tr>
</tbody>
</table>
Inspection Results

- Inspections have documented over 2,000 problems
- 55% of problems noted required corrective maintenance or an E/E evaluation

<table>
<thead>
<tr>
<th>Problem Category</th>
<th>Any Problem</th>
<th>Corrective Maintenance</th>
<th>Engineering Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Action Code 0-5*</td>
<td>Action Code 2-4*</td>
<td>Action Code 5*</td>
</tr>
<tr>
<td>Debris/Trash</td>
<td>433</td>
<td>157</td>
<td>5</td>
</tr>
<tr>
<td>Erosion</td>
<td>232</td>
<td>152</td>
<td>21</td>
</tr>
<tr>
<td>Ponding</td>
<td>246</td>
<td>25</td>
<td>149</td>
</tr>
<tr>
<td>Vegetation</td>
<td>745</td>
<td>243</td>
<td>123</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>349</td>
<td>159</td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td>2005</td>
<td>736</td>
<td>357</td>
</tr>
</tbody>
</table>

*Action Code: 0 = No Action, 1 = Routine Maintenance, 2-4 = Corrective Maintenance, 5 = Engineering Evaluation
### Inspection Results

#### Most common problems

<table>
<thead>
<tr>
<th>Problem Category</th>
<th>Most Common</th>
<th>Number</th>
<th>Second Most Common</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Problem Type</td>
<td></td>
<td>Problem Type</td>
<td></td>
</tr>
<tr>
<td>Debris/Trash</td>
<td>Inflow Channels</td>
<td>118</td>
<td>SCM Floor/Surface or in SCM</td>
<td>104</td>
</tr>
<tr>
<td>Erosion</td>
<td>SCM Bottom Side Slopes</td>
<td>87</td>
<td>Inflow Channels</td>
<td>84</td>
</tr>
<tr>
<td>Ponding</td>
<td>Standing Water</td>
<td>167</td>
<td>Other Signs of Poor Drainage</td>
<td>59</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Hydrophytic Vegetation</td>
<td>257</td>
<td>Wood Vegetation in Embankment</td>
<td>199</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Sediment Build-Up</td>
<td>108</td>
<td>Other (Type Varied)</td>
<td>76</td>
</tr>
</tbody>
</table>
Inspection Results

**Basins**
- Every problem category represented
- Most E/E evaluation requests are for standing water in dry basins

**Bioretention**
- Mostly minor problems noted (localized erosion and sediment/debris accumulations)

**Infiltration**
- Most problems symptomatic of poor infiltration

**Swales**
- Problems related to change in intended flow pattern (erosion and obstructions)
- Missing components (e.g., check dams) led to requests for engineering evaluations
Conclusions

- Many facilities will need rehabilitation due to lack of upkeep and a formal SCM operation and maintenance.
- Extent of corrective maintenance and E/E evaluations noted was expected as many existing SCMs were inspected for the first time.
Conclusions

- Bioretention has relatively few problems, which may be attributable to design parameters:
  - Shallow ponding depths
  - Native plants
  - Small drainage areas

- Ponding issues are prevalent in basins designed to dry cycle

- Standing water leads to other problems in SCMs

- Infiltration SCM problems are all related to poor dewatering, which could be traced to both design and construction
**Recommendations**

- In-depth condition assessments are needed to determine cause of ponding issues (e.g., design, construction, lack of maintenance) in SCMs designed to dry cycle.
- Provide training for construction inspectors to ensure critical stages of SCM construction are observed.
- Department representative to perform QA/QC of as-built stormwater plan.
- Improve design and construction guidelines for infiltration SCMs.
- Facilitate coordination between Design, Construction, and Maintenance on SCM selection and implementation.
NCDOT’s BMP Inspection & Maintenance Program: Past, Present, and Future

Andrew McDaniel
Manager, Highway Stormwater Program
North Carolina Department of Transportation
NCDOT’s BMP I&M Program

- Past: Accomplishments and challenges
- Present: What we’re working on today
- Future: What we hope to achieve moving forward
NPDES Permit Background

- NPDES permit covers most all NCDOT activities across the state
- ~ 80,000 miles of state-maintained roads
- > 200 industrial facilities (maintenance yards, etc.)
- BMP Implementation and Maintenance requirements began in 2005
NPDES Permit Requirements

- Maintain a BMP Inspection and Maintenance Manual
- Implement a BMP Inspection and Maintenance Program
- Evaluate Inspection and Maintenance needs for new BMP types
- Annual training
Past Accomplishments and Challenges

- What kinds of BMPs do we have and where are they?
2006 BMP Inventory Survey

- Written survey:
  - Division staff
  - Central office design staff
- Field investigations
- Initial inventory yielded ~ 410 BMPs
BMP I&M Manual

I&M Manual

- Fifteen Chapters
  - General I&M Chapters (1-4)
  - Bioretention basin
  - Filtration basin
  - Infiltration basin
  - Detention basins-Dry and Wet
  - Hazardous Spill Basin
  - Stormwater wetland
  - Swale
  - Level Spreader
  - Permeable Pavement
  - Preformed Scour Hole

- Individual BMP Chapter Contents
  - BMP Overview
  - BMP Components Description
  - I&M Procedures

- Inspection Checklists

- BMP Naming Convention
Illustrations Depicting Major Components

Note: Most stormwater controls are not located adjacent to a water body, as the above diagram may depict, but rely on water conveyances such as ditches, swales, and buffers to transport treated runoff to the nearest river, lake, or stream.
1) Pollutants are filtered out as stormwater soaks through the filter media to the underdrain.
Level of Service Ratings

- Level of Service (LOS)
  - A – No maintenance needs
  - B – Minor maintenance needs
  - C – Moderate maintenance needs
  - D – Major maintenance needs
  - F – BMP not functional
Stormwater Control Management System

- SCMS – authenticated web based application
~ 1,900 BMPs in the SCMS Database
SCMS Stores Data For Individual BMPs

Control ID: IM-10-60-IB-2569  Phase: Maintenance  Type: Infiltration Basin (IB)

<table>
<thead>
<tr>
<th>General</th>
<th>Hydrologic</th>
<th>Design</th>
<th>Construction</th>
<th>Details</th>
<th>Documents</th>
<th>Images</th>
<th>Admin</th>
</tr>
</thead>
</table>

Quick Links
- Inspection and Maintenance
- View Control Map
- Back to Search

General Information
- County: Mecklenburg
- Control Type: Infiltration Basin (IB)
- Control ID: IM-10-60-IB-2569
- Hydro ID: D10_C060_0011
- Retrofit: Yes
- TIP: SC-2569
- Road Tier: Secondary
- Tier Type: -Select-
- Route Type: SR
- Route: 1784 (Rozelles Ferry Rd)
- Removed: Control has been removed from the ground.
- Nearest Town: Charlotte
- Latitude: 35.2631900
- Longitude: -80.9213700
- Location Description: Paw Creek Maintenance Yard
  8820 Rozelles Ferry Rd
  Charlotte, NC 28214
- Location Type: County Maintenance Yard (CMY)
- Notes Keywords: Located in SW portion of yard behind bulk storage bins
SCMS Stores Both Inspection and Maintenance Data
Present Accomplishments and Challenges

- Inspection and maintenance optimization
- Training and recordkeeping
- Inspection and Maintenance manual upkeep
I&M Optimization

- Preformed Scour holes (PSH)
- Swales
- Dry detention basins
Preformed Scour Holes

- The Problem: Difficult to access – often located at the bottom of a fill slope
- The Question: Do preformed scour holes need to be inspected and maintained every year?
PSH Condition Assessment

- Initial study conducted in 2013
  - Findings: For properly sited and constructed PSHs, failure does not increase with age of BMP. Almost all PSH failures were attributable to improper siting and/or construction.
  - Result: Optimized I&M frequency
    - Inspect after construction
    - Inspect after 1 year, and if good,
    - No further I&M requirements

- Follow-up study conducted in 2017
  - Findings: Same as in 2013
  - Result: Retain optimized PSH I&M frequency
Swale Condition Assessment

- Currently under study...

- The Problem: Resource intensive to inspect due to large number of swales across the state; not all swales sited within routine roadside mowing pattern.

- Goal:
  - Develop an optimized I&M policy for swales
  - Siting guidance to take advantage of routine roadside mowing
Dry Detention Basin Assessment

- Currently being researched by NC State University
- The Problem: Regular vegetation management required, not typically performed by routine roadside mowing operations
- Goal:
  - If appropriate, develop an optimized I&M policy
Future Goals and Challenges

- Improve cost tracking – common issue identified in the State-of-the-Practice report
- Pilot I&M outsourcing model
  - Initially inspections only
  - Ultimately maintenance too
- Increase training options
  - Leverage university I&M certification programs
  - On-demand video training
Thank You!

Google search for "ncdot stormwater"

Highway Stormwater Program (HSP) - Connect NCDOT
https://connect.ncdot.gov › Connect NCDOT › Resources › Hydraulics
The Highway Stormwater Program (HSP) was established in 1998 as an NCDOT-wide initiative to protect and improve water quality while fulfilling NCDOT's ...
You've visited this page 5 times. Last visit: 9/20/18

People also search for
- ncdot smp
- ncdot rainfall intensity
- ncdot pcsp
- guidelines for drainage studies ncdot
- ncdot infiltration basin
- ncdot permit drawings
Managing Maryland’s Stormwater – One Road at a Time
An Overview of the MDOT SHA Drainage and Stormwater Assets Management Program

Kiona Leah, P.E.
Drainage and SWM Assets Manager
Maryland Department of Transportation
Managing Maryland’s Stormwater – One Road at a Time

Kiona Leah, P.E.

An Overview of the MDOT SHA Drainage and Stormwater Assets Management Program
October 18, 2018
As of June 30, 2018, MDOT SHA manages:

- nearly 8,500 permanent stormwater management facilities and ESD practices;
- nearly 168,500 hydraulic structures; and
- over 141,000 conveyance features (over 9 million linear feet) statewide.
Maryland NPDES in a Snapshot

- As of June 30, 2018, MDOT SHA, within the MS4 coverage area, includes:
  - over 7,800 permanent stormwater management facilities and ESD practices;
  - nearly 123,000 hydraulic structures; and
  - almost 100,000 conveyances (nearly 7 million linear feet).
Program Operation Snapshot

A. Planning
- Inspections & Inventory,
  Performance Rating, Data Management

B. Engineering
- Remediation Rating
- Work Order Generation, Retrofit Design

C. Construction
- Area Wide Contracts, Bid -Build Contracts
- Design Build Contracts, MOUs, Immediate Response

D. Operations
- Minor Maintenance
- Routine Maintenance Procedures

E. Future Focus
- Business Process Improvements
- Additional Program Support
Program Planning

Inspections and Inventory
- Triennial in NPDES Counties
- Regularly in all others
- Evolving Technology and Efficiency
Program Planning

Inspections and Inventory

BMP Inventory
- BMP ID Number
- In Stream
- Location
- Road Name
- Fence
- Dam

BMP Inspection
- BMP ID Number

33 Inspection
Parameters for Triennial
- Road Name
- Fence
- Dam
- Debris
- Inflow Conditions
- Vegetation
- Ponding
- Access
- Mowability
- Emergency Spillway
- Orifice
- Riser
- Outfall
- Other inspection protocols for annual, as built and emergency inspections
Performance Ratings

- **A No Issues** – The SWM facility is functioning as designed with no adverse conditions identified.
- **B Minor Problems** – The SWM facility is functioning as designed but minor issues are observed that may worsen to the next rating level if not repaired.
- **C Moderate Problems** – The SWM facility is functioning as designed but efficiency, performance, and function are at risk.
- **D Major Problems** – The SWM facility no longer functions as designed, and efficiency has been compromised.
- **E Severe Problems** – The SWM facility no longer functions as designed and efficiency as well as several critical parameters have been significantly compromised.
Program Planning

Data Management

- Extensive and Complex SQL database that is viewed primarily through Esri tools, both internal and external.
- Collector and Survey 1-2-3 are used for inventory and inspections
  - SWM Facilities
  - Video Pipe Inspection
  - Outfall Inspection
Data Management

• ArcGIS Online tools often create the interface from field tools to office planning tools.
  • HHD Web Research App
  • NPDES Field Data App

• Enterprise GIS (eGIS) internal operations and interface with data.
  • Inspections and Ratings Tab
  • Maintenance and Permit Tracking Tab
Program Engineering

Remediation (Action) Rating

- **I No Action**— schedule for annual maintenance in next cycle

- **II Routine Maintenance**— *attention needed* to sustain BMP performance- vegetation management, mowing, trash removal, minor sediment removal, wildlife control (beaver issues)

- **III Remediation Work Order**— is needed to return the site to original functionality within the existing footprint of the facility. Structural defects include excess brush and trees, excess sediment dredging, infiltration media replacement, outfall failure or blockage. Historically also slope erosion, structural damage

- **IV Retrofit/Enhancement Design**— is required on-site or at another location, since BMP cannot be returned to its original functionality by maintenance or remediation activities; typically BMP type is changed and functionality upgraded to meet current standards
Program Engineering

- Work Order Generation
  - Traditional Reporting and Needs
    - BMP Maintenance Report
      - Based on additional field assessment once assigned
      - Location Map
      - Maintenance Work Order
      - Maintenance Plan
      - Cost Estimate
      - As Built Plans and Details
    - Developed in approximately 16 manhours
  - Traditional Permit Requirements
    - MDOT SHA General Permit Allowed
      - Clearing and Grubbing
      - Sediment Removal
      - Slope and Structural Repairs
      - Pipe Cleaning
      - Facility Dredging

Average Number of Facilities Maintained Annually ~ 100
Program Engineering

Work Order Generation

- **Current Reporting and Needs**
  - BMP Remediation Work Order
  - Based on additional field assessment once assigned
  - Location Map
  - Erosion/Sediment Control General Notes, Details, Sequence of Construction
  - Remediation Action List
  - Erosion Sediment Control Exhibits
  - Detailed Design Plan Blowup
  - Remediation Figures and As Built Plans
  - Remediation Verification Form
  - Maintenance of Traffic
  - Inspection Report
  - Development Time 64–240 hours
  - BMP Remediation Design Report
  - Site and Computation Summary
  - MD Pond Code 378 Flow Chart
  - SWM Design Report and Mapping Excerpts
Program Engineering

Work Order Generation

- MDE Environmental Permitting
  - Joint Permit Applications
  - Delineation and permitting for wetlands

- MDE Pilot Program
  - Tree Removal Standards vary
  - Dam Classification
  - 5-Phase Joint coordination should benefit all
Program Engineering

- Retrofit Design
  - DBOM (Design/Build/Operations and Maintenance Contracts)
  - TMDL adds to the retrofit list, so double bonus
  - Contractor feedback indicates this is easier for them
Program Construction

• Area Wide Contracts
• Bid Build Contracts
• Design Build Contracts
• Memorandum of Understanding (MOU)
• Immediate Response
Program Operations

• Coordination with other Offices
  • Outreach thru the MDOT SHA website
  • Development of location Apps

• Minor Maintenance

• Routine Maintenance

• Manuals
Program Future Focus

- Maintenance Location Apps
- File Scans Search Function
  - Quick search for file management
  - Available to all inside MDOT SHA
Program Future Trends

Highway Hydraulics Division
Stormwater Facility Inventory

- **Retrofit Design / Functional Enhancement**
- **Remediation Construction Needed**
- **Functioning as Designed**
- **2A Grass Swales**

- **TMDL Implementation - Inventory Increases Begin 2013**
- **2A Grass Swale Implementation - Inventory Increases Begin 2015**
- **SWM Act of 2007 - Inventory Increases Begin 2012**

MD Fiscal Year:
- 2007: 1243
- 2008: 1416
- 2009: 1574
- 2010: 1733
- 2011: 1983
- 2012: 2245
- 2013: 2761
- 2014: 3118
- 2015: 3313
- 2016: 3610
- 2017: 3913
- 2018: 4143
- 2019: 4340
- 2020: 4514
- 2021: 4679
- 2022: 4891
- 2023: 5113
- 2024: 5367
- 2025: 5425
Presented by:
Kiona Leah, P.E
Program Manager
410-545-8044
kleah@sha.state.md.us
Submit your questions
Type in the Q&A box on the panel on your screen.
- Select ‘Host & Presenter’ in the drop down.
- Click ‘Send’
CoP Questions/Discussions

William Fletcher
- Oregon DOT
- William.B.Fletcher@odot.state.or.us

Richard Heineman
- Pennsylvania DOT
- rheineman@pa.gov

Andy McDaniel, PE
- North Carolina DOT
- ahmcdaniel@ncdot.gov

Kiona Leah, PE
- Maryland DOT
- Kleah@sha.state.md.us

Melissa Savage
- AASHTO CEE
- msavage@aashto.org

Scott McGowen, PE
- Michael Baker International
  - scott.mcgowen@mbakerintl.com
A recording of this webinar will be available on the Center for Environmental Excellence by AASHTO Website.

http://environment.transportation.org
Products & Programs > Communities of Practice > Stormwater Management
Stormwater BMP Maintenance and Operations

Thank you for attending

CEE by AASHTO Stormwater Community of Practice
October 18, 2018