Center for Environmental Excellence by AASHTO
Stormwater Management White Paper

Connecting the DOTs through Collaboration in Stormwater Management

Proceedings from the

2012 AASHTO National Stormwater Practitioners Meeting

Raleigh, North Carolina

October 2012

American Association of State Highway and Transportation Officials
AASHTO
The Voice of Transportation

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Disclaimer

Acronyms

µg/L	Micrograms per Liter
AASHTO	American Association of State Highway and Transportation Officials
ADOT	Arizona Department of Transportation
ALDOT	Alabama Department of Transportation
BMP	Best Management Practice
Caltrans	California Department of Transportation
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
Center	Center for Environmental Excellence
CGP	Construction General Permit
CWA	Clean Water Act
DelDOT	Delaware Department of Transportation
DOT	Department of Transportation
DWQ	Division of Water Quality
ELG	Effluent Limitation Guideline
ECOD	Environmental Compliance Oversight Database
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FGM	Flexible Growth Medium
FHWA	Federal Highway Administration
GIS	Geographic Information System
GSRD	Gross Solids Removal Device
HRM	Highway Runoff Manual
IC/ID	Illicit Connection/Illegal Discharge
ICR	Information Collection Request
IDDE	Illicit Discharge Detection and Elimination
LID	Low Impact Development
LOS	Level of Service
MaineDOT	Maine Department of Transportation
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MCTT	Multi-Chamber Treatment Train
MDSHA	Maryland State Highway Administration
MEP	Maximum Extent Practicable
mg/L	Milligrams per Liter
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
MSE	Mechanically Stabilized Earth
NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NCSU	North Carolina State University
NDOR	Nebraska Department of Roads
NJDOT	New Jersey Department of Transportation
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
NTU	Nephelometric Turbidity Units
ODOT	Oregon Department of Transportation
OGFC	Open Graded Friction Course
PAM	Polyacrylamide
PEA	Program Effectiveness Assessment
PFC	Permeable Friction Course
PWQS	Post-construction Water Quality Structures
SCM	Stormwater Control Measure

SMM	Stabilized Mulch Matrix
SWIT	Stormwater Inspection Tool
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TxDOT	Texas Department of Transportation
U.S.C.	United States Code
U.S. EPA	United States Environmental Protection Agency
VDOT	Virginia Department of Transportation
WERF	Water Environment Research Foundation
WIP	Watershed Implementation Plan
WLA	Waste Load Allocation
WSDOT	Washington Department of Transportation

Introduction

State departments of transportation (DOTs) face new and increasingly prescriptive and complex state and federal regulations to reduce pollution in their stormwater discharges. This document provides information presented and discussed at the American Association of State Highway and Transportation Officials (AASHTO) National Stormwater Meeting held in June 2012, in Raleigh, North Carolina. The theme of the meeting was "Connecting the DOTs" and provided state DOTs from across the country an opportunity to learn and discuss the latest information on stormwater regulations and on how DOTs are dealing with the challenges of being a unique municipal stormwater conveyance and discharger.

This white paper discusses U.S. Environmental Protection Agency (U.S. EPA or EPA) stormwater updates, National Pollutant Discharge Elimination System (NPDES) permitting trends and new permit activities, information about DOT audits conducted by the states or U.S. EPA, stormwater asset management programs, contemporary post-construction stormwater controls, effectively focused construction stormwater management, and using a watershed approach to stormwater management. Presentations provided during the national meeting and a recorded webinar are available for on-demand viewing at AASHTO's Center for Environmental Excellence (Center) website: http://environment.transportation.org

This White Paper contains definitions, discussion on importance to DOTs, case studies from DOTs, future implications, considerations for moving forward, and key contacts and references for each of the key topics presented at the meeting. This document highlights information for practitioners across multiple functional areas within a DOT organizational structure.

1. Stormwater Updates: U.S. EPA Rulemaking and ELG

1.1. Definition

The U.S. EPA has initiated a national rulemaking to reduce the quantity of and improve the quality of stormwater discharges from newly developed (construction) and from redeveloped (reconstruction) sites and make other regulatory improvements to strengthen the stormwater program. In the proposed national rulemaking, the following key actions are being considered:

- Develop performance standards for newly developed and redeveloped sites to better address stormwater management as projects are built;
- Explore options for expanding the protections of the municipal separate storm sewer system (MS4) program;
- Evaluate options for establishing and implementing a municipal program to reduce discharges from existing development;
- Evaluate establishing a single set of minimum measures requirements for regulated MS4s (although industrial requirements may only apply to regulated MS4s serving populations of 100,000 or more);
- Explore options to establish specific requirements for transportation facilities; and
- Evaluate additional provisions specific to the Chesapeake Bay watershed.

Another separate EPA ruling that applies to DOT construction activities is the Effluent Limitations Guidelines (ELGs). On December 1, 2009, EPA published ELGs and new source performance standards (NSPS) to control the discharge of pollutants from construction sites. Effective February 1, 2010, all future permits issued by EPA or delegated states must incorporate the final rule requirements. All construction sites required to obtain permit coverage must implement a range of erosion and sediment controls and pollution prevention measures. The EPA issued a numeric limit for turbidity in the 2009 final effluent guideline rule for the Construction and Development Point Source Category that established national monitoring requirements and enforceable numeric limitations on stormwater discharges from construction sites. Effective January 4, 2011, EPA has stayed the numeric limitation of 280 Nephelometric Turbidity Units (NTU) that was published in the December 1, 2009, Construction and Development Effluent Limitation Guideline. EPA may propose a revised numeric or non-numeric limit in a future rulemaking.

1.2. Importance to State DOTs

The proposed rulemaking will result in changes that will be incorporated into stormwater NPDES permits issued by the EPA and state regulators. DOTs hold both Phase I (large MS4) and Phase II (small MS4) stormwater NPDES permits.

The Phase I and Phase II stormwater regulatory programs were originally developed primarily for municipalities. DOT stormwater programs are unique compared to those for traditional MS4s. DOTs primarily operate and maintain transportation infrastructure (highways, and facilities) with the mission to provide the movement of people and goods. DOT facilities are passive and uniform, diffuse (covering a wide geographic area), and include safety as a primary objective. DOTs are considered single land use facilities (roads and highways), which can allow for a permit with more focused objectives as compared to a traditional MS4 permit that addresses multiple land uses and activities. DOTs are often issued (or are co-permittees on) multiple NPDES permits, resulting in varied and inconsistent program requirements throughout their states. DOT agencies cross many city and county jurisdictional boundaries and typically occupy a very small land area in any watershed, with limited right-of-way for improvements. Finally, the number-one goal of DOTs is the safety of the traveling public, the DOT, and contracted staff and affects the design of the infrastructure and constrains activities that can occur in the right-of-way.

The EPA has delegated the authority for administration of the NPDES permitting system in most states to the individual state. The state entity administering the NPDES program has the latitude to impose permit requirements that are more protective of water quality than the EPA's Phase I and Phase II rules, but the state's rules cannot be less protective. Under this system, it is possible that state regulators can feel constrained, with little discretion to modify the basic EPA permit framework to better accommodate the unique aspect of DOT operations and infrastructure. The water quality benefit of some permit elements is subjective and difficult to assess quantitatively. NPDES permit programs are based on the "maximum extent practicable" (MEP) standard. To establish permit requirements for a DOT that differ from the "standard" provisions for an MS4, the permitting authority must assess MEP for the DOT as compared to the MS4. Absent national guidance for a DOT specific permit framework, states do not have such an assessment basis to modify DOT NPDES permits.

1.3. Available Resources

EPA has been working with DOTs, AASHTO, and the Federal Highway Administration (FHWA) and has acknowledged the fundamental differences between DOT and other MS4 stormwater programs. EPA is exploring options for establishing specific requirements for transportation facilities as part of the rulemaking. AASHTO and FHWA continue to collaborate with EPA on awareness of concerns and uniqueness of stormwater programs for DOTs and the highway environment.

EPA Resources

EPA, in collaboration with DOTs and AASHTO has initiated the development of a website focused primarily on Road-Related Municipal Separate Storm Sewer System (MS4). EPA has recognized that stormwater program management approaches for the DOT environment are unique and have acknowledged this on its website at http://cfpub.epa.gov/npdes/stormwater/municroads/home.cfm.

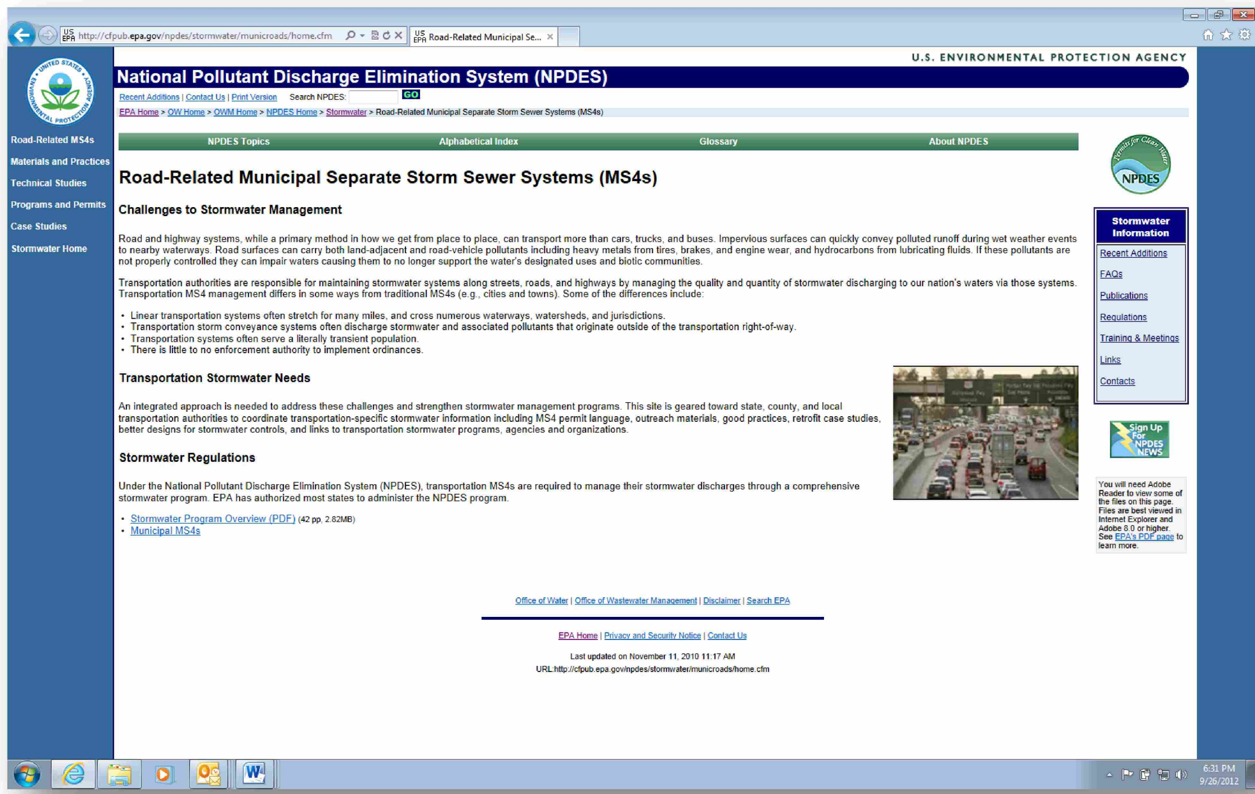

Figure 1: U.S. EPA Resource Website for DOTs

AASHTO Resources: Community of Practice Reports

The Community of Practice provides a resource based on feedback of the state of practice as shared by various DOTs and is available to all DOT practitioners. While not all topics discussed during the community of practice are relevant to the proposed national stormwater ruling, state of practice information on specific program elements can provide additional insight to this topic. Summary reports are available on the Center for Environmental Excellence website (http://environment.transportation.org). Discussions on the following topics of a DOT stormwater program are available:

- Construction Stormwater Management
- Effluent Limitations Guidelines
- Total Maximum Daily Loads (TMDLs)
- Post-Construction Best Management Practices (BMPs)
- EPA Post-Construction Stormwater Rulemaking
- Source Control
- Operation and Maintenance BMPs

AASHTO Resources: Stormwater Practitioner's Handbook No. 13, *"Developing and Implementing a Stormwater Management Program in a Transportation Agency"*

The AASHTO Stormwater Practitioner's Handbook No. 13 highlights key stormwater program elements.

- Clean Water Act (CWA) and the NPDES program
- State and Local Stormwater Regulations
- Conducting a Program Effectiveness Assessment (PEA)
- Developing a Stormwater Management Plan (SWMP)
- Public Education and Outreach
- Construction Site Stormwater Compliance
- Integrating BMPs into Transportation Project Delivery
- Roadway Maintenance Stormwater Practices and NPDES Compliance
- TMDLs and other Special Requirements
- Important Stormwater Management Terms

Figure 2: AASHTO Practitioner's Handbook on Stormwater Management for DOTs

1.4. Future Implications

The proposed rulemaking will have a significant impact on state DOT stormwater programs in that the rules may change the way DOTs must manage stormwater on highway infrastructure related work. All aspects of the rulemaking will likely have important impacts in all phases of project development process and into maintenance and operations practices. The proposed stormwater rules may impact DOT resources (support and capital) in order to comply and implement the new regulations.

Combining Phase I and Phase II programs would bring significant changes to DOTs currently operating under Phase II permits, and some DOTs could see a geographic expansion of their permit coverage area. The EPA may be specifying the types of post-construction BMPs for new and redevelopment under this rulemaking. This is a critical issue for DOTs that have unique physical and safety constraints, in addition to unique constituents of concern. There are four primary areas associated with the rulemaking that may place technical and/or resource challenges on DOTs:

1. Implementation of LID – The regulations will likely require DOTs to implement low impact development (LID) stormwater measures, control runoff volume, provide mitigation for hydromodification impacts, and address retrofitting of existing infrastructure.
2. Retrofit – Retrofit of stormwater management measures in existing infrastructure will be costly and must be assessed relative to benefit and maintenance requirements.

3. Coverage Area Expansion – The expansion of the coverage area of regulations outside of existing Phase I and Phase II areas will have considerable cost with a potentially low benefit. DOT facilities in rural areas traditionally incorporate passive stormwater management measures, such as sheet flow off the roadway, vegetated shoulders, swales for drainage conveyance, and natural dispersion and infiltration.
4. Increased Costs – DOT construction stormwater compliance programs will be subject to increased costs for monitoring, BMP implementation, inspections, reporting, and potential enforcements as a result of complying with stringent effluent limitations.

1.5. Considerations for Moving Forward

EPA intends to propose a rule to strengthen the national stormwater program by June 10, 2013 and complete a final action by December 10, 2014. The agencies regulating DOT stormwater programs will need to revise their NPDES Permits to comply with the new rule. DOTs should continue to track the development of the rulemaking, and review and respond to notices issued soliciting for public comments. DOT Management and all affected functional areas should be made aware of impacts the rulemaking may have to DOT business practices. DOTs should anticipate and plan for minimizing impacts to project delivery, and resource needs (support and capital) to comply with new regulations. If the rulemaking includes the items listed above (Future Implications), DOTs should begin the process to align staff and budgets as needed to comply with the new regulation.

1.6. Key Contacts

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1.7. References

- U.S. EPA National Stormwater Rulemaking
- Center for Environmental Excellence by AASHTO Stormwater Management Community of Practice State-of-the-Practice Reports
- Center for Environmental Excellence by AASHTO Stormwater Management Practitioner's Handbook

2. NPDES Permitting, Trends and Streamlining

2.1. Definition

DOTs are now faced with the next generation of NPDES permits (MS4 and Construction General Permits or CGPs). EPA issuance of the national stormwater rule, the release of the federal CGP, and state permitting authority issuance of recent NPDES permits for DOTs have required DOTs to focus on strategic planning and streamlining of their permit implementation processes. The NPDES permitting activities and trends toward increased regulation have required DOTs to balance environmental stewardship, and project delivery, within the and limitations and challenges of DOT stormwater programs and the highway environment. Increased regulations based on recently adopted DOT permits have included requirements to address:

- New construction/reconstruction triggers for highways and non-highway projects
- Requirements for LID and post-construction treatment BMPs
- Water quality monitoring
- Retrofit BMPs
- TMDLs and waste load allocations (WLAs)
- Increased inspections, reporting, and enforcement programs
- Program effectiveness assessment

Construction General Permit

On February 16, 2012, EPA issued the final federal 2012 CGP. Stormwater discharges from construction activities (such as clearing, grading, excavating, and stockpiling) that disturb one or more acres, or smaller sites that are part of a larger common plan of development or sale, are regulated under the NPDES stormwater program. Prior to discharging stormwater, construction operators must obtain coverage under an NPDES permit, which is administered by either the state (if it has been authorized to operate the NPDES stormwater program) or EPA, depending on where the construction site is located. Where EPA is the permitting authority, construction stormwater discharges are almost all permitted under the CGP. The CGP requires compliance with effluent limits and other permit requirements, such as the development of a Stormwater Pollution Prevention Plan (SWPPP).

2.2. Importance to State DOTs

NPDES Permits are enforceable and will require DOTs to develop new programs not currently in place or to enhance current programs. This will require each state DOT to develop strategies to incorporate new requirements under the current DOT business practices involving project development, and maintenance and operations. Streamlining of activities, assignments of roles, responsibilities, and accountability for compliance with water quality regulations will need to be assessed. The trend of more stringent stormwater management regulations and risks to the state DOT for non-compliance will require support from DOT management, review of the organizational structure, understanding the roles of management, the functional areas responsible for implementation of NPDES permit requirements.

Collaborating with the NPDES regulatory agency to streamline implementation requirements will be important. The states and the EPA have regulated the state transportation systems within the traditional MS4 general permit framework, although DOTs do not fit well within this model. For example, it is evident that additional characterization monitoring of roadway runoff has little value unless the monitoring is focused on new constituents that have not previously been assessed. While pollutant loads can vary somewhat depending on the size of the transportation facility and traffic volumes, there is a well-documented range of expected values (concentrations) for known constituents in highway runoff. Additionally, the nature of transportation facilities tends to limit the number of sources and pathways for potential stormwater contamination, unlike the diverse multi-land use environment characteristic of a traditional MS4.

DOT facilities occupy most watersheds within a state resulting in an infrastructure that crosses many city and county jurisdictional boundaries. State DOT facilities typically occupy a very small land area (often less than 4%) in any given watershed and possess limited right-of-way beyond the edge of pavement, especially in urbanized areas. Consequently, DOTs have the potential to be assigned stakeholder responsibility in a vast number of TMDLs for a variety of constituents.

The current NPDES permitting framework can be inconsistent with the structure of most DOTs that develop policy and provide technical guidance from a central office. A DOT permitting structure comprised of multiple NPDES permits can result in a disproportionate expenditure of resources on stormwater program administration for multiple NPDES permits and TMDL implementation plans.

Stormwater BMPs must operate passively and cannot interfere with state and federal safety requirements, such as clear recovery zones, which are designed to minimize the likelihood of serious injury in the event that an errant vehicle leaves the travel lanes. Considerations also must be given to the safety of maintaining facilities.

For construction activities, new permitting requirements associated with renewals of state CGPs will also need to be incorporated into DOT business practices. Coverage under the federal 2012 CGP applies to non-delegated states, including Idaho, Massachusetts, New Hampshire, New Mexico, and the District of Columbia.

2.3. Case Studies

The following highlights information specific to DOTs related to trends on stormwater regulations – EPA's Information Collection Request, New Hampshire DOT's implementation of the new federal CGP, and implementation by Maryland State Highway Administration (MDSHA) of the Chesapeake Bay requirements.

State DOT MS4s – Overview from U.S. EPA's Information Collection Request

DOTs responded to the Information Collection Request (ICR) from EPA. Relevant facts noted by state DOTs included the following:

- Statewide permit coverage included Arizona, California, Illinois, Michigan, Nevada, New Jersey, New Mexico, North Carolina, Oregon, South Carolina, Tennessee, and Utah.

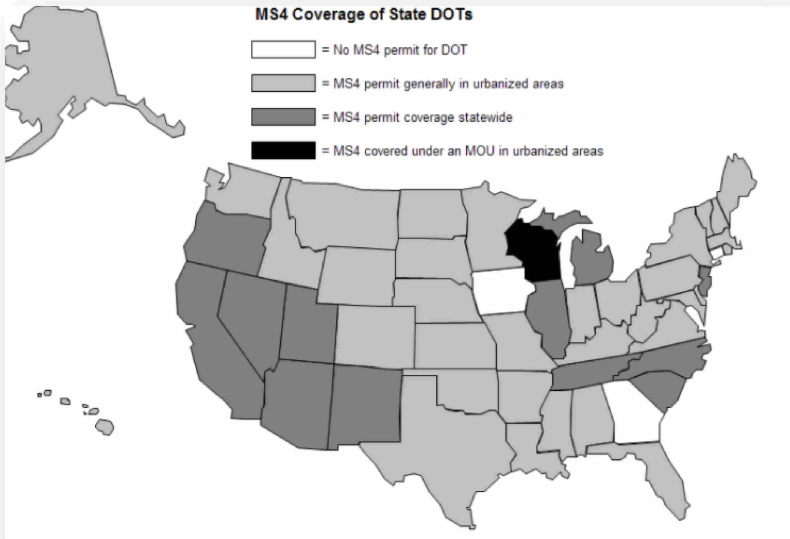

Figure 3: MS4 Coverage of State DOTs

- A majority (about 57%) of state DOTs have only one MS4 permit; roughly, 26% have more than three MS4 permits.
- Most permits are general Phase II MS4 permits and some permits were individual Phase I MS4 permits. Others were individual Phase II MS4 permits.
- Most (62%) of state DOTs have an administrative approach that splits responsibility for stormwater program implementation between a headquarters office or division and regional/divisional offices.
- Types of roads owned, operated, or maintained by individual state DOTs vary widely. Nearly all state DOTs have state level highways, interstates, expressways, and principal arterials. Some DOTs manage county level roads, minor arterials, and municipal/local roads/collectors. Only a very small percentage of DOTs are responsible for rural roads or all roads in state.
- Most DOT MS4 permits (77%) do not specify different requirements for linear and non-highway transportation facilities.
- Illicit Discharge Detection and Elimination (IDDE) – More than half of the DOTs train their field staff and have database/paper tracking/inventory of outfalls, storm drain system mapping, and public reporting.
- Construction Site Runoff Control Minimum Measures – Responses showed that a large number of DOTs perform construction site inspections, 85% train their field staff, review site plans, track/inventory construction sites, have developed approved construction control manuals, and train contractors.
- Post-Construction Controls for DOT Discharges – A majority of state DOTs had some form of inspection, review, and maintenance regime, but fewer than half had a tracking

system for post-construction stormwater controls, and fewer still offer contractor training. Of state DOTs surveyed, most inspect and maintain post-construction stormwater controls and review site plans for post-construction stormwater water quality and/or water quantity requirements for the DOT's discharging from new construction projects.
- Post-Construction Controls on Adjacent Properties – Less than half of the DOTs reviewed site plans for post-construction stormwater water quality and/or water quantity requirements for discharges from new construction projects on adjacent properties that discharge into the DOT's MS4.
- The most common stormwater controls used include grass swales, wet/dry ponds, and oil/water separators.
- Post-Construction Operation and Maintenance – Less than half of the DOTs had a tracking database of post-construction stormwater controls, and just over half have a standardized prioritization of activities based on the severity of operation and maintenance required.
- Alternative Program to Comply with Performance/Design Standards – A little less than three-quarters of DOTs do not have an alternative to performance/design standard based compliance for stormwater management. Approximately 85% of DOT respondents said they do not have an opportunity for off-site mitigation or payment-in-lieu programs.
- Pollution Prevention/Good Housekeeping – Of state DOTs surveyed, most had an inventory of their facilities, facility inspections, field staff training, fueling operations requirements, de-icing/anti-icing material storage, street sweeping/vacuuming activities, storm sewer system maintenance activities (including inspections and cleaning), vehicle maintenance requirements, pesticide/herbicide application and management requirements, vehicle washing requirements, and tracking of the amount of de-icing/anti-icing materials used.
- Retrofits – Approximately 66% of respondents do not have a retrofit program.

Implementing the New Federal CGP – New Hampshire DOT

New Hampshire is subject to the requirements of the new federal CGP. The permit requires corrective actions according to the following:

- Immediate repairs – benefit of no reporting required.
- More substantial repairs – reporting and SWPPP amendments required.
- Develop a tool to get DOT desired repairs completed by the contractor.
- Develop an incentive/disincentive program for contractor construction stormwater compliance.

The state requirement for an effluent discharge limit is 66 NTUs (100 mg/L Total Suspended Solids [TSS]). Expectations of the new federal CGP include:

- Construction Exits – Stone aprons and sweeping
- Predicted Storms – General BMPs required

- Polyacrylamide (PAM) and Shallow Groundwater – Allowed if directed to sedimentation basins and good engineering practice
- Fueling and Maintenance – focus on spill prevention
- Turbidity Monitoring – Currently not applicable due to stay of the ELG
- SWPPP Preparer – Contractor-land owner (team)

Approach of Maryland SHA to Meeting the Chesapeake Bay TMDL Goals and NPDES Permit Requirements

The requirements for MDSHA to meet the Chesapeake Bay TMDL include restoring by treating urban runoff by 30% of pre-1985 impervious surfaces in Phase I areas by 2017 and restoring 20% of pre-1985 impervious surfaces in Phase II areas by 2017. The MDSHA TMDL implementation is conducted in three phases:

1. Phase I Watershed Implementation Plan – Includes preparation of the Watershed Implementation Plan (WIP).
2. Phase II Watershed Implementation Plan – Includes an integrated plan to address local TMDL and the Chesapeake Bay TMDL, and load reductions in each county. Implementation strategies include implementation of structural BMPs and alternative restoration practices.
3. Phase III Watershed Implementation Plan – Includes executing 60% of the WIP, calibration of field data and the Chesapeake Bay Model, identification of gaps, and an adaptable revised plan for full Chesapeake Bay TMDL achievement by 2025.

The MDSHA Implementation Plan Strategy involves commitment and partnerships at various levels:

- Internal – Heighten the level of commitment and understanding within MDSHA.
- External – Seek partnership opportunities with private and public sectors.
- Explore TMDL trading through partnerships with other state or local MS4 permit holders, such as counties and the Department of Natural Resources.
- Explore opportunities for collaborative partnerships or trading with non-regulated groups, such as agriculture, land conservation groups, Department of Interior, etc.
- Examine opportunities statewide to make the best use of money and labor.
- Build on one another's work and match up priorities.
- From a regulated state agency perspective, incentivize conservation to the maximum value. Locate stormwater facilities where feasible within the right-of-way.

2.4. Future Implications

The trends in NPDES permitting will have measurable effects on DOT stormwater programs. The primary trends that will affect DOT programs are:

1. Level of specificity – Permit writers are moving toward performance-based permits and deemphasizing accounting and activity-based requirements.

2. Volume reduction – A reduction in runoff volume and the "use" of stormwater runoff for beneficial uses is encouraged. Currently, DOTs do not have adequate tools to meet this objective.
3. Use of a design storm – BMPs will need to be designed to a specific and consistent design storm or established volume of runoff standard.
4. TMDLs – TMDLs will be included in DOT MS4 permits as enforceable elements.

Future NPDES permits will have fewer institutional requirements, such as specifying sweeping schedules or litter pickup frequency, in favor of performance-based measures such as improvement in water quality at storm drain outfalls or in the receiving water. This shift will require DOTs to expend more resources on monitoring as well as establishing BMPs for priority constituents that will allow a demonstration of improvement in water quality. Prioritization and the establishment of baseline and target standards are likely.

DOTs will also likely be faced with the requirement to reduce runoff volume from roadways. The National Cooperative Highway Research Program (NCHRP) program has initiated a research project, NCHRP 25-41, *Guidelines for Achieving Volume Reduction of Highway Runoff in Urban Areas*. There is currently a lack of tools for DOTs to achieve runoff volume reduction or to "use" stormwater for beneficial uses and this study should assist with requirement. Completion of this report is expected in 2014.

Future NPDES Permits may also include a design storm requirement. Post-construction BMPs will need to be designed to mitigate runoff from a selected design storm, or runoff volume, often expressed as a percentage of the average annual event. This requirement may result in BMP sizes larger than those currently used and additional design time, construction cost, and operation and maintenance cost for post-construction BMPs.

The inclusion of TMDLs in NPDES permits will mean that the TMDL is an enforceable requirement for the DOTs. TMDLs have specified load allocations and schedules for obtaining those allocations. For TMDLs in which a DOT is a stakeholder, additional non-structural and post-construction BMPs will likely be required in the affected watershed. Increased resources will be required for the development and implementation plans targeted to respond to TMDL requirements.

2.5. Considerations for Moving Forward

DOTs should leverage available research findings focused on volume reduction and BMP performance to prepare for future permit requirements. DOTs should review and expand the approved list of BMPs in their toolbox and evaluate measures to address volume reduction. DOT's named as a stakeholder in multiple TMDLs should prioritize implementation plans to match available resources to address receiving water impairments in order of importance. Priority should be focused on areas where the DOT is documented as a major source of the pollutant (e.g., metals, trash, salts, etc.) and where the implementation schedule milestones are pending. Plan for resources required for the planning, design, and maintenance and operation of projects to meet mitigation obligations imposed by TMDL's.

2.6. Key Contacts

Mark Hemmerlein Water Quality Manager New Hampshire DOT Phone: 603-271-1550 Email: mhemmerlein@dot.state.nh.us	Rachel Herbert Physical Scientist U.S. EPA Headquarters Water Permits Division Phone: 202-564-2649 Email: herbert.rachel@epa.gov
Karuna Pujara, P.E. Chief, Highway Hydraulics Division Maryland State Highway Administration (MDSHA) Phone: 410-545-8390 Email: kpujara@sha.state.md.us	Scott McGowen, P.E. Chief Environmental Engineer California Department of Transportation (Caltrans) Phone: 916-653-4446 Email: scott_mcgowen@dot.ca.gov
Andy McDaniel, P.E. North Carolina DOT Phone: 919-707-6737 Email: amcdaniel@ncdot.gov	

2.7. Reference Websites

- U.S. EPA Construction General Permit
- U.S. EPA Information Collection Request for Proposed Rulemaking

3. The Audit Process and How to Prepare

3.1. Definition

The EPA or state agencies with CWA authority delegated by the EPA may have authority to conduct audits to assess compliance with an NPDES permit pursuant to the authority vested in the Administrator of the EPA under CWA Sections 308(a) and 309(a)(3), (a)(4), and (a)(5)(A) of the CWA, as amended, 33 United States Code (U.S.C.) §§ 13 18(a) and 13 19(a)(3), (a)(4), and (a)(5)(A). The EPA grants authority to states for inspections, monitoring, and entry relative to determining compliance with an NPDES permit through the following protocol:

> "Each State may develop and submit to the Administrator procedures under State law for inspection, monitoring, and entry with respect to point sources located in such State. If the Administrator finds that the procedures and the law of any State relating to inspection, monitoring, and entry are applicable to at least the same extent as those required by this section [CWA 308(a)], such State is authorized to apply and enforce its procedures for inspection, monitoring, and entry with respect to point sources located in such State (except with respect to point sources owned or operated by the United States)."

DOT stormwater programs have been subject to audits by EPA and the delegated state regulatory agency and the trend seem to indicate that more are forthcoming.

3.2. Importance to State DOTs

DOTs that own and maintain MS4s are subject to audits by EPA for compliance with their NPDES permits. Subsequent to an inspection, the EPA may issue a "Findings of Violation and Order for Compliance," if the audit determines that the DOT does not comply with one or more Permit provisions. The Order for Compliance will generally require the DOT to take corrective actions, detailed in the Findings of Violation, and provide a compliance schedule for completion of the corrections.

EPA staff generally carries out audits, and they may include the services of an EPA contractor, as well as representatives from the state department charged with environmental compliance, especially in the case where the state has been delegated authority for implementation of the CWA. The audit will examine the DOT protocols (policies and procedural) of a DOT and then continue into the field to examine how the construction and maintenance activities reflect those protocols.

Phase I DOT stormwater programs are entering their 20th year of existence, and Phase II programs have been established for about eight years. Accordingly, the states and the EPA are interested in using the audit process to assess compliance, improve program performance and implementation, and enforce NPDES permit requirements. DOTs have experience in completing the auditing process and can improve their performance on future audits by incorporating audit feedback into their stormwater programs.

The figure below depicts the location of recent audits specific to DOTs.

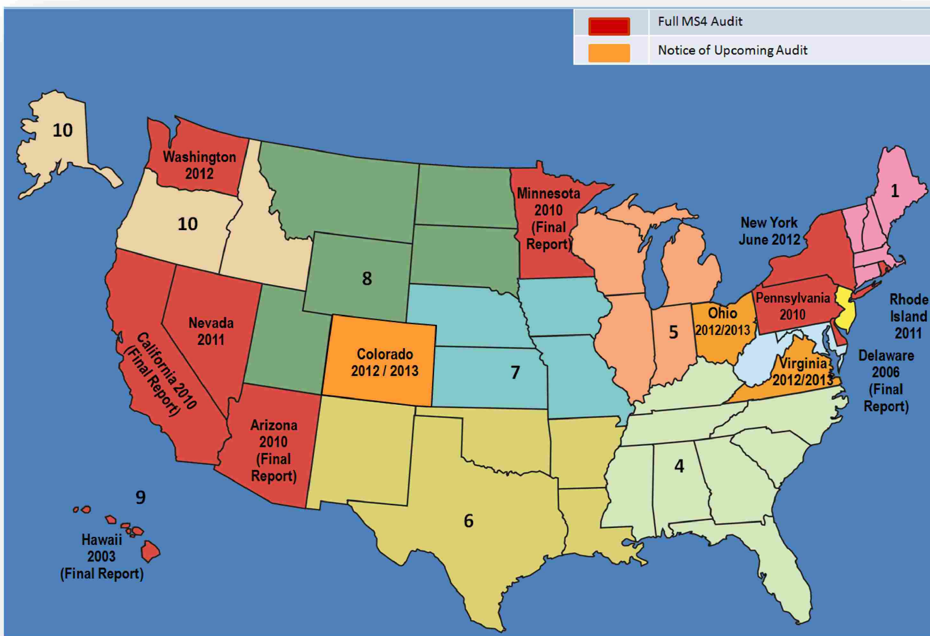

Figure 4: State DOT Stormwater Program Audits History

3.3. Case Studies

Several DOTs have experienced stormwater program audits, resulting in changes to process improvements. Each DOT program reflects NPDES Permit requirements and procedures; therefore, the level of detail of audits and the outcomes of audits can differ. Audits conducted by EPA for the Arizona DOT and California DOT stormwater programs provide examples of procedures, general findings, and lessons learned.

Arizona DOT

The U.S. EPA conducted an audit on the Arizona DOT (ADOT) Stormwater Program in October 2010. ADOT Headquarters staff conducted an internal pre-audit prior to the formal EPA audit in order to identify potential violations and implement program changes. Internal audits were conducted of both program responsibilities and field operations. ADOT briefed all affected stakeholders including Management, District staff, and various divisions (Construction, Maintenance, and Design) during the pre-audit process on what to expect during the audit. The EPA audit consisted of four teams simultaneously performing inspection and interview activities in different districts of the state.

Findings (both positive and negative)

1. ADOT Environmental Management personnel demonstrated a thorough knowledge of Permit requirements and ADOT's Statewide Stormwater Management Plan.
2. ADOT implemented sound monitoring and sampling practices at construction projects within ¼-mile of outstanding and sensitive waters.
3. The District Environmental Coordinators were knowledgeable of local stormwater features and maintenance issues and effectively communicated stormwater maintenance needs to ADOT staff.
4. ADOT had not fully implemented its Employee Stormwater Training Program.
5. ADOT had not conducted inspections of post-construction BMPs and had not implemented a system to inspect and track conditions of its MS4 system.
6. ADOT had not submitted an initial inventory of ADOT post-construction (permanent) BMPs.
7. ADOT had not conducted dry-weather outfall screening of its 71 major MS4 outfalls.
8. ADOT had not implemented an adequate illicit connection and illicit discharge detection and elimination program.
9. Inspection of ADOT's facilities and construction sites revealed common housekeeping deficiencies, including improperly installed BMPs, inadequate containment of pollution sources, and uncertified or outdated SWPPPs.

Primary Lessons Learned

1. Training required improvements that should focus on key emphasis areas.
2. There was a need to review and evaluate the effectiveness of the governance, and the actual field activities and practices.
3. Inspections not specific to stormwater did not qualify as BMP performance inspections.
4. Program lacked the philosophy of "Plan, Do, Check, Act."
5. There was a need to establish the governance necessary to develop and rollout policy, standards, and directives. As a result of the audit, the following policies were developed specific to addressing water quality:
    - Facility Pollution Prevention Plans
    - Stockpile Management
    - Outfall Cleaning Frequency
    - Environmental Signatory Authority Policy
    - Environmental Data Management and Compliance Reporting Policy

California DOT

California DOT (Caltrans) is organized with twelve Districts responsible for project delivery and the day-to-day maintenance and operations. Headquarters is responsible for developing and setting statewide policy, guidance, and training. In October 2009, Caltrans Headquarters and its Districts 1 through 4 were audited for NPDES permit compliance. The audit was completed by EPA Region 9 through their contractor. The audit team included EPA, the State Water Resources Control Board (SWRCB), and Regional Water Quality Control Boards (RWQCB). The SWRCB and its nine RWQCBs are the delegated authority in California for implementation of the CWA.

Prior to the audit, EPA Region 9 indicated that the probable locations of interest could include sites near 303(d) listed water bodies, having past enforcement issues, or having other water permitting activities. Caltrans took steps in anticipation of the audit to help ensure locations likely to be audited reflected Caltrans policy direction and level of program implementation. Headquarters staff communicated with each District and explained the audit process, and reviewed potential maintenance and construction sites that fit the criteria mentioned.

Fifty-five construction, maintenance stations, and material storage locations were inspected during the seven-day inspection. A portion of the time was also spent reviewing DOT records and documentation. On October 26, 2010, Caltrans received an Administrative Order from the EPA in the form of a *"Findings of Violation and Order for Compliance."*

EPA continued the audit in the summer and fall of 2011, visiting 12 sites (ten construction and two maintenance) within six Districts, including a follow-up visit to a previous District.

Findings

The findings of the audit were generally classified into three categories. Corrective actions were prescribed in each of the categories where EPA found compliance issues:

1. Stormwater Management Plan. Update the Caltrans Stormwater Management Plan (SWMP) to enhance the program management, training, tracking, and inspection programs as well as provide for municipal coordination.
2. Maintenance Program. Ensure that all maintenance and material storage facilities have a Facility Pollution Prevention Plan, and that all inspections are completed and documented. Develop a more robust illicit connection/illegal discharge (IC/ID) program, and improve training.
3. Construction Program. Implement an inventory of all construction sites and improve the training program.

Primary Lessons Learned

The primary lessons learned from the audit process were:

- Auditors will only review program requirements that are explicit in the Permit.
- The auditors will focus on the six minimum control measures specified by the EPA.
- Statewide consistency is important in program implementation.
- Auditors will interview DOT staff to verify training and program knowledge.
- Construction and maintenance sites (physical implementation of the permit) should receive the most attention.

- EPA wants to know how the DOT ensures a consistent implementation statewide – from executive management on down to staff in the field.
- EPA wants a designated responsible person in charge of making sure that deficiencies in the field are corrected.

3.4. Future Implications

Program audits are likely to be used on an increasing basis by the EPA and state regulatory agencies as pressure intensifies to make measured progress on achieving the goals of the CWA. DOTs can expect an increased audit frequency, feedback of audit findings in subsequent NPDES Permits, and an emphasis on performance-based metrics, such as demonstrating pollutant load reduction, improvement in end-of-pipe discharge quality, TMDL compliance, and receiving water improvement. DOTs must be ready to respond to these changes by:

- Improving program record keeping (undocumented compliance activities are assumed to be non-performed);
- Enhancing stormwater program asset management;
- Shifting emphasis to high-performing BMPs;
- Targeting high-priority problems;
- Performing an documenting staff training;
- Promoting a culture of environmental stewardship;
- Enhancing communication from the initial policy and guidance to the field staff; and
- Improving the elevation of deficiencies in order to make corrections expeditiously.

The EPA rulemaking currently underway and expected in draft form in June 2013 will provide some insight into the areas that EPA will emphasize in future permits. The rulemaking elements can serve as guidance for future DOT program development and assist in meeting performance goals.

3.5. Considerations for Moving Forward

DOT's should conduct self-audits (with or without notice to audit by EPA or State Regulators) of key elements of the stormwater program focusing on construction practices, maintenance facilities and activities, and consistent program implementation statewide. In addition, DOTs should develop an internal inspection and enforcement program, and a process that can be used to correct deficiencies and procedures to internally elevate/resolve compliance problems stemming from non-responsive staff or contractors. A review of the organizational structure may be prudent to improve program compliance. Should a DOT receive notice of an audit, consult with other DOTs with audit experience and review and apply lessons learned as applicable.

3.6. Key Contacts

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Wendy Terlizzi Water Quality Manager Arizona DOT Phone: 602-712-8353 Email: wterlizzi@azdot.gov	

3.7. Reference Websites

- CWA Protocol for Conducting Environmental Compliance Audits under the Stormwater Program (U.S. EPA)
- MS4 Program Evaluation Guidance
- U.S. EPA, Audit and Self Auditing and Audit Protocols – Policy and Guidance – Compliance and Enforcement
- U.S. EPA MS4 Program Audits in Region 9 (Arizona, California, Hawaii, and Nevada), Case Studies, Evaluation Guidance, MS4 Program Evaluations, Report Summaries, and Contact Information

4. Asset Management Programs

4.1. Definition

The term "Asset Management," as it applies to stormwater management, may refer to the inventory, record keeping, maintenance, and evaluation of the condition and remaining service life of stormwater management systems, including open and closed drainage systems and permanent structures constructed to mitigate the impacts of stormwater runoff. Asset management programs for stormwater consider asset condition assessments and consider how they are used to comply with state and/or federal stormwater permitting requirements.

DOTs are at an early stage of tracking, inspecting, and estimating maintenance costs of their stormwater BMPs compared to other infrastructure, such as pavements and bridges. A significant amount of new stormwater infrastructure has been installed over the last 20 years, for compliance with NPDES Phase I and Phase II programs. NPDES permits generally require an inventory of storm drain inlets, outfalls, and stormwater facilities that capture, convey, or treat stormwater runoff (e.g., treatment BMPs or post-construction BMPs).

4.2. Importance to State DOTs

Asset management is an important program for DOTs not only for NPDES compliance, but also and more importantly, for resource planning of maintenance of stormwater controls (BMPs). NPDES permits require DOTs to clearly inventory the highway storm drain system, including catch basins and outfalls, to address stormwater management of storm drain collection, conveyance, and discharge of stormwater runoff from the highway system and non-highway facilities. Asset management also includes inventory, tracking, and planning for operation and maintenance of stormwater treatment BMPs or water quality mitigation measures.

It is important for DOTs to programmatically budget for maintenance of post-construction stormwater controls. Since the DOT budget approval process can take on to two years, it is critical that asset management include the early planning stages of BMPs. Traditionally, DOTs have made only very rough estimates of the maintenance needs and costs of roadside assets, but now DOTs are inventorying assets, creating asset registries, and establishing and tracking cost per unit to maintain and operate those assets. Maintenance of stormwater BMPs, including such activities as removing excess sediment, re-vegetating ditches and embankments, trash removal, etc., has occurred without the benefit of performance tradeoff data in state DOT maintenance areas, with BMPs maintained "on an emergency basis, when their hydraulic conveyance function is impaired enough to threaten the structural integrity of the highway or impair roadway safety."

Documentation of maintenance costs for post-construction BMPs is rare at DOTs. DOTs can follow an established process for full cost determination of permanent BMPs, as for any maintenance asset, as outlined in NCHRP Report 688:

Step 1: Gather and Classify Maintenance Program Activities and Expenditures.
Step 2: Allocate Maintenance Support Expenditures to Line Activities.
Step 3: Gather and Classify Enterprise Programs and Expenditures.
Step 4: Allocate a Portion of Enterprise Support Expenditures to the Maintenance Program.
Step 5: Combine Cost Categories to Derive Full Cost.

4.3. Case Studies

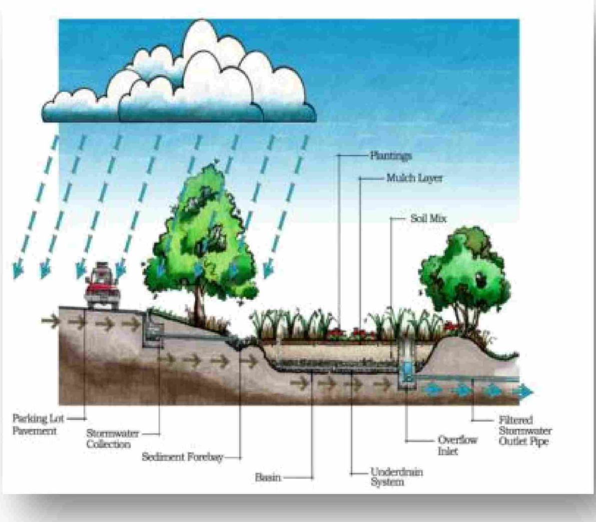
Stormwater asset management by individual DOTs vary in scale, complexity, and technology. Examples of elements of stormwater asset management are highlighted below from Washington DOT, Colorado DOT, and Maryland SHA.

<u>Colorado DOT's System for Recording Post-Construction BMP Assessments</u>

Colorado DOT (CDOT) has been inspecting the full inventory of over 900 post-construction BMPs since 2010. Headquarters staff consults with maintenance staff and as-built plans, locates, and reviews all BMPs in the field. Stormwater staff records results in the Stormwater Inspection Tool (SWIT). The software application to record inspection results and reviews is tailored to BMP types. Inspectors send the results to Maintenance to help identify labor/maintenance actions needed to address identified issues. Maintenance performed and costs/labor hours are recorded in CDOT's accounting database, SAP ERP. CDOT annually reports to the state regulatory authority on the number of post-construction water quality structures (PWQS) inspected and their total maintenance expenditures, and the results of limited, automated stormwater runoff monitoring.

<u>North Carolina DOT Asset Management Program</u>

The Asset Management Program for North Carolina DOT (NCDOT) is a statutory requirement to fulfill the biennial report on maintenance condition and costs. Comprehensive statewide surveys are conducted. NCDOT uses a sampling system for maintenance needs to accomplish the following:



- Predict funding levels needed to achieve an acceptable level of maintenance.
- Relate funding to improved conditions.
- Develop priorities when funding levels are less than the calculated needs.
- Achieve a uniform level of service throughout the state.
- Identify areas requiring additional employee skills and equipment.

NCDOT uses performance measures based on Level of Service (LOS) rankings. The LOS rating is based on the following:

- LOS A – Some aging and wear but no major deficiencies.
- LOS B – Minor structural deterioration and maintenance needs identified.
- LOS C – Moderate structural deterioration and maintenance needs identified but is still functioning properly.
- LOS D – Serious deterioration in a least one structural item and major maintenance needs identified. Function is inadequate.
- LOS F – Device has general or complete failure.

Washington State DOT

Washington State DOT (WSDOT) NPDES permit requirements require an inventory and to populate the database with all known stormwater treatment and flow control facilities (BMPs) and all known stormwater outfalls. Extensive staff training was required for office and field personnel to discuss procedures and definitions, safety, and field data collection equipment operation. The database is populated with new stormwater BMPs and outfalls as they are constructed and located, to complete stormwater conveyance systems to outfalls and stormwater BMPs, and to provide information on interconnections between WSDOTs stormwater system and other municipalities' storm sewers. The stormwater outfalls and discharge points were grouped according to five sub-types: surface water, managed systems, incoming discharge (potential illicit discharges or illegal connections), subsurface from groundwater, and land surface discharges.

The outfall inventory process is documented using both office-based (digital and non-digital data referencing as-built plans) and field-based using GPS and interactive software with mapping capabilities.

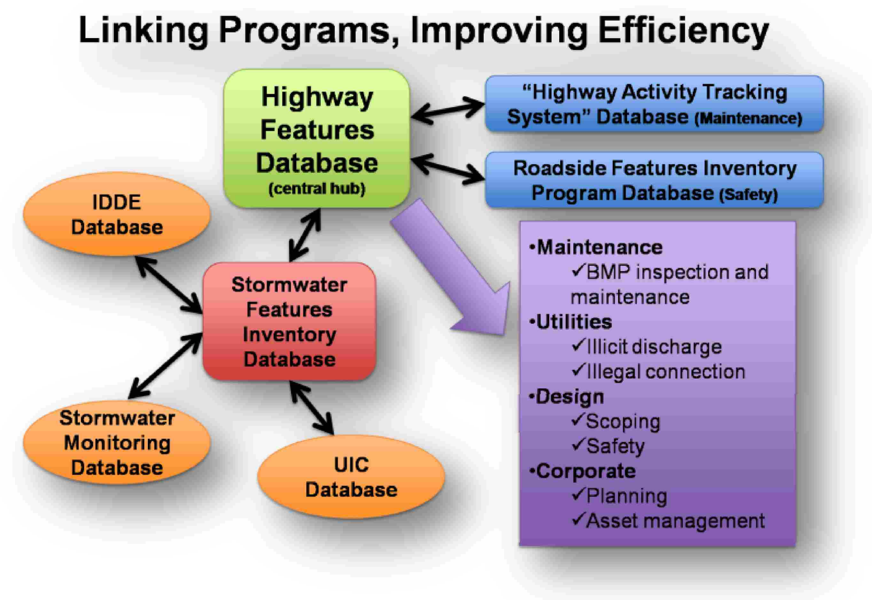


Figure 5: WSDOT Stormwater Features Inventory Database Relationship with Other NPDES Activities.

<u>Maryland SHA Drainage Infrastructure Assessment System</u>

The MDSHA Drainage Infrastructure Assessment System was the first comprehensive system for recording and storing inspection results. MDSHA's system was also the first evolved system to assess conditions in a tested, duplicable way.

MDSHA uses the system to track the approximately 1,500 stormwater management facilities, with inspection teams of trained staff who identify further needed environmental improvements. MDSHA has complemented this work by mapping the entire state for opportunities for retrofitting BMPs, for pollution prevention and stream restoration, and for development of a plan for systematic implementation of those improvements. The grade-based rating system for stormwater management facilities includes an inventory, database, and photo record of all facilities statewide and their maintenance status, within a geographic information system (GIS). Under the rating system, those graded "A" or "B" are considered functionally adequate.

The use of MDSHA's drainage system GIS is designed for planning-level computations and operations-level activities, rather than for design or simulation modeling, though such capabilities are a future consideration. The database is used to determine the general location of systems and drainage areas, to track maintenance activities, and to address public complaints.

Information in the drainage infrastructure asset management database is intended to be sufficient to identify, locate, and evaluate every BMP to provide an overall assessment of MDSHA's BMP inventory. The information in the system assists the agency with decisions on inspection, maintenance, repair, and retrofit of BMP facilities, in addition to supporting compliance with MDSHA's NPDES MS4 permit.

4.4. Future Implications

Asset management programs will play an important role in decision-making for DOT infrastructure upgrade and improvement. DOTs need to incorporate stormwater quality infrastructure assets into their programs to allow for the planning of and expenditure of resources t with the greatest environmental benefit for the lowest cost. Coordinating stormwater quality enhancements with the replacement of other infrastructure that is at the end of its design life will reduce the cost of such improvements compared to stand-alone BMP retrofit programs.

Comprehensive asset management programs will also allow DOTs to forecast cash flow requirements on a more consistent basis, as well as improve projections for operation and maintenance budgeting. Asset management programs can also be expanded to include non-structural BMPs, allowing program managers to assess projects based on greatest environmental benefit, as well as cost. This will also assist in TMDL implementation plans.

4.5. Considerations for Moving Forward

DOTs that do not have an asset management program should consider developing some level of a program. DOTs with asset management programs should consider integrating them with NPDES program requirements. The asset management program should be structured to allow resource estimation and budget forecasting based on maintenance triggers and frequencies of BMP maintenance. DOTs may also apply for Federal funding or assistance for BMP maintenance; a well designed asset management program can assist in this area.

4.6. Key Contacts

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4.7. Reference Websites

- Colorado DOT SWIT
- Colorado DOT Asset Management

- WSDOT Quarterly Environmental Highlight January–March 2011
- Chesapeake Bay TMDL and MD's Watershed Implementation Plan and 2012-13 Milestone Goals
- Asset Management Data Collection for Supporting Decision Processes (FHWA)
- Virginia Department of Transportation (Case Study)
- Maryland State Highway Administration (Case Study)

5. Contemporary Post-Construction Stormwater Control

5.1. Definition

The goal of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The CWA was implemented through EPA's NPDES, which requires the control of stormwater runoff water quality discharged by MS4s using BMPs.

State and federal laws and regulations have increased the need for DOT practitioners to focus on developing effective post-construction stormwater controls as part of their stormwater management programs. Among the many laws and regulations that have prompted the need for DOTs to focus on post-construction stormwater controls are:

- NPDES regulations under the CWA;
- TMDL requirements;
- Water quality mitigation under Section 401 of the CWA;
- State regulations, including post-construction development requirements as part of CGPs;
- Local regulations that require coordination with other agencies and municipalities;
- Endangered Species Act (ESA); and
- Other mandates, e.g., protection of groundwater or aquifers and protection of environmentally sensitive areas and outstanding or high-quality waters.

Post-construction stormwater controls are evolving in design and practice. Research continues on stormwater controls in order to meet hydrologic and water quality objectives. LID or green infrastructure practices are being integrated into highway projects. The goal of LID is "to reduce runoff and to mimic a site's predevelopment hydrology by minimizing disturbed areas and impervious cover and then infiltrating, filtering, storing, evaporating, and detaining stormwater runoff close to its source." (U.S. EPA 901-F-09-003, April 2009)

5.2. Importance to State DOTs

Many states and jurisdictions have adopted advanced stormwater requirements for new and redevelopment projects. For transportation agencies in those states, stormwater practices related to post-construction runoff control calls for implementing approved stormwater treatment systems on all new projects where feasible. Effectively controlling post-construction runoff using specific structural and non-structural post-construction treatment measures (BMPs) and sound roadway maintenance stormwater practices are necessary to reduce the generation of pollutants from highways and related facilities. DOTs are challenged with stormwater management and protecting water quality while carrying out their primary mission: moving goods, ensuring safety of motorists and DOT staff, and operation and maintenance.

Not all DOTs currently have or are required to implement a post-construction treatment BMP program. Many DOTs, however, are evaluating the applicability, constraints, and lessons learned of post-construction BMP implementation for pollutant removal performance, technical feasibility, life cycle cost, and water quality benefits. Many DOTs have begun evaluating the technical requirements for post-construction BMPs for future projects, especially in light of the recently proposed EPA stormwater program rulemaking, which includes a focus on post-construction treatment control BMPs. Specific issues include the following:

- What are current post-construction BMPs that are in the DOT treatment BMP toolbox?
- What are some alternative or emerging BMPs?
- What types of additional research on post-construction stormwater controls and technologies would DOTs most benefit from?

5.3. Case Studies

California DOT

Caltrans has developed a BMP toolbox with a list of approved treatment controls, including roadside vegetated treatment sites (RVTS), infiltration trenches and basins, media filters, extended detention basins, multi-chambered treatment trains (MCTTs), wet basins, traction sand traps, gross solids removal devices (GSRDs), and dry weather diversion. Ongoing research is focused on open graded friction course (OGFC) as a source control BMP for stormwater management.

Caltrans RVTS for example, identifies the minimum length of filter strips to achieve acceptable treatment levels. Studies showed that vegetated shoulders that were not designed for water quality treatment or that were specially maintained still provide substantial water quality benefits. The effluent from vegetated strips for TSS discharge concentrations, typically about 20-25 mg/L, is compared to untreated runoff at 100+ mg/L. Conceivably, DOTs might ultimately be able to identify what percentage of their system has viable vegetated overland flow systems. This has led to the question of how far off other vegetated slopes are from this criteria, and what enhancements might be feasible and appropriate in a variety of situations. Likewise, DOTs and others have been performing research on the effectiveness of vegetated swales.

North Carolina DOT

NCDOT operates over 500 post-construction structural BMPs or structural stormwater control measures (SCMs). NCDOT is required to design, construct, inspect, and maintain these devices through state regulations and NCDOT's statewide NPDES stormwater permit. SCMs are required in both sensitive water areas as well as urbanized areas. The North Carolina Division of Water Quality (DWQ), the delegated authority for administration of the NCDOT NPDES permit, has required and approved a stormwater BMP Toolbox for the NCDOT that defines the control measures and design requirements to be used in the highway environment.

Oregon DOT

Oregon DOT (ODOT) has requirements for post-construction BMPs that are driven less by their NPDES permit (which is outdated by ten years) and more by compliance with the ESA and by 401-certification when projects impact wetlands or waterways. The requirements for stormwater treatment were developed in a collaborative process that involved ODOT, the Department of Environmental Quality (DEQ), the National Marine Fisheries Service (NMFS), and FHWA. Products of the collaboration include defining the types of actions that trigger the need for post-construction stormwater controls, treatment expectations, how much stormwater the DOT treats, and guidance on BMP selection.

The interagency team identified and evaluated water quality BMPs. The BMPs are rated based on pollutant removal processes, with the highest rating, “preferred,” given to those capable of attacking multiple pollutants at the same time. The area subject to treatment for a project, called the “contributing impervious area,” includes all ODOT impervious surface within and draining into the project area, but excludes sources outside of the ODOT right-of-way. This information is codified in several places. The first resource is the Geo/Environmental Section’s Hydraulics Manual. The other is the programmatic biological opinion (PBO) for projects with 404 permits, referred to as “Standard Local Operating Procedures for Endangered Species (fourth iteration)” (SLOPES IV), which includes stormwater management requirements. Upcoming changes are expected for projects funded by FHWA, with another programmatic BO. The stormwater requirements are very similar to SLOPES IV, and the PBO uses federal funding, not the 404 permit as the ESA nexus.

Virginia DOT

Virginia DOT (VDOT) is in the process of creating a statewide BMP clearinghouse website involving regulatory agencies, as well as different development groups and state agencies. As a part of the clearinghouse, a testing protocol is being set up for acceptance of all types of manufactured devices and non-proprietary devices, testing standards, and an approved list of facilities that can be used for post-construction applications statewide that will be completed this fiscal year. There are concerns with different technologies and special proprietary items, and the acceptance of their use by regulators will vary depending on pollutant removal performance.

Washington State DOT

WSDOT has had its own Highway Runoff Manual (HRM) since 1995. It has undergone several revisions, the latest being June 2008, and it is available online. It is both a directional document, in terms of including minimum requirements for stormwater management, and a design manual. It includes specific design and maintenance criteria for each approved BMP the WSDOT uses. WSDOT also has a DOT-only NPDES municipal permit, which applies statewide in all the Phase I and Phase II areas. The permit adopts by reference the HRM, so it is required for use through the permit. Stormwater management for WSDOT, as with many other states, is best achieved using linear BMPs that fit well into the highway environment.

BMP Research

NCHRP developed a BMP technical report series that included categorical performance assessments for all BMPs with sufficient water quality data in the American Society of Civil Engineers (ASCE) International BMP Database for statistical analysis. The reports included comparative box plots and summary statistics for various BMPs and constituents. Table 1 summarizes the median effluent concentration results from the updated BMP performance analyses for TSS, cadmium, copper, lead, nickel, zinc, phosphorus, and nitrogen. These constituents are commonly reported in the BMP Database and are often considered constituents of concern for state DOTs.

All BMP types show statistically significant reductions in TSS concentrations and achieve median effluent concentrations below 25 mg/L. Bioretention, media filters, and wetland basins have the lowest median effluent TSS concentrations. Most BMPs show significant reductions in total cadmium, copper, lead, and zinc concentrations, but the dissolved fraction of these metals are only significantly reduced by certain BMP types. Total metals include particles bound to sediment and can be removed through sedimentation and physical straining, while dissolved metals are mostly only removed through sorption and biochemical processes (WERF, 2005). Therefore, BMPs that provide adsorptive filtration or have long hydraulic residence times to allow for microbial transformations and plant uptake are expected to perform the best in dissolved metal concentration reductions.

Of the BMP types with available data, grass strips show the best performance in removing dissolved metals (significant reduction in all dissolved metal effluent concentrations except for dissolved lead, which suffers from a high percentage of non-detects). Not enough studies (< 3 studies) were available to evaluate the dissolved metal performance for bioretention, wetland basins, and wetland channels. Bioswales (vegetated swales) significantly reduced effluent concentrations for dissolved cadmium, dissolved nickel, and dissolved zinc, but not for dissolved copper and dissolved lead. Swales are expected to provide similar performance as filter strips during small storms when flows are shallow and there is high contact with surface soils. For larger storms, however, as the depth of flow increases, the contact area and contact time is reduced, thereby decreasing the removal efficiency, particularly for dissolved constituents.

With regard to nutrients, retention ponds tend to perform the best in significantly removing all forms of phosphorus and nitrogen, followed by wetland basins. These practices include a permanent pool, which increases the hydraulic residence time, allowing sedimentation and biochemical processes to take place while also having both aerobic and anaerobic zones to facilitate both nitrification and denitrification processes. The vegetated strip, bioretention, bioswale, and wetland channel show significant increases in median phosphorus concentrations in the effluent. Leaching of phosphorus from soils/planting media and re-suspension or degradation of captured particulate phosphorus may be a cause of the phosphorus increases observed. If soil amendments contain high concentrations of phosphorus (e.g., compost) the phosphorus could be released into the stormwater runoff instead of being retained in the BMP.

Table 1: BMP Median Effluent Concentration for Constituents Commonly Reported in the BMP Database

BMP Type	TSS, mg/L (95% CI)[a]	Dissolved Cadmium µg/L (95% CI)[a]	Total Cadmium µg/L (95% CI)[a]	Dissolved Copper µg/L (95% CI)[a]	Total Copper µg/L (95% CI)[a]	Dissolved Lead µg/L (95% CI)[a]	Total Lead µg/L (95% CI)[a]	Dissolved Nickel µg/L (95% CI)[a]	Total Nickel µg/L (95% CI)[a]
Grass Strip	**19.1 (16.0, 21.5)**	0.09 (0.07, 0.11)	**0.18 (0.09, 0.20)**	**5.40 (4.50, 5.90)**	**7.30 (6.40, 7.90)**	0.26 (0.19, 0.35)	**1.96 (1.30, 2.20)**	**2.09 (2.00, 2.15)**	**2.92 (2.40, 3.10)**
Bioretention	**8.3 (5.0, 9.0)**	NA[d]	**0.94 (0.25, 1.00)**	NA[d]	**7.67 (4.60, 9.85)**	NA[d]	2.53 (2.50, 2.50)	NA[d]	NA[d]
Bioswale	**13.6 (11.8, 15.3)**	**0.12 (0.09, 0.15)**	**0.31 (0.27, 0.34)**	8.02 (6.30, 9.24)	**6.54 (5.70, 7.70)**	1.08 (0.76, 1.60)	**2.02 (1.80, 2.29)**	**2.04 (2, 2.40)**	**3.16 (2.30, 4.20)**
Composite	**17.4 (12.4, 18.8)**	NA[d]	**0.50 (0.43, 0.50)**	5.00 (5.00, 5.00)	**5.88 (5.05, 6.79)**	0.29 (0.09, 0.44)	**4.78 (3.00, 5.61)**	NA[d]	NA[d]
Detention Basin	**24.2 (19.0, 26.0)**	0.50 [b] (0.50, 0.50)	0.31 (0.25, 0.35)	3.52 (2.80, 4.72)	**5.67 (4.00, 6.80)**	0.66 (0.48, 0.90)	3.10 (2.15, 4.30)	2.55 (2.00, 3.00)	**3.35 (2.20, 3.75)**
Manufactured Device	**18.4 (15.0, 19.9)**	0.30 (0.24, 0.39)	**0.28 (0.20, 0.31)**	6.08 (4.82, 7)	**10.16 (7.94, 11.0)**	1.24 (1.00, 1.38)	**4.63 (3.80, 5.16)**	1.92 (0.44, 2.00)	4.51 (3.11, 5.00)
Media Filter	**8.7 (7.4, 10.0)**	0.18 (0.11, 0.20)	**0.16 (0.10, 0.20)**	4.35 (3.58, 5.10)	**6.01 (5.10, 6.60)**	1.00 (1.00, 1.00)	**1.69 (1.30, 2.00)**	1.90 (0.99, 2.00)	**2.20 (2.00, 2.60)**
Porous Pavement	**13.2 (11.0, 14.4)**	**0.04 [c] (0.02, 0.05)**	0.25 [c] (0.25, 0.25)	5.75 (4.90, 5.91)	**7.83 (6.80, 8.10)**	0.50 [c] (0.50, 0.50)	**1.86 (1.38, 2.21)**	**0.43 [c] (0.33, 0.52)**	**1.71 (1.40, 1.80)**
Retention Pond	**13.5 (12.0, 15.0)**	0.10 (0.07, 0.13)	**0.23 (0.20, 0.29)**	**4.24 (4.00, 4.57)**	**4.99 (4.06, 5.00)**	0.48 (0.23, 0.96)	**2.76 (2.00, 3.00)**	2.11 (1.40, 2.53)	**2.19 (2.00, 2.60)**
Wetland Basin	**9.06 (7.0, 10.9)**	NA[d]	**0.18 (0.10, 0.20)**	NA[d]	**3.57 (3.00, 4.00)**	NA[d]	**1.21 (1.00, 1.55)**	NA[d]	NA[d]
Wetland Channel	**14.3 (10.0, 16.0)**	NA[d]	0.49 (0.19, 0.50)	NA[d]	4.81 (3.61, 5.20)	**0.52 (0.12, 0.75)**	2.49 (1.40, 3.11)	NA[d]	2.18 (2.00, 2.40)

(**Bolded** to show statistically significant decrease between influent and effluent median concentrations)

Notes:

µg/L: micrograms per liter

a. Computed using the Bias Corrected and Accelerated (BCa) bootstrap method by Efron and Tibishirani (1993)

b. Hypothesis testing shows statistically significant increases for this BMP category.

c. Conclusions are limited for this BMP category due to a large percentage of non-detects in the influent.

d. NA – not available or less than three studies for BMP/constituent.

Table 1: BMP Median Effluent Concentration for Constituents Commonly Reported in the BMP Database (continued)

BMP Type	Dissolved Zinc µg/L (95% CI)[a]	Total Zinc µg/L (95% CI)[a]	Total Phosphorus mg/L (95% CI)[a]	Orthophosphate mg/L (95% CI)[a]	Dissolved Phosphorus mg/L (95% CI)[a]	Total Nitrogen mg/L (95% CI)[a]	Total Kjeldahl Nitrogen mg/L (95% CI)[a]	NO_x as Nitrogen mg/L (95% CI)[a]
Grass Strip	**14.0 (10.0, 16.0)**	**24.3 (16.0, 26.0)**	0.18 [b] (0.15, 0.20)	0.06 [b] (0.04, 0.07)	0.25 [b] (0.16, 0.26)	1.13 (1.00, 1.23)	**1.09 (0.97, 1.12)**	**0.27 (0.24, 0.31)**
Bioretention	NA[d]	**18.3 (7.7, 25.0)**	0.09 (0.07, 0.10)	0.04 [b] (0.02, 0.05)	0.13 (0.05, 0.18)	**0.90 (0.74, 0.99)**	**0.60 (0.46, 0.72)**	**0.22 (0.19, 0.25)**
Bioswale	**24.5 (21.3, 27.5)**	**22.9 (20.0, 26.6)**	0.19 [b] (0.17, 0.20)	0.12 [b] (0.10, 0.13)	0.07 [b] (0.05, 0.11)	0.71 (0.63, 0.82)	0.62 (0.50, 0.70)	0.25 (0.20, 0.28)
Composite	**9.9 (4.4, 10.0)**	**33.0 (28.5, 39.5)**	**0.13 (0.11, 0.15)**	0.07 (0.04, 0.10)	**0.08 (0.06, 0.09)**	**1.71 (1.45, 1.81)**	**1.02 (0.88, 1.14)**	**0.40 (0.33, 0.46)**
Detention Basin	11.08 (8, 17)	**29.7 (17.1, 38.2)**	**0.22 (0.19, 0.24)**	0.39 (0.24, 0.56)	0.11 (0.08, 0.12)	2.37 [b] (1.75, 2.69)	1.61 (1.16, 1.78)	**0.36 (0.24, 0.45**
Manufactured Device	53.3 (44.0, 64.0)	**58.5 (52.8, 63.5)**	**0.12 (0.10, 0.13)**	**0.10 (0.06, 0.13)**	0.06 (0.04, 0.07)	2.22 (1.90, 2.41)	1.48 (1.32, 1.55)	0.41 (0.35, 0.44)
Media Filter	**12.2 (8.3, 17.0)**	**17.9 (15.0, 20.0)**	**0.09 (0.08, 0.10)**	**0.03 (0.02, 0.03)**	0.08 (0.06, 0.09)	**0.82 (0.68, 0.99)**	**0.57 (0.50, 0.61)**	0.51 [b] (0.46, 0.57)
Porous Pavement	**6.5 (4.9, 7.9)**	**15.0 (12.5, 16.8)**	**0.09 (0.08, 0.09)**	0.05 (0.04, 0.06)	0.05 (0.04, 0.05)	1.49 (1.28, 1.65)	**0.80 (0.74, 0.90)**	0.71 [b] (0.59, 0.77)
Retention Pond	**9.6 (5.3, 10.9)**	**21.2 (20.0, 23.0)**	**0.13 (0.12, 0.14)**	**0.04 (0.03, 0.05)**	**0.06 (0.06, 0.07)**	**1.28 (1.19, 1.36)**	**1.05 (0.98, 1.10)**	**0.18 (0.15, 0.20)**
Wetland Basin	NA[d]	**22.0 (16.7, 24.3)**	**0.08 (0.07, 0.09)**	**0.02 (0.01, 0.02)**	**0.05 (0.03, 0.06)**	1.19 (1.04, 1.21)	1.01 (0.92, 1.09)	**0.08 (0.05, 0.11)**
Wetland Channel	9.5 (2.9, 10.0)	15.6 (11.0, 20.0)	0.14 (0.13, 0.17)	0.06 [b] (0.04, 0.06)	0.09 (0.07, 0.10)	1.33 (1.05, 1.56)	**1.23 (1.10, 1.30)**	**0.19 (0.15, 0.22)**

(**Bolded** to show statistically significant decrease between influent and effluent median concentrations)

Notes:

µg/L: micrograms per liter

a. Computed using the Bias Corrected and Accelerated (BCa) bootstrap method by Efron and Tibishirani (1993)

b. Hypothesis testing shows statistically significant increases for this BMP category.

c. Conclusions are limited for this BMP category due to a large percentage of non-detects in the influent.

d. NA – not available or less than three studies for BMP/constituent.

5.4. Future Implications

The EPA is currently collecting information for a proposed new rulemaking that may change the geographic and technical permit coverage and introduce requirements, such as a design or compliance storm, for post-construction BMPs in MS4 NPDES permits that are more prescriptive. Stormwater runoff from existing and new development/redevelopment, including transportation facilities and highways, can result in impacts to receiving water quality. State and federal laws and regulations have increased the need for DOT practitioners to focus on developing effective post-construction stormwater controls as part of their stormwater management programs.

The construction, operation, and maintenance cost of post-construction BMPs is one of the fastest growing line items in a DOT budget. The capital cost of construction is generally only a portion of the whole life cost, which is dominated by operation and maintenance.

The majority of DOT infrastructure was constructed prior to the requirement for consideration of post-construction BMPs. Retrofit of BMPs into existing infrastructure is costly and may require the purchase of additional right-of-way. “Green” BMP infrastructure, such as vegetated swales and strips, is generally preferred to “grey” infrastructure, such as detention basins and slow sand filters, due to lower capital and operation and maintenance costs. Research shows, however, that grey infrastructure may be more practical for achieving watershed retrofit goals than green infrastructure.

Texas DOT (TxDOT) has pioneered research that is consistent with the philosophy of incorporating existing infrastructure into improved highway stormwater management. Permeable friction course (PFC) overlays are in routine use throughout most of the southern states to reduce pavement noise and hydroplaning potential. TxDOT research shows that PFC has a substantial benefit for highway runoff water quality. A second example also under study by TxDOT is batch detention, which can easily and inexpensively be retrofitted to existing dry detention and flood control basins. When runoff without discharge is impounded for a pre-determined period prior to release, the result is a significant improvement in effluent quality compared to dry detention. While neither of these technologies reduces runoff volume, they exemplify the characteristics of approaches that maximize the use of existing highway infrastructure.

5.5. Considerations for Moving Forward

To reduce future capital, operation, and maintenance costs of post-construction BMPs, more research is needed to develop management practices that can be easily incorporated into existing infrastructure. Emphasis must be placed on measures that can operate passively with minimum maintenance over their design life. It will be imperative to use the existing highway and drainage infrastructure in stormwater management solutions to meet the rulemaking requirements. Implementation of retrofit approaches that require significant structural changes to the roadway system and/or appurtenances are unaffordable and inconsistent with sustainable infrastructure practices. DOTs should consider updating their post-construction

BMP guidance to incorporate measures and approaches for treatment BMPs that can be easily incorporated into existing infrastructure and pursue research in this area.

5.6. Key Contacts

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Stephen Tibbetts Senior Environmental Engineer Maine DOT Phone: 207-557-3471 Email: stephen.w.tibbetts@maine.gov	

5.7. Reference Websites

- BMP Database
- Instructional animations for approved Caltrans BMPs
- U.S. EPA Post-Construction Stormwater Management in New Development and Redevelopment
- MaineDOT Main Mall Road Porous Pavement Project
- Technical Report 10-05 – Performance of a Porous Pavement System on the Maine Mall Road in South Portland
- Long Creek Restoration Project
- Connecticut DOT Stormwater Management Plan – Draft – February 2004 Section 5 – Post Construction Site Runoff Control
- WSDOT Roadside Manual M 25-30.01 – July 2012

6. Effectively Focused Construction Stormwater Management

6.1. Definition

State DOT stormwater discharges during construction activities are generally regulated under the state CGP (or federal CGP for non-delegated states), and implementation of the new ruling will be subject to the requirements of the state permitting authorities, including monitoring and reporting requirements. In general, transportation projects trigger the threshold of one acre or more of soil disturbance during project construction, requiring compliance and coverage under the CGPs. Construction stormwater runoff management from highway construction presents many challenges from DOTs due to the linear nature of the projects crossing or adjacent to receiving waters. Effective, focused construction stormwater management for DOTs involves:

- Construction contract administration to ensure contractor compliance (plans review, specifications, DOT staff and contractor accountability);
- Inspection, tracking, monitoring, and enforcement of field implementation of erosion and sediment control measures; and
- Improvements on BMP practices appropriate for site runoff controls during highway construction.

6.2. Importance to State DOTs

Poor construction stormwater compliance practices resulting in discharge of sediment to receiving waters are subject to enforcement under the CGP. DOTs have been subject to enforcements (administrative and monetary fines) and legal actions because of erosion and sediment control failures. Linear infrastructure construction is challenging, especially in urbanized areas with constrained work areas, and roadway improvement projects may cross multiple small streams and watersheds.

Most construction by transportation agencies is typically conducted by private contractors, so a comprehensive and effective, focused construction stormwater management program is essential, and an emphasis on communication, training, construction documentation, inspection, and accountability is important.

6.3. Case Studies

Construction stormwater management is most effective when focused on managing three key areas: communication, work, and water. Following are some examples of researched construction stormwater management practices in Nebraska, Alabama, Connecticut, and North Carolina.

<u>Nebraska Department of Roads</u>

Nebraska Department of Roads (NDOR) has developed the Environmental Compliance Oversight Database (ECOD) to improve accountability, transparency, and basic project management through electronic communication and tracking of environmental commitments.

The ECOD is an electronic reporting software application used to document and track environmental commitments on NDOR construction projects. Field inspections use the inspection software loaded on field machines and a web-based headquarters module that harvests and manages the data. A synchronized process exchanges data between user machines and headquarters.

A product of the ECOD tool includes a corrective action log that is automatically populated with inspection findings and follow-up requirements to closeout corrective actions, overdue and pending corrective actions. Response staff receives a notification email message containing a link to the corrective action log for a particular project. The tool also provides a punch list print feature and a list of NDOR Certified Erosion Control Inspectors.

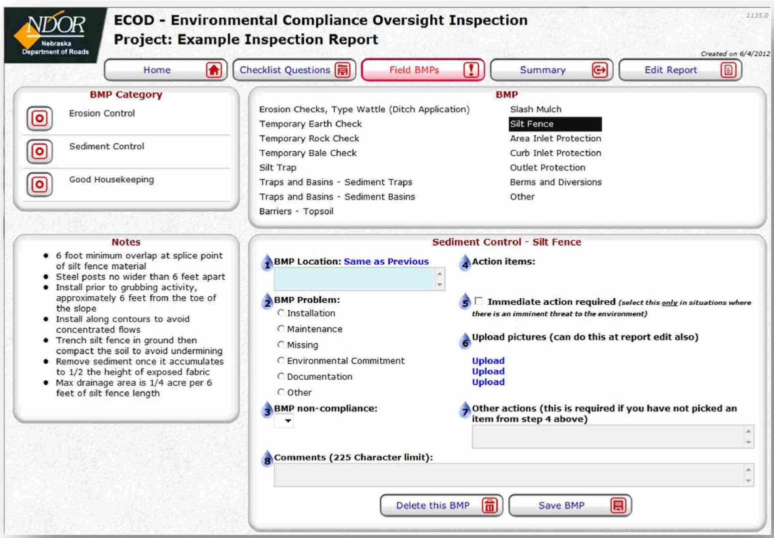


Figure 6: Sample NDOR ECOD Environmental Compliance Oversight Inspection Report

Alabama DOT

Construction stormwater management for Alabama DOT (ALDOT) focuses on five pillars: 1) Manage the Communication, 2) Manage the Work, 3) Manage the Water, 4) Manage the Erosion, and 5) Manage the Sediment. Key focus areas include addressing/review of plans issues, mass haul diagrams, and other key practices.

The plan reviews emphasize that erosion and sediment control plan sheets must be phased. The initial phase begins prior to any grubbing or grading work (e.g., stabilized entrances, perimeter barriers, stream protection, temporary basins, and vegetated buffers). The intermediate phase includes temporary diversions, ditch checks, sumps, inlet protection, temporary soil drains, earth berms, and BMPs for material stockpiles. The final phase continues until permanent vegetation is established (e.g., inlet protection, permanent stabilization, erosion control products, ditch linings, and ditch checks).

Mass haul diagrams analysis is conducted considering environmentally sensitive areas, sequence of construction/project phasing, bridges/culverts/mechanically stabilized earth (MSE) walls, and intermediate earthwork balance points. Other practices include development of an adequate Contractor SWMP, project inspections and site visits, and correct designs for sedimentation basins. ALDOT has also applied findings from Auburn University Ditch Check Research.

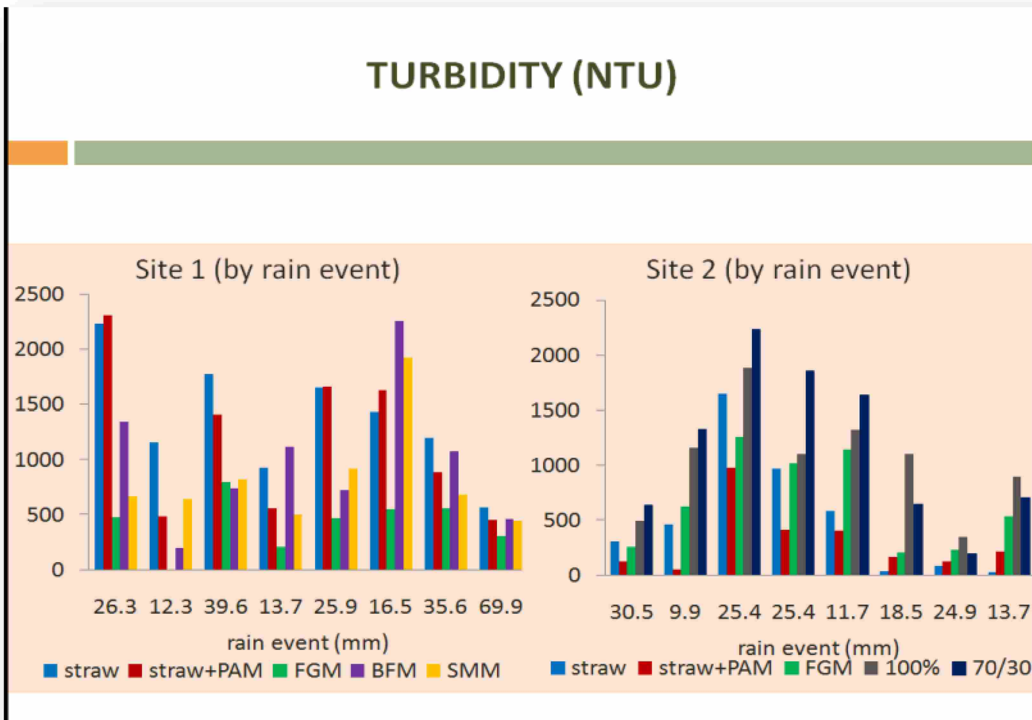
North Carolina DOT

To assist in improving construction stormwater compliance and BMP practices, NCDOT has collaborated with North Carolina State University (NCSU) on BMP research. One research study focused on improving infiltration by restoring perviousness to compacted construction site soils through soil tillage. The key findings from the study include:

- Tillage is widely used in agriculture and has potential use for construction settings to reduce stormwater runoff.
- Shallow and deep tillage resulted in high infiltration for the monitoring period; longer-term data will be collected.
- Infiltration remained high, even with bulk density increases due to, for example, soil settling and lawnmower traffic.
- Infiltration rates may allow discharge from impervious surfaces into these areas.

Another research study is ongoing to evaluate the effects of different mulch types on runoff and vegetation establishment on steep slopes. The key findings from the study include:

- Performance of any mulch type depends on specific site conditions but is largely determined by the weather.
- No clear advantage of any mulch type was found.
- Straw application rate is very important.
- More replications of the same study need to be done in different locations with different soil types (currently underway).



PAM: Polyacrylamide, FGM: Flexible Growth Medium,
BFM: Bonded Fiber Matrix, SMM: Stabilized Mulch Matrix

6.4. Future Implications

Nationally, regulatory emphasis is being placed on construction site stormwater quality programs. Most state GCPs are activity based, and inspections and audits can be easily targeted to quantitative assessments. As a result, substandard programs are likely to expose the DOT to substantial liability in the form of litigation and fines.

Construction NPDES permits must be obtained through a public process. This ensures that permit applications, compliance reports, and permit termination applications will be available to the public for review. Consistent and diligent recordkeeping and documenting implementation of a fully compliant program will be required.

6.5. Considerations for Moving Forward

DOTs will need to invest resources in staff training, procedures, and quality assurance and quality control in construction stormwater program implementation. This will require additional resources dedicated to program implementation as well as to capital construction budgets to implement and inspect BMPs during construction. Contract time may also need to be increased to limit the portion of the site that is active at any time, and to schedule large earthmoving operations outside of the rainy season.

6.6. Key Contacts

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6.7. Reference Websites

- NDOR's Commitment to Conservation
- NDOR Stormwater

7. The Watershed Approach

7.1. Definition

Watershed-based stormwater management (the "watershed approach") is an important emerging tool to assist DOTs in meeting priority water resource and environmental permitting goals. The watershed approach can be an effective way to improve the quality of surface water resources. Stakeholders within a watershed have varying levels of control over pollution sources. Matching pollutant load reductions with the degree of control a stakeholder has for a pollutant can be one way to reduce mitigation costs and improve receiving water quality.

U.S. EPA describes the watershed approach as having the following characteristics:

- Hydraulically defined
    - geographically focused
    - includes all stressors
- Involves all stakeholders
    - public (federal, state, local) and private sector
    - community-based
    - includes a coordinating framework
- Strategically addresses priority water resource goals (such as water quality and habitat)
    - integrates multiple programs (regulatory and voluntary)
    - based on sound science
    - aided by strategic watershed plans
    - uses adaptive management

7.2. Importance to State DOTs

DOT facilities are dispersed throughout many of a state's watersheds and yet they generally account for a relatively small fraction (2–5%) of the total impervious area in a watershed. Accordingly, it is not always practical for DOTs to develop specific programs and construct capital stormwater enhancement projects on a pollutant basis, particularly if the DOT has a low degree of control over the pollutant. In some instances, DOTs may prefer to participate in a larger coordinated watershed-based program with in-kind services or financial support.

Contractual tools used by DOT and other stakeholders for an effective municipal coordination program include but are not limited to memorandums of understanding (MOU), intergovernmental agreements, and cooperative agreements.

An objective of the watershed approach is to improve program pollution control effectiveness while reducing the implementation cost. The cost and effectiveness of pollution control strategies is partially based on the degree of control a discharger has over the pollutant of concern. For example, while runoff from DOT facilities generally contains pathogens, few sources of pathogens actually exist within a DOT's right-of-way. The DOT would better leverage its ability to mitigate for pathogens by participating in a regional, watershed-based program for pathogen control, focusing on "hot spots" within the watershed rather than a strict runoff-based approach established in a traditional NPDES program.

The watershed approach can also be used to facilitate other environmental objectives, such as wetland restoration or resource protection, by developing and clearly communicating these objectives as part of a comprehensive watershed plan that targets specific goals. An effective watershed plan establishes a system that allows the participating stakeholders to "trade" pollution and/or mitigation credits. The credit-trading process involves reducing or removing a pollutant in an area geographically distinct from the project area.

Some of the challenges implementing a stormwater watershed approach to mitigation include:

- Defining "credits" and methods of applying them to non-point sources;
- Funding constraints for constructing outside the DOT right-of-way;
- Categorizing TMDLs as prerequisites or as applicable in a broader context;
- Assigning offset ratios (if desired) for pollutant removal;
- Setting up an in-lieu fee mitigation program (if desired); and
- Selecting arbitrators and decision makers for naming appropriate credits and setting the standards for pollutant removal.

One goal of watershed plans is to prioritize problems. Mitigation may focus on problems or pollutants that are not a direct consequence of the project construction or operation and maintenance. The biggest challenge agencies and DOTs have in achieving consensus is the issue of environmental or water quality credit and applying mitigation resources to problems not directly related to the project.

DOTs use different methods to apply and implement the watershed approach to mitigation and BMP retrofits. Some of the criteria to determine which method is used are:

- Implementation during mitigation and/or BMP retrofit;
- Feasibility of using the watershed approach;
- Limitations of the watershed approach and/or BMP retrofit;
- Policy of in-lieu fees (if used); and
- Purchases offsite or outside the right-of-way.

7.3. Case Studies

Several DOTs have used a watershed approach to mitigation, among them are Colorado, Delaware, New Jersey, and Massachusetts.

<u>Colorado DOT</u>

CDOT recently proposed to the state regulator using a mitigation fund approach as part of CDOT's new post-construction program. It is a single statewide mitigation fund originating from CDOT's construction budget and used for high priority water quality improvement projects across the state. The fund would give CDOT an opportunity to collaborate with local government and watershed groups. The fund would enable CDOT to focus on improving water quality where it is most needed or most effective. Emphasis would be placed on collaborative problem solving with other agencies or groups. Compliance would be measured by multi-year average funding of the most critical water quality BMPs, regardless of location. The fund would be administered by a joint committee, and it could subsidize project-related BMPs, watershed-based improvements, joint ventures with other water quality groups, and projects inside or outside MS4 areas. As a result, larger projects could be funded, long-term BMP operation and maintenance could be ensured through agreements and collaboration, tax dollars would be used more effectively, and future maintenance costs would be reduced by building fewer BMPs. CDOT continues to work with the regulatory agency to develop a workable program. Concerns from Colorado Department of Public Health and Environment (CDPHE) focused on the lack of CDOT's approach to implement a program to reduce the discharge of pollutants from the permitted MS4 to the maximum extent practicable (MEP). Flexibility is being considered that will allow controlling pollutants system-wide through more pollutant reduction in one area of the MS4 versus another, or by implementing controls in areas subject to future redevelopment within the MS4 in lieu of focusing solely on current projects within the MS4.

Delaware DOT

Delaware DOT (DelDOT) has TMDLs for nitrogen, phosphorus, and bacteria. DelDOT participates with stakeholder "Tributary Action Teams," groups convened by the state regulator to recommend actions to reduce nonpoint source pollution in several TMDL watersheds. The recommendations include voluntary and regulatory actions, and they are used to develop pollution control strategies. In addition to these documents, other watershed plans and strategies have been developed by the regulator over the years, including a WIP for Chesapeake Bay TMDLs. DelDOT helped write the stormwater section of the WIP. DelDOT's proposed new permit requires implementation of Water Quality Improvement Plans on a watershed basis. DelDOT, in coordination with seven co-permittees, must plan and implement projects that aim toward meeting TMDL allocations and applicable water quality standards in two priority watersheds during the five-year permit term.

In addition, DelDOT has partnered with various agencies and organizations in the state on two smaller sub-watershed assessment and improvement projects. An official MOU for DelDOT on stormwater program compliance was signed in 1996. New regulations expected in January 2013 will include a new banking agreement with new regulations. DelDOT will engage in shared use agreements with developers, counties, and municipalities.

New Jersey DOT

New Jersey DOT (NJDOT) wanted to conduct a study and pilot project to demonstrate the technical and legal feasibility of stormwater quality banking in New Jersey. The state regulator provided information on water quality improvement initiatives for selected watersheds and developed a process to identify need, banks, and the project-level process. The DOT proposed using the banking approach to mitigate nitrogen eutrophication in Barnegat Bay and upgrade or replace deficient state-owned stormwater basins throughout the watershed, with a focus on total nutrient reduction. Discussions were held with the regulator to attain approval for the retrofitting of existing basins. The regulator ultimately agreed with the proposal for close to $5.5 million to retrofit eight to ten basins, in Barnegat Bay, to meet stormwater quality and nitrogen reduction requirements. The permit application is currently being reviewed by the regulator.

Massachusetts DOT

Massachusetts DOT (MassDOT) conducted a retrofit program focus on DOT properties in urban areas that directly discharges stormwater runoff from DOT roads to impaired waters. The impaired waters BMP retrofit assessment steps include:

Step 1: Total watershed has more than 9% impervious cover (IC)
Step 2: Subwatershed has more than 9% impervious cover (IC)
Steps 3 and 4: Calculate amount of effective IC reduction to meet the 9% IC goal in the subwatershed and in MassDOT's directly draining watershed
Step 5: Calculate effective IC reduction credit from existing MassDOT BMPs
Step 6: Propose BMPs to maximum extent practicable to meet IC target

BMP retrofit initiatives also considered FHWA Innovative Contracting (Special Experimental Project SEP - 14). The retrofit project process was based on streamlined design submission schedules (accelerated in-house reviews) and no ROW required. A simplified environmental approval process was conducted including: programmatic NEPA clearances, programmatic Section 106 clearances, and isolated difficult projects as 'standalone' retrofits.

7.4. Future Implications

Application of a watershed approach to stormwater permitting compliance for DOTs will require the development of an implementation framework that does not currently exist. The NCHRP program has funded the research project, NCHRP 25-37, "*A Watershed Approach to Mitigating Stormwater Impacts.*" This research is planned for completion in 2014, and it will assist DOTs in implementing a watershed-based NPDES compliance program.

New stormwater policy may be required to implement a watershed approach that will allow for the application of mitigation in areas geographically different from the project area. It is unclear whether the CWA as currently written would allow the use of "credit trading." In addition, a credit system would need to be developed that could be universally applied within a watershed, or potentially allow transition between watersheds.

7.5. Considerations for Moving Forward

It is recommended DOTs consider investigating whether their legal authority needs to be expanded to allow for participation in joint mitigation projects or to use of state funds on private mitigation projects. The use of federal funds for projects outside of the right-of-way may also be limited by current guidelines.

Staff will need to be dedicated to policy oversight, compliance, and enforcement, as well as reporting and tracking of watershed projects. It is likely that new positions will be required within the DOTs to implement watershed programs and provide implementation support during the planning, design, construction, and operation phases. Staff will also be required to provide public education and receive public input on the watershed programs of DOTs.

7.6. Key Contacts

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7.7. Reference Websites

- DelDOT Watersheds
- MassDEP TMDLs
- MassDOT NPDES Phase II Small MS4 General Permit Annual Report April 2011–March 2012
- CDOT Stormwater Programs
- U.S. EPA "A Watershed Approach"