

Day 1 – Monday - April 11, 2022

Registration and Reception – Marriott City Center - Raleigh, NC

Day 2 – Tuesday - April 12, 2022

Plenary Session

This session welcomed the practitioners and provided them with a vision of the future of the stormwater program from the national and state level. DOTs were challenged with meeting the requirements of their NPDES Permits. This, against a backdrop of aging infrastructure, climate change and adaptation of infrastructure, changed at the user level including ridesharing, electric vehicles, and intelligent highways.

Speakers:

- Opening Remarks by Scott McGowen – Michael Baker International, Moderator
- Stephen Morgan, PE – State Hydraulics Engineer, North Carolina DOT
- David Harris, PE – State Roadside Environmental Engineer, North Carolina DOT
- Edward Parker – FHWA Deputy Administrator North Carolina Division

Topics addressed included climate change, sustainability, resilience, funding, implementation, and clean water programs.

8:00 am – 8:30 am – Welcome and Opening Remarks

- Scott McGowen, PE – Michael Baker International
- Stephen Morgan, PE – State Hydraulics Engineer, North Carolina DOT
- David Harris, PE – State Roadside Environmental Engineer, North Carolina DOT
- Edward Parker – FHWA Deputy Administrator, North Carolina Division

Scott McGowen: *Welcome*





The first National Practitioner’s meeting was held in San Diego in 2008, hosted by Caltrans. The conference was highly rated, very successful.

This first Practitioner’s meeting led to an NCHRP Domestic Scan -- 08-03 on Best Practices in Addressing NPDES and other Water Quality Issues in Highway System Management.

The second Practitioner’s meeting was held in Denver in 2010 and hosted by Colorado DOT. See slide for agenda topics.

In 2012, practitioners met in Raleigh, North Carolina, hosted by North Carolina DOT. See slide for agenda items.

In 2014, practitioners met in Washington DC, hosted by the District Department of Transportation. See slide for agenda items.

Eight years later, we are again meeting. Some of the issues remain today, but many new challenges as well. This meeting is sponsored by FHWA and hosted by North Carolina DOT. A special thanks to Susan Jones at FHWA, Brian Smith at FHWA, and Andy McDaniel at NCDOT for making it happen.

Steven Morgan of NCDOT, State Hydraulics Engineer - First Speaker

Thanked attendees and noted the integral role stormwater plays in a DOT and implementing the DOT mission.

David Harris, State Roadside Environmental Engineer - Second speaker

NC has 80,000 miles of state-maintained highways. TMDLs are a unique compliance challenge for NCDOT. Working towards a one water approach. Nature based stormwater practices are also something they are exploring and using, looking at soil improvements, and utilizing the research facility at North Carolina State.

Partnerships – Maintenance budgets are a key issue. It does not matter what you can build but matters what you can maintain and building something that will last. In creating natural systems, you will be better off for it.

Edward Parker, FHWA Administrator – Third Speaker

Noted the partnership with NC State as well as a partnership with USGS. This is valuable for knowledge sharing and networking. The IIJA – bipartisan infrastructure law (BIL). A once in a generation in infrastructure improvement opportunity provides \$550B in funding for infrastructure. It will also invest in electric vehicle charging, as well as water and broadband for rural areas. This translates to about 29% increase in federal aid funding. The Clean Watershed Needs Survey is supported and a billion dollars for grants focusing on emerging contaminants is provided.

8:30 am – 9:30 am – Scott McGowen – Introduction of Practitioners

Mark Hemmerlein – New Hampshire DOT – WQ Program Manager – One person

Shawn Slaymon – Indiana DOT – 4 staff

Bren Edwards – Utah DOT – cover the six northern counties

Sarah Esposito – Delaware DOT

Rhonda Thiele – Utah DOT – southern manager with six staff.

Vince Davis – Delaware DOT – Environmental Scientist

Eric Strecker – Terraphase Engineering.

Merv Lare – Kansas DOT – 4 years. One man department.

William Fletcher – Oregon DOT (former). With ODOT for 30 years. Stormwater specialist

Ben Nuwit – North Carolina DOT – Construction and stormwater

Wes Stafford – Mississippi DOT, two people that work the statewide program.

James Murphy – Nevada DOT – used to be a one person, now have several people

Jeff Austin – North Carolina DOT – Erosion control

Becky Humphreys – Ohio DOT stormwater program manager, two employees

Paul Wirfs – Oregon DOT – State hydraulic Engineer

Megan Quick – North Carolina DOT – Heads up the MS4 compliance

Andy McDaniel – North Carolina DOT – Hydraulics, host.

Laura Nordan – Arizona DOT – MS4 program coordinator.

Alex G – North Carolina DOT - Construction stormwater and post construction stormwater

Joseph Yoo – Massachusetts DOT, works with Henry Barbaro

Brian Smith – FHWA, Resource Center

Eileen Dunn – Arizona DOT – a few staff.

Henry Barbaro – Massachusetts DOT. Stormwater unit is lean, 3 people

Brad McManus – Georgia DOT – Roadway Hydraulics Engineer, water resources group. About 5 engineers in the department to manage the permit

Tracy Janus – Texas DOT Environmental program manager. Team of four. Manage the stormwater permit.

Dan Imig – Connecticut DOT - Position created in 2018. Has a staff of two working for him. Focus on post construction

Greg Granato – USGS.

Ryan Lizewski – FHWA hydraulics engineer

Jake Bauckman – Virginia DOT.

Steven Wright – Delaware DOT – design

Matt Sperry – North Dakota DOT

Victoria Jeffery – Nevada DOT

Hans Hallanger – Wisconsin DOT

Kory Boe – North Dakota DOT

Charlie Hebson – Maine DOT

Alissa Salmore – Idaho Trans Dept. Works at District level

Mike Perez – Auburn University – run the Stormwater research facility

Susan Jones – FHWA

Ron Poe – Nebraska DOT – 9 staff.

Kiona Leah – Maryland SHA – stormwater assets manager

Ryan Mullins – North Carolina DOT, Highway stormwater program manager

Shane Sisel – Nebraska DOT

Brian Lipscombe – North Carolina DOT – Post Construction program

Rich Darden – FHWA Headquarters. Role is 404 wetlands/waters. Backup for Susan Jones

Lindsay Zwiefel – Arkansas DOT – was with the DEQ. Two-person stormwater team.

Tracy Harmon – Virginia DOT – support the MS4 program for TMDLs
Nick Tiedeken – Minnesota DOT
Wes Spoonemore – Wyoming DOT
David Mack – Arizona DOT – industrial stormwater coordinator
Rich Heineman – Pennsylvania DOT – MS4 and post construction and construction
Vince Davis – Delaware DOT – NPDES program
Barry Fagan - Volkert, Inc. – Env infrastructure group, former Alabama DOT
Steve Sights – North Carolina DOT – Stormwater Group
RoseMarie Klee – Texas DOT, hydrology and hydraulics section director.
Scott Taylor – Michael Baker International
Scott McGowen – Michael Baker International

Session 1 – EPA and FHWA Updates

DOTs face the challenge of Permit Implementation at a time when general program revenues are static and spread over multiple priorities, while permit requirements and TMDLs are increasing. The federal government can provide support and consistency to DOTs to implement their programs.


Panel members:

- Scott McGowen, Michael Baker International, Moderator
- Heather Goss, U.S. EPA - National Transportation Liaison to DOT-FHWA (Virtual)
- Susan Jones, Office of Project Delivery and Environmental Review | Federal Highway Administration (FHWA) | U.S. Department of Transportation

The panel session discussed the current and future resources available to DOTs by USEPA and FHWA as partners in stormwater development and implementation. Each speaker provided an overview of the resources and programs that state DOTs can take advantage of to implement their stormwater programs.


9:30 am – 9:45 am – Heather Goss – Overview of EPA current and future resources available to state DOT stormwater practitioners and EPAs future “future directions”.

Heather Goss: Stormwater Resources for DOTs



Stormwater Resources for DOTs

Heather Goss, EPA's National Transportation Liaison to FHWA
Stormwater Practitioners' Meeting
April 2022



EPA's Stormwater Permitting Program

GOAL: The program strives to reduce polluted stormwater discharges entering waterways. Clean water is essential to health, community vitality, and economic development.


COLLABORATION: EPA works with states, the regulated community, and other federal agencies, to invigorate smart stormwater management, the green infrastructure, with community investments.

SCOPE: Regulates stormwater discharges from three sources (approximate numbers of permits/MS4s):

- Municipal separate storm sewer systems (MS4s): 7,550
- Construction sites: 180,000 / year
- Industrial facilities: 50,000

National Menu of Best Management Practices (BMPs)

Recently updated factheets on representative practices that can successfully achieve the Stormwater Phase II rule's 6 minimum control measures.



Transportation Stormwater Related Webinars

EPA webinars available via archive including:


- [Introduction to the Clean Water Act \(CWA\) Part 123](#)
- [The Pathway to Smart and Complete Streets](#)
- [Update the State on Storm Pollution Control for State DOTs](#)
- [2021 Construction General Permit](#)

EPA's Central Use for Specifications Webinar (2021 general permit)

- Includes a segment on compact use specifications for roadside application

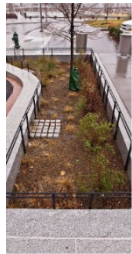
Spotlight 2022 Green Infrastructure Webinar series features an overview to green infrastructure:

- Successful residential approaches to green infrastructure
- Green infrastructure asset management
- Green infrastructure O&M and end-of-life development
- Financing Green Infrastructure O&M




Green Infrastructure Resources

- In 2015, Congress enacted the [Water Infrastructure Improvement Act](#) (referred to as the Clean Water Act) which defines green infrastructure as: "the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspire stormwater and reduce flows to sewer systems or to surface waters."
- EPA promotes green infrastructure with resources on:
 - [community partnerships, technical assistance, and collaborative financing](#)
 - [barriers to green infrastructure adoption](#), and
 - [funding opportunities](#).
- As of 2021, EPA established the [Green Infrastructure Policy Collaborative](#). Webinars have focused on accessing funding, incorporating environmental justice, and overcoming barriers.




Models & Tools

- [Stormwater/Green Infrastructure Modeling Kit](#)
 - **Stormwater Management Model (SWMM):** Planning, analysis, design related to SW runoff and other systems, can represent combinations of green infrastructure practices to determine effectiveness.
 - **National Stormwater Calculator (NSWC):** estimate annual amount of SW runoff from a specific location, to inform developers how well they can meet a desired SW retention target.
 - **Others:** WMOST, QGIS, VELLA, GINTM, CLASIC, I-DST.
- [Green Infrastructure research](#)



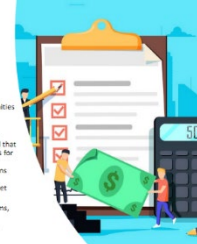
Clean Water Funding

- **Clean Water State Revolving Fund (CWSRF):** a federal-state partnership that provides communities low-cost financing for a wide range of water quality infrastructure projects, including projects related to roadway stormwater discharges. **Green infrastructure solutions** eligible for assistance include: infiltration basins, bioretention, green streets, and permeable pavement.
 - 2021 Bipartisan Infrastructure Legislation contains a \$18.5 billion in the CWSRF to address PFAS and Emerging Contaminants, including through stormwater discharges.
- EPA administers the **Clean Water Act Section 319 Nonpoint Source Program**, which addresses urban runoff from roads in non-MS4's permitted areas. State-issued Section 319 grants can be used to implement projects that address roadway-related runoff.




Navigating Stormwater Finance

- **Water Infrastructure and Resiliency Finance Center (WIRFC)** helps communities make informed decisions for water infrastructure investments.
 - **Water Finance Clearinghouse:** an easily navigable web-based portal that contains available funding sources for water infrastructure and other resources on financing mechanisms and approaches that can help communities access capital to meet their water infrastructure needs.
 - **Water finance webinars and forums,** e.g., [Stormwater Funding and Financing Webinar Series](#) (2021).



Integrated Planning

- EPA's **Integrated Stormwater and Wastewater Planning Framework** helps municipalities meet clean water goals while prioritizing infrastructure investments with the greatest water quality improvements and community benefits.
- This approach can also lead to more sustainable and comprehensive solutions, such as green infrastructure, that improve water quality and provide multiple benefits that enhance community vitality.



Integrated Planning Resources

- EPA is providing technical assistance to states and municipalities to develop components of their integrated plans, now until Sept. 2022.
 - To receive technical assistance contact: Evan Kirk emkirk@epa.gov
- Integrated Planning Workshop to help small-medium sized communities under \$10,000 get started with integrated planning April 20, 2022, 2-3:30pm ET
 - Register at <https://epa.zoom.us/j/95411489803>
- Other resources on EPA's approved planning website:
 - Report to Congress
 - Fact sheets
 - Plans already developed
 - Case Studies
 - Toolkits for states (coming soon - Summer 2022)

EPA's Municipal Ombudsman

- The EPA's **Municipal Ombudsman** is an independent, impartial, and confidential resource to assist municipalities in navigating EPA's Clean Water Act programs.
- To subscribe to the weekly "Clean Water Act Corner" list of federal clean water resources with a municipal focus:
 - send an email with the word "subscribe" in the subject line to municipalombudsman@epa.gov

Other Stormwater Resources

- National Municipal Stormwater Alliance (NMSA) web resources.
- EPA's Trash Free Waters program has provided technical and financial support for grants designed to prevent trash from entering waterways, including several initiatives that target roadways.
- EPA's ongoing source program also addresses pollutant and water quality issues related to low-income communities and minority neighborhoods.
- EPA jointly administers the CWA 312 Coastal Nonpoint Pollution Control Program with NOAA. This program addresses roads, highways and bridges and the program includes management measures that address runoff from these transportation corridors.
- 2022 release of EPA's Construction General Permit.

Example MS4 permit conditions

- MS4 permit compendia series for stormwater permit writers includes:
 - Transportation Stormwater Permit (MS4) Compendium
 - Truck Stormwater Permit Compendium

More Resources in Development

- Long-term Stormwater Planning resources including:
 - A guidebook on how to incorporate green infrastructure practices into roadway projects developed with Texas A&M.
 - A case study summary showcasing a green and complete street design Charlotte that was then leveraged by Burlington, VT to address its 2022 TCR grant application.
- Off-site Stormwater Management resources
- MS4 permit compendium on green infrastructure requirements
- Stormwater Guide

Looking ahead...

- Definition of "urbanized area"
 - Stormwater Phase II Rule automatically covers all nationwide basin MS4s located in "urbanized areas" as determined by the latest U.S. Decennial Census.
 - On March 24, 2022, the Census Bureau ceased designating different types of urban areas, including "urbanized areas".
 - More information will be posted on EPA's MS4 website when it becomes available.
- Per- and Polyfluoroalkyl Substances (PFAS) MS4 Strategic Roadmap, 2022-2024
 - EPA will seek to incentivize use existing NPDES authorities to reduce discharges of PFAS at the source and obtain more comprehensive information through monitoring.
 - EPA will issue new guidance on monitoring for PFAS at facilities where PFAS is expected or suspected to be present in wastewater and stormwater discharges.

QW @ EPA

Contact: Heather Goss, EPA's liaison to FHWA
EPA Office of Water
Goss.heather@epa.gov
202-566-1198

EPA Office of Water stormwater permitting team shared resources from EPA that are available.

Recent updates to the BMP menu – based on the six minimum control measures. The practices listed are helpful in supporting the minimum control measures. EPA has recorded transportation stormwater webinars on their website.

Green infrastructure program. Use the CWA definition. Filter and absorb stormwater where it falls on the LID surface. EPA promotes the use of GI.

Question: When will standards be promulgated?

Ans: States have the authority to adopt their own water quality criteria. In May, 2022, EPA proposed national recommended criteria under Clean Water Act 304(a) for PFOS and PFOA based on the latest science. Once those recommendations are finalized, states will need to consider them in the next triennial review of their state water quality standards. Per 40 CFR 131.20, if a state chooses not to adopt new or revised criteria for any parameters for which EPA has published new or updated criteria recommendations under CWA section 304(a), they must explain their decision when reporting the results of their triennial review to EPA under CWA section 303(c)(1) and 40 CFR 131.20(c). Once the EPA recommendations are finalized, states will be considering them at the time of triennial review, and potentially adopting them. This is likely to occur in the range of the next 3-5 years in many states - however specific timelines for state triennial reviews vary among states

Question: What BMPs work for construction PFAS requirements?

Ans: Not aware at this time

9:45 am – 10:00 am – Susan Jones: *FHWA's stormwater support and involvement, regulation language and specific sections in the latest infrastructure bill.*

Susan Jones: FHWA Stormwater Support and Involvement



- FHWA
- Office of Environment, Realty and Planning
 - Office of Project Development and Environmental Review
 - Mitigation Team
 - Susan Jones



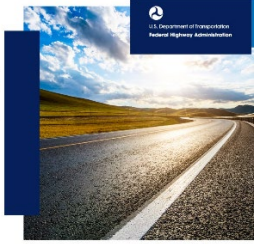
History

- 2008 San Diego
- 2010 Denver
- 2012 Raleigh
- 2014 DC
- 2022 Raleigh



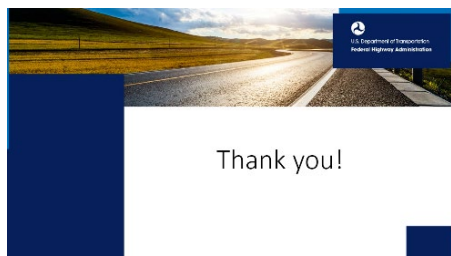
Show Me the Regs!

- **22 USC §328 Environmental Restoration and Pollution**
 - When would a **study** project be considered or identified as necessary?
 - What are the planning and environmental review analyses in what context?
 - What activities are included in environmental restoration?
 - Can derivatives of analysis and professional services be accepted to reduce the cost of environmental restoration and pollution avoidance activities?



The Infrastructure Investment and Jobs Act (IIJA)/Bipartisan Infrastructure Law (BIL)

- **Sec. 11520. Study on Stormwater Best Management Practices**
 - Study to:
 - (1) estimate pollutant loads from stormwater runoff;
 - (2) provide recommendations on SWM and TMDL compliance strategies;
 - (3) examine potential for OST to assess State DOTs in carrying out and communicating SWM practices
 - Study to:
 - "Approaches for Determining and Complying with TMDL Requirements Related to Roadway Stormwater Runoff"
- **Sec. 11521. Stormwater Best Management Practices Reports**
 - "Determining the State of the Practice in Data Collection and Performance Measurement of Stormwater Best Management Practices"
 - "Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring"



10:00 am – 10:15 am – Facilitated Q & A session

Question for Heather on 401s and State Authority – On June 1, 2022, the EPA Administrator signed a proposed rule to improve the CWA section 401 certification process. The proposed rule would replace and update the existing regulations at 40 CFR 121, to be more consistent with the statutory text of the 1972 CWA and clarify elements of section 401 certification practice that has evolved over the 50 years since the 1971 regulation was promulgated. On June 9, 2022, the proposed rule was published in the *Federal Register*. The public comment period is open until August 8, 2022. More information on the proposed rule is available [here](#).

Question on using Federal aid money for BMP maintenance: Generally, you cannot use federal funds for maintenance, must be tied to the roadway/pavement. Inspections are not allowable under Federal Aid. Bridge inspections are ok, stormwater not an identified use of federal funds. Maintenance activities are owner/operator- state funded.

Question for Heather Goss – What is the current status of 401 issuances. Ans: On April 6, 2022, the U.S. Supreme Court issued a stay of the October 2021 order by the U.S. District Court for the Northern District of California that vacated EPA's 2020 Clean Water Act Section 401 Certification Rule. The stay of the vacatur applies nationwide. Therefore, the CWA section 401 certification process is once again governed by the CWA section 401 certification regulations promulgated by EPA in 2020,

codified at [40 CFR 121](#). For more information, see <https://www.epa.gov/cwa-401/2020-clean-water-act-section-401-certification-rule-0>.

Question for Susan Jones – Federal requirement is that each site is its own project. Paperwork is required for each site. This buries the DOT in paperwork. DOTs would like to federal funds to apply on a program rather than site basis. Ans: Susan will ask her asset management group at FHWA about this issue.

Question for Susan: States complete 4R projects, and FHWA does participate in those. These projects include stormwater BMPs. NH treats the stormwater facilities the same as any other DOT infrastructure. This is one way to use federal funds for BMP upgrades. Maintenance is not federal funds eligible. Ans: This is an interesting approach.

Question: What impact does the current census and elimination of ‘urbanized areas’ have on the stormwater program that relies on these definitions.

Ans: EPA has been following these developments closely and is assessing any potential impacts to the small MS4 program. The agency is evaluating appropriate next steps to provide clarity for our regulated Phase II MS4s, including whether revisions to the Phase II regulations may be needed. More information will be posted on EPA’s website when it becomes available:
www.epa.gov/npdes/stormwater-discharges-municipal-sources

Question: What about climate change and resiliency.

Ans: FHWA is relying on scientific information. It is a tough decision. And there is no clear guidance at this time

Ans:. EPA resources available include: [Climate and Extreme Weather Tools for the NPDES Program](#) and [Climate Change and Water Tools](#)

10:15 am – 10:45 am – Break

Session 2 – Total Maximum Daily Loads and Impaired Waters Program

TMDLs are a reality for most DOT stormwater programs. In most states, the number of TMDLs that a DOT must implement are increasing yearly. There is no additional funding stream for DOTs to implement TMDL programs. These challenges are prompting DOTs to identify innovative solutions.

Panel members:

- Nick Tiedeken, Minnesota DOT, Moderator
- Laura Larsen, Michael Baker International
- Henry Barbaro, Massachusetts DOT
- Jean Cordova, Colorado DOT

TMDL implementation and how TMDL requirements can be implemented synergistically with the DOT stormwater program to reduce implementation costs while remaining in compliance. Case studies were presented from DOTs across the country.

10:45 am – 10:50 am – Nick Tiedeken – Welcome and introduction/overview.

10:50 am – 11:05 am – Laura Larsen – California utilizing “Compliance Units” for TMDLs.

Laura Larsen: Caltrans Statewide TMDLs



Caltrans Statewide TMDLs
Cooperative Implementation Agreements
2022 National Practitioners Forum
April 11, 2022
Laura Larsen, PE
Michael Baker International



Caltrans NPDES Permit requires compliance with 84 TMDLs

- Permit Effective July 1, 2013
- Caltrans Permit Reopened
- Adopted on May 20, 2014
- Caltrans – 12 Districts
- EPA Delegated Authority:
 - CA State Water Board
 - 9 Regional Water Boards



Caltrans TMDL Area covers 28% of the State

Currently named in 84 TMDLs

- Over 4000 centerline miles of Caltrans highway
- 28% of State Highway
- 56,000 acres estimate total TMDL right-of-way
- 2/3 of the state drains to impaired water bodies, many do not currently have a TMDL
- TMDLs are likely to increase as we move forward
- Generally, Caltrans is less than 2% of the watershed

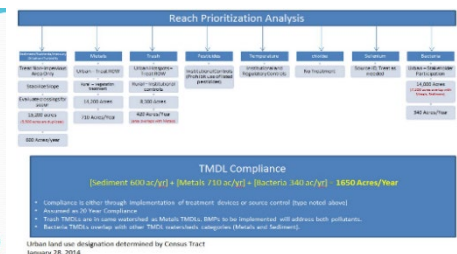
Past vs. Present TMDL Requirements
(Result of collaboration: a new way of doing business)

1999 Permit	2012 Permit
<ul style="list-style-type: none"> • Prescriptive Individual Requirements (84 ways of doing business) • Basin Plan/Watershed-specific • CT Waste Load Allocations • Time lines revised (90 to 30+ TMD) • Three-pronged approach <ul style="list-style-type: none"> • Retrofits (SHOPP & Capital Projects) • Institutional Controls • Public Education (DTC) • Unsustainable <ul style="list-style-type: none"> • Everything, everywhere • Prioritized High/Med/Low 	<ul style="list-style-type: none"> • Model Practices by Pollutant • Consistent Statewide Approach • 30-year timeline • Objective Compliance Measure • Acres treated • Credit starts at programming • Greatest WQ Benefit per Dollar Spent • Flexibility in Implementation • Credit for Some Region-Specific Retrofits

Past vs. Present TMDL Requirements
(Result of collaboration: a new way of doing business)

1999 Permit	2012 Permit
<ul style="list-style-type: none"> • Prescriptive Individual Requirements (84 ways of doing business) • Basin Plan/Watershed specific • CT Waste Load Allocations • Time lines revised (90 to 30+ TMD) • Subjective approach • Retrofits (SHOPP & Capital Projects) • Institutional Controls • Public Education (DTC) • Unsustainable (Everything, Everywhere) • Prioritized High/Med/Low 	<ul style="list-style-type: none"> • Model Practices by Pollutant • Consistent Statewide Approach • 30-year timeline • Objective Compliance Measure • Compliance Unit - Acre treated • Credit starts at programming • Greatest WQ Benefit per \$ • Clean Performance Measures • Flexibility in Implementation <ul style="list-style-type: none"> • \$88,000/acre • Additional Post-Implementation • Cooperative Implementation • Other

Reach Prioritization Analysis



TMDL Compliance
 $(\text{Budgeted } 400 \text{ ac/yr}) + (\text{Metric } 710 \text{ ac/yr}) = (\text{Bacteria } 460 \text{ ac/yr}) = 1650 \text{ Acres/Year}$

Compliance is either through implementation of treatment devices or source control (Bios noted above).

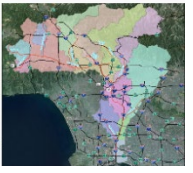
Each TMDL will be called out as a Model TMDL, BMP, to be implemented will address both pollutants.

Based on TMDLs currently with total TMDL requirements categories (Bios and Sediment).

Caltrans land use designations determined by Census Tract January 28, 2014

Permit Allowed for TMDL Prioritization based on Relative Reach Water Quality Impairments

- Reach Prioritization for Each
- Of Eight Pollutant Category
- Identify Reaches (In Most Watersheds)
- Prioritize Reach Criteria
- TMDL deadlines
- Impairment Status
- CT percent of Drainage Area
- Proximity to Receiving Water
- Community Environmental Health Impact



TMDL Reach Prioritization Focused Caltrans Efforts for Implementation

- Reach Prioritization for Pollutant Categories
- Identify and Prioritize Reaches
- Initial efforts will focus on LA Region and Tahoe
- Implementation
 - Submit TMDL Status Report yearly
 - 1650 compliance units (acres) per year

Rating Factor	Criteria		
	High	Medium	Low
Impairment Status (Percent Exceed)	Over 75%	20% - 75%	Less than 20%
Proximity to Receiving Water	Less than 1/4 mile	Between 1/4 and 1/2 mile	1/2 mile or more
Community Environmental Health Impact	Over 75% compliance and 70% connected to the reach	Between 25% and 70% compliance and 70% connected to the reach	Less than 25% compliance and 70% connected to the reach
Community Environmental Health Impact	Top 3 categories	10th to 4th categories	Lower 3 categories

The Permit has incorporated an incentive for Cooperative Implementation Activities

- Collaboration with MS4s
- Implementation activities
- \$88,000 = 1 compliance unit (acre)
- Examples
 - Bay Area (Trash and Iig)
 - LA Watershed Programs (FWMP or WMP)
 - San Diego Watershed Program (WQIPs)
- Programmatic Agreements
 - SWRCB Grant
 - Third-Party Brokers



Managing, Coordinating and Tracking These Compliance Unit Credits From Inception to Operation is a Substantial Undertaking

- Coordination
 - State and Regional Boards
 - Caltrans Districts and Functions
 - Local Municipal NPDES Agencies (Cities and Counties)
 - Other Stakeholders
 - Watershed Manager
- Compliance Credit and Tracking of 1650 Units/Yr
 - Project Delivery – Post Construction BMPs (above and beyond)
 - SHOPP – 335 Stormwater (Stand alone retrofit projects)
 - Cooperative Implementation – Cooperative Agreements, MOUs, etc.

Cooperative Collaboration has Lead to Many Successful Implementation Projects



Caltrans funded \$15,000,000
CUs = 170
Caltrans ROW area treated 51 acres
Local Tributary watershed 2,383 acres

Where Does Caltrans Go From Here?

- Currently negotiating new permit
- Adoption expected June 2022
- Removal of Compliance units
- Change from CU back to WLAs
- Uncertainty in future cooperative projects
 - Crediting
 - Funding

Questions or Comments?

11:05 am– 11:20 am – Henry Barbaro – SCM implementation and tracking using the Massachusetts DOT Water Quality Data Form.

Henry Barbaro: Enhanced Stormwater Management using the Water Quality Data Form




Enhanced Stormwater Management using the Water Quality Data Form

Henry Barbaro
Massachusetts Department of Transportation
April 12, 2022

Introduction to Impaired Waters Program

- Over 650 impaired waters across the state
- Over 3,500 roadway miles in the Urbanized Area (regulated)
- Over 2,000 MassDOT outfalls




MassDOT Water Quality Data Form (WQDF)

The Problem:
Missed opportunities to incorporate stormwater treatment into programmed projects

The WQDF solves this!

1. Prompts designers with WQ requirements
2. Collects data for WQ tracking




WQDF as a Tool for Implementing Design Guidance

- Gives designers project-specific requirements in line with DOT's watershed-scale needs
- Companion tool to MassDOT Stormwater Design Guide

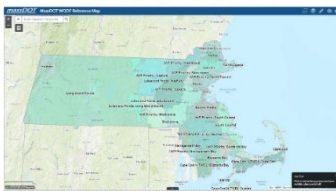


WQDF for Data Collection

- Data used for:
 - Compliance
 - Planning
 - Tracking
 - Reporting

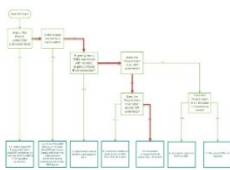


WQDF Companion Web Map




Generating Project Requirements

Project Watershed: Boston Harbor
Within Urban Area: Yes
Owned by a Municipality: No
Does Project Result in an Increase in Impervious cover: No



Designer Certification

- Asks **two key questions**:
 - Does the design meet the WQ requirements?
 - If no, explain why.
- Also ensures designer has completed all required fields/tabs in the form



Benefits of the WQDF

- Simple form allows for communication back/forth with designers
- Flexible to adapt to changing WQ priorities
- Helps incorporate stormwater management into programmed projects
- Facilitates water quality credit calculation for projects and watersheds



Questions?

Contact Information:
• Henry Barbaro, MassDOT - henry.barbaro@state.ma.us

Related Links

Water Quality Data Form:
<https://www.mass.gov/lists/forms-documents-massdot-environmental-services#stormwater-management>

Reference Map:
<https://massdot.maps.arcgis.com/apps/webappviewer/index.html?id=46b8552a03e474d9b9fa4724d77002>

11:20 am – 11:35 am – Jean Cordova – Permanent water program and the use of the mitigation pool fund in Colorado.

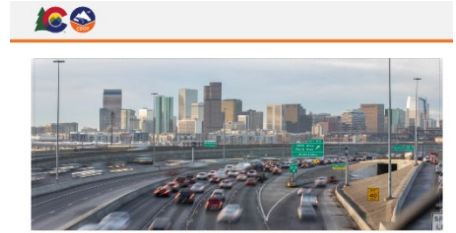
Jean Cordova: Meeting MS4 permit compliance: A new way



Meeting MS4 permit compliance:
A new way



Program Goals and Benefits



PWQ Program Requirements

PWQ Mitigation Pool Fund

1. Watershed-based approach
2. Work with local agencies
3. CDOT contributes \$6.5 million each FY
4. Funds expended = compliance
5. Used only for PWQ installation
6. Can not be used to fund the cost of maintenance
7. Treatment occurs prior to entering a State Water
8. Administered by a committee
Must meet the permit design standards



How can we make it better?

New Ideas Ahead!!

1. Meet the intent of the Clean Water Act and associated state regulations
2. Improve water quality on a watershed basis
3. Ensure safe and efficient maintenance
4. Encourage collaboration
5. Provide procedural clarity and consistency
6. Increase cost effectiveness
7. Reduce CDOT's administrative burden



PWQ Program Requirements

Sometimes need to install PWQ CMs on-site

1. Treats runoff from CDOT roadway or ROW
2. In MS4 area
3. Disturbs 1 or more acres
---AND---
1. Project is an EA/EIS
--OR--
1. Increases impervious area by 20%
2. Drains to the CC Watershed, or a 303(d) (impaired) stream
Must meet the permit design standards



Lessons Learned

1. Get the word out
2. Creates opportunities
3. Tracking expenditures
4. Effort required
5. Training



Key Takeaways

You will not know everything up front
Get stakeholders involved early and often
PWQ is still new and we are still learning!!



Acknowledgements

- Jane Hann
Environmental Programs Branch Manager
- Rachel Hansgen
MS4 PWQ Program and Mitigation Pool Fund Manager



THANK YOU!

Jean Cordova, CPMSM
Water Quality Section Manager
Jean.cordova@state.co.us
Colorado Department of Transportation



11:35 am – 12:00 pm – Facilitated Q & A session

Question: Henry, you mentioned MEP for TMDL compliance, how does this work with a WLA?

Ans: The use of MEP is only for when there is an impaired water body, not a TMDL with a WLA.

Question: Do your DOTs monitor to show compliance with Waste Load Allocations? The monitoring costs must be substantial and take away from BMP construction? Was this considered?

Ans (Larsen): This point was made during permit negotiations, and the State has various options for how to show compliance with the WLA.

Question: Is there any risk on your permit if the recipient does not live up to the constructing AND

maintaining the BMP?

Jean: For CDOT, yes, which is why the intergovernmental agreement (IGA) is important. CDOT tracks the maintenance and will do the maintenance and charge the local entity if the maintenance is not done. They are ultimately responsible.

Laura: In the California scenario, the municipality that built the BMP is responsible and will have action taken against them by the regulator if they fail to operate or maintain it correctly.

Day 2 Lunch Presentation

The International BMP Database serves as an excellent reference for stormwater practitioners, including DOTs. It was recently enhanced during under NCHRP projects to include filters that allow only DOT related records to be accessed and analyzed as well as added additional DOT requested parameters and information including new DOT BMP Monitoring Study sites.

Speaker:

- Eric Strecker, Terraphase Engineering, Inc

The topic of the presentation was an overview of the International BMP Database, the new Transportation Portal, and how it can be used specifically to access and analyzed DOT related monitoring and performance information. It also summarized a national summary of DOT BMP performance that was conducted and reported on.

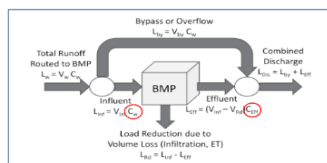
Eric Strecker: The International BMP Database and the DOT Portal

What is the Urban Stormwater BMP Database?

- A large collection of BMP performance studies containing metadata on site conditions and design parameters and real stormwater monitoring results (water quality, precip., flow)
- Researchers, MSAs and others voluntarily submit data to a clearinghouse for screening and upload to the master database
- Process: Enter data in standardized Excel spreadsheets, submit to Clearinghouse, upload to Access (downloadable database), web tools in SQL
- Data and project findings are publically available through www.bmpdatabase.org

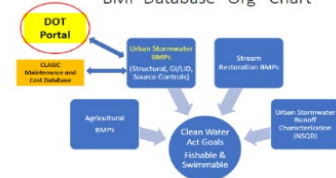
- Much more than % Removal
- Test Site/Location
- Watershed/Land Use
- BMP Design & Maintenance
- Monitoring Methods
- Event-Based Data: Precip, Flow, WQ for inflow/outflow
- Costs
- Consistent statistical approaches for data analysis

Conceptual BMP Performance Model



For BMP Database, we mostly evaluate influent and effluent concentrations, but there is much more to BMP performance

BMP Database "Org" Chart



Growth of BMP Database



~700 BMP performance studies with metadata

Urban BMP Database Summary

• Most recent Update: 2020

• Hundreds of Green Infrastructure practices

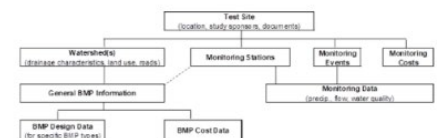
• Over 120 manufactured devices

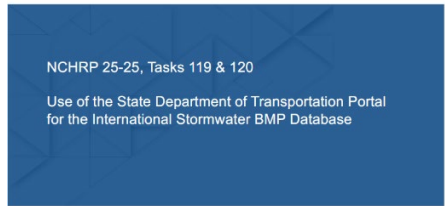
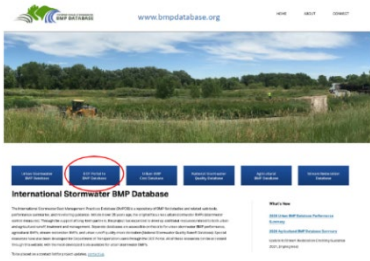
• Transportation-related studies are a key focus area

BMP Types in 2020 Release	Total
Subcatchment	14
Cross Slope	15
Grass Swale	17
Grassed Swale	17
Media Filter	17
Retention Pond	17
Retention Basin	17
Retention Channel	17
Retention Basin	17
Retention Trench/Wall	17
Manufactured Treatment Device	17
Low Impact Development	17
Permeable Pavement	17
Permeable Paving Course	17
Green Roof	17
Retention Management	17
Low Impact Development	17
Stormwater Capture/Storage	17
Maintenance Practice	17
Other	17
Control Sites	17
Total	700

Manufactured Device Sub-type	Total
Detention	31
High Rate Media Filtration	31
High Rate Retention	31
Oil/Grease Separator and Buffer	31
Manufactured Inflow	31
Control/Retention	31
Multi-Barrier Treatment	31
Trap	31
Characterization System	31
Other	31
Legal	31
Total	123

Relational Structure of Urban BMP Database



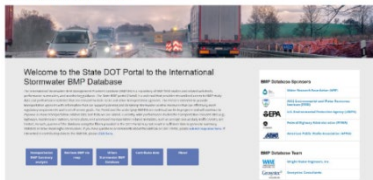


NCHRP: National Cooperative Highway Research Program

NCHRP 25-25 Tasks 119 and 120

- Task 119- Enhancing the International Stormwater BMP Database to Serve as a Highway Specific BMP Database
 - Built State DOT Portal - a web tool that provides streamlined access to BMPDB study data and performance statistics that are relevant to state DOTs and other transportation agencies.
- Task 120- Use of the State Department of Transportation Portal to the International Stormwater BMP Database
 - Used the enhanced Portal for an original analysis of BMP effectiveness for water quality analyses of interest to state DOTs.
 - Also included initial outreach to increase awareness of the BMPDB and the Portal.

DOT Portal to the BMP Database



Using the Analysis Tool – Simple Data Query

- Available Query Fields
 - Parameter Group (required)
 - Parameter (required)
 - BMP Category (type)
 - Site Type (DOT-related land use activity)
 - EPA Rain Zones
 - AADT Ranges (currently disabled)
- After above field selections made
 - Select Submit button to get statistics
 - Download All Data
 - Download Paired Data Only (influent/effluent data pairs only)



Using the Analysis Tool – Generating Statistics

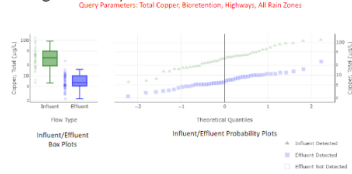
Query Parameters: 'All States, Copper, Highways, All Rain Zones'

Statistic	Value	Units	Location
Number of Sites	2	452	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention
Number of Parameters	2	228	Detention

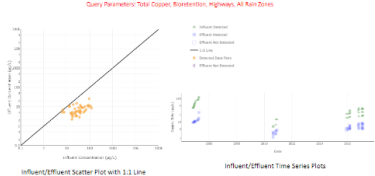
Hypothesis Testing

Statistical Test	Obs. Null Hypothesis	p-value	DOT Between All DOTs
Mean Difference	The means of the inflow and outflow CUPs are equal	0.0000	DOT=1
Median	The median of the inflow and outflow CUPs are equal	0.0000	DOT=1
1-Tail (Greater) Significance Test	The mean of the inflow and outflow CUPs are equal	0.0000	DOT=1
1-Tail (Greater) Significance Test	The mean of the inflow and outflow CUPs are equal	0.0000	DOT=1

Using the Analysis Tool – Interactive Plots



Using the Analysis Tool – Interactive Plots (cont.)

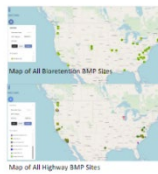


Using the Map – Basic Features and Navigation



Using the Map – Data Filtering

1. Select Show Filters
2. Apply Desired Filters
 - Parameter Group
 - Parameter
 - BMP Category
 - Site Type
3. Select Submit to update Map
 - Wait a few seconds for query to complete
 - Message box will indicate number of BMP sites that were successfully retrieved
4. Zoom/pan to a geographic region of the map



Using the Map – Selecting / Exploring a Site (cont.)



Data Analysis Report

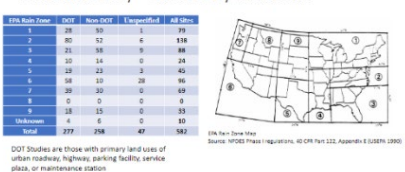
- Provides an inventory of BMP studies in the BMPDB focused on DOT-related studies
- Includes a statistical summary of influent and effluent data by BMP category
- Identifies data gaps and needs for expanding the BMPDB and conducting future analyses



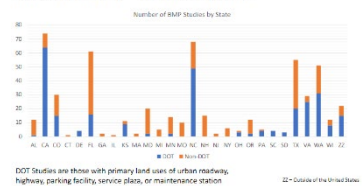
Constituents and BMPs Analyzed

Constituent	BMP Category	Code
Soil	Total suspended solids (TSS)	04
Metals	Total dissolved solids (TDS)	05
	Total copper (CUP)	06
	Ammonia total and dissolved	07
	Cadmium (total and dissolved)	08
	Copper (total and dissolved)	09
	Copper (total and dissolved)	10
	Lead (total and dissolved)	11
	Nickel (total and dissolved)	12
	Zinc (total and dissolved)	13
Organics	Total phosphorus	14
	Phosphorus	15
	Total nitrogen	16
	Total Kjeldahl nitrogen (TKN)	17
	Nitrate (NO3)	18
	Nitrite and Nitrate plus nitrite (NO2+NO3)	19

Data Inventory – Studies by Rain Zone



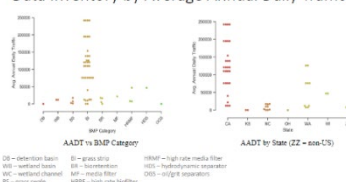
Data Inventory – Studies by State



Inventory by BMP Category and DOT Site Type

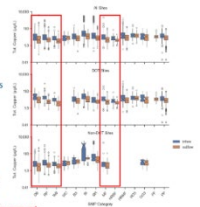
BMP Category	DOT Site Type	Urban	Highway	Parking	Service	Maintenance	Other	All Sites	All DOT
Detention Basin (DB)	1	6	7	0	0	2	2	17	30
Retention Basin (RB)	6	1	2	0	1	4	11	47	47
Media Basin (MB)	2	1	0	0	1	3	15	46	46
Retention Basin (RB)	2	2	0	0	0	1	17	23	23
Detention Basin (DB)	2	24	7	0	1	13	50	107	107
Retention Basin (RB)	0	42	2	0	2	1	47	46	46
Retention Basin (RB)	7	7	31	1	2	10	25	83	83
Retention Basin (RB)	2	6	7	1	4	8	22	30	30
High Rate Media Filtration (HRMF)	1	1	3	0	0	0	1	4	4
High Rate Media Filtration (HRMF)	4	4	7	1	1	1	0	6	23
Hydraulic Separation (HS)	1	0	4	0	2	1	1	10	10
Hydraulic Separation (HS)	2	1	3	0	3	1	9	19	19
Retention Basin (RB)	0	8	0	0	0	0	0	8	8
Retention Basin (RB)	4	2	13	0	0	1	6	26	26
Retention Basin (RB)	17	113	107	3	17	47	298	542	542

Data Inventory by Average Annual Daily Traffic



Data Analysis – Copper

- Influent concentrations at DOT sites are often higher than non-DOT sites, but there are some high values for grass strips and bioretention for non-DOT sites*
- Many BMP types show statistically significant reductions for both total and dissolved copper
- Detention basins, retention ponds, wetland basins, media filters, and high rate bioretention are top performers with median effluent < 5 µg/L



Data Gaps and Needs

- Additional DOT-related BMP studies!
 - Only 13 state DOTs are currently represented in the BMPDB
 - Only 4 have more than 10 studies
 - Study sites especially needed in the Midwest, Southwest, Northern Plains, and Rocky Mountain states
- AAOT and other relevant metadata
 - Of the 150 highway and urban roadway sites, only 47 (31%) have reported AAOT data (might be able to be back-filled with additional effort in the future)
 - Watershed and other land use information is lacking in many studies
- Sparse data sets for:
 - Fecal indicator bacteria
 - Heavy metals other than copper, lead, and zinc
 - Organic pollutants, such as TPH, PAHs, PCBs, phthalates, and dioxins
- Additional media filter and biofiltration studies with more engineered media mixes (e.g., peat, biochars, oxide-coated sands, etc.)
- Additional porous pavement and permeable friction course studies

Acknowledgments

Study was conducted for:
 The ASHRAE Committee on Environment and Sustainability with funding provided through the National Cooperative Highway Research Program (NCHRP) Project 25-25, Task 130. Use of the State Department of Transportation Portal to the International Stormwater BMP Database
<https://apps.fhwa.dot.gov/transportation/bmpdb/>

Project was managed by:
 Ann Hanel, Senior Program Officer, NCHRP

Work was guided by a technical work group:
 Wilson Fletcher, Ohio, Oregon DOT (retired)
 Fred Noble, Florida DOT
 Greg Grenier, U.S. Geological Survey
 Melissa Schaefer, Missouri DOT
 Brandon Stone, Washington State DOT
 Scott Crafton, Virginia DOT
 Scott McDowen, Michael Baker International

Agency liaisons include:
 Susan Jones, Federal Highway Administration
 Melissa Savage, American Association of State Highway and Transportation Officials

6PPD-quinone Influent/Effluent Performance?

T18 Research Needs Statement in progress

- Emerging Stormwater Pollutants:
- PCBs (limited)
 - PAHs (limited)
 - Dioxin (almost none)
 - PFAS (none)

A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon

None in BMP Database

U.S. Pacific Northwest National Laboratory researchers recently discovered that 6PPD-quinone, a chemical used in tires, causes acute mortality in coho salmon. The study, published in *Environmental Science & Technology*, is the first to show that 6PPD-quinone is a potent acute toxin to salmonids. The researchers found that 6PPD-quinone is highly toxic to coho salmon, with a 50% lethal dose (LD50) of approximately 0.1 mg/kg body weight. This is significantly higher than the concentrations of 6PPD-quinone found in stormwater runoff from urban areas. The researchers also found that 6PPD-quinone is highly persistent in the environment, with a half-life of approximately 100 days. This suggests that 6PPD-quinone could be a significant threat to aquatic life in urban watersheds. The researchers are currently working to identify the mechanism of toxicity and to develop strategies to reduce 6PPD-quinone concentrations in stormwater runoff.

- Future:
- Toxicity Influent/Effluent
 - DOC in future evaluations
 - Other Biotic Ligand Model parameters

Summary and Conclusions

- The DOT Portal to the BMP Database provides streamlined, online access to stormwater BMP monitoring data and performance statistics
- The Portal can be used to assist DOTs with:
 - BMP selection and implementation planning
 - Regulatory discussions/negotiations
 - Comparisons to site monitoring data and permit benchmarks/limits
 - Development of stormwater management guidance and decision support tools
 - And much more...
- As data gaps are filled and new featured added, additional utility for the BMPDB and Portal will be realized
- The continued support of the BMPDB project will help ensure the Portal is maintained and available as a resource to transportation agencies

Additional Useful Reports/Guidance



Current Status of the International BMP Database

- The BMP Database has been unfunded for over 2 years
- Current needs:
 - Continued maintenance of the database (general)
 - Continued addition of studies submitted to the database
 - QA/QC, uploading to make available, etc.
 - Specific software updates to improve/fix web access and updates to the search/analysis/mapping tools
 - Periodic update of the Transportation BMP Performance Summary due to added studies and data
 - Improve data extraction tools by adding more filters on metadata (e.g., watershed characteristics, design parameters, etc.) and influent quality
 - Improve statistical data analysis tools/output, such as influent/effluent regressions, SELDM model inputs, and other statistics (e.g., percentiles, gmeans, trimmed means, etc.)

Models/Tools by Federal Agencies Utilizing BMP Database Data

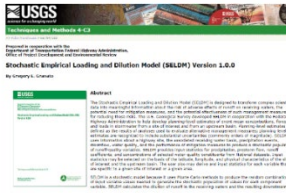


Table 3-3. Influent/Effluent Summary Statistics for Total Phosphorus as P (mg/L)

Water Category	Study & Sample Count (n, N)	Stochastic Mean (mg/L)	Stochastic SD (mg/L)	Median (mg/L)	95th Percentile (mg/L)	99th Percentile (mg/L)	99.9th Percentile (mg/L)
Urban	41 (34)	0.118	0.010	0.100	0.130	0.150	0.170
Suburban	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
Rural	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
Green Space	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
Green Strip	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
Health Facility	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
Industrial	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
MSW	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
Other	15 (12)	0.118	0.010	0.100	0.130	0.150	0.170
Mean	150	0.118	0.010	0.100	0.130	0.150	0.170
Median	150	0.118	0.010	0.100	0.130	0.150	0.170
95th Percentile	150	0.118	0.010	0.100	0.130	0.150	0.170
99th Percentile	150	0.118	0.010	0.100	0.130	0.150	0.170
99.9th Percentile	150	0.118	0.010	0.100	0.130	0.150	0.170

Example Uses and Applications of the BMP Database

EWRI Urban Water Resources Research Council (UWRR) 2016 Survey Results

Observed Uses of BMP Database	Frequency	Percentage
Stormwater Guidance Manuals	10	44.4%
Stormwater Modeling	8	35.6%
Expected EMCs for performance	7	31.1%
Benchmarking/comparing BMP performance	6	26.7%
Supporting Others' research (conference presentations)	5	22.2%
TMDL Development and Implementation	4	17.8%
Regulation Development	3	13.3%

Most Frequently Used BMP Database Products

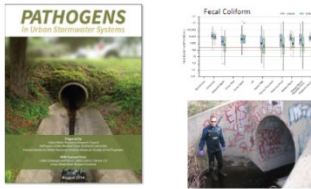
Answer Choices	Responses
Summary Reports for BMP Categories/Pollutants	44.4%
On-line Search Tool for Individual BMP Performance	36.3%
On-line Custom Statistical Analysis Tool (Beta Version, currently under revision)	16.7%
Google Earth Map of Individual Studies	12.8%
Access Database for Independent Analysis	7.9%
Stormwater Monitoring Guidance Manual	7.1%
Name of the Above	7.1%
Other (please specify)	1.3%
Total Responses: 149	

Urban Drainage and Flood Control District Denver, CO

- Used in **Criteria Manual** to guide BMP selection and performance expectations for various pollutants.
- Used in **BMP-REALCOST** model to estimate performance and lifecycle costs. (used both BMPDB & NSQD)
- UDFCD Supporting **Stream Restoration Database**
- UDFCD Submits annual monitoring data to the database—long-term performance



EWRI-ASCE Pathogens in Stormwater Report



NCHRP Report 792

- Developed guidance and decision support tools for state DOTs
- BMPDB and NSQD data used to predict pollutant load removals
- Tools can be used estimate performance and life-cycle costs of stormwater BMPs for highway runoff (and other land uses)
- <http://apps.fhwa.dot.gov/transportation/bmpdb/ProjectDisplay.asp?ProjectID=3192>



WERF BMP Performance Algorithms

- Developed algorithms to support larger project/food development on receiving water protection
- BMPDB was analyzed to develop parameters for the algorithms
- <https://www.werf.org/ak/Search/ResearchPortal.aspx?ReportID=SWC1R06bmp>



Used in MANY Theses and Dissertations!

- Colorado State University
- Colorado School of Mines
- U. of Alabama
- Villanova University
- North Carolina State U.
- Pennsylvania State
- U. of Texas-Austin
- U. of California-Los Angeles
- Massachusetts-Amherst
- Portland State University
- ...Many others



Stream Restoration Database and Crediting Guidance

- WERF-U5R14: Stream Restoration BMP Database Module
- WERF-IT13 Stream Restoration as a BMP (Crediting)
 1. Stabilization/Erosion Protection
 2. Riparian Buffers
 3. Floodplain Reconnection
 4. Instream Enhancement



Questions?

- Marc Lossingier, Geosyntec Consultants, Inc. (mlossingier@geosyntec.com)
- Eric Strecker, TerraPhase Engineering, Inc. (eric.strecker@terraphase.com)
- Steve Clary, Wright Water Engineers, Inc. (clary@wrightwater.com)



Project Team:
 Jane Clary and Jonathan Jones, P.E., Wright Water Engineers
 Marc Lossingier, P.E., and Dan Franklin, P.E., Geosyntec Consultants
 Eric Strecker, P.E., TerraPhase Engineering
 Harry Zhang, Ph.D., P.E., and Jeff Mosler, P.E., Water Research Foundation

BMP Database Awards:

- ASCE-2003 "State-of-the-Art in Civil Engineering" Award
- CASQA "Outstanding Stormwater Research" award, 2018
- ASCE/EWRI 2022 "Urban Water Resources Research Council Founders Award" to the original Principal Investigators (June)



Enhancing the International Stormwater BMP Database to Serve as a Highway Specific BMP Database.

12:45 pm – 1:00 pm – Facilitated Q & A session

Question: Will the Database include real time BMPs – BMPs that use remote sensing and real time technology?

Ans: Yes, there is a category for that.

Session 3 – Collaborative Agreements with Local MS4s/Joint Treatment Facilities/ Off Site Treatment

Tuesday, April 12, 2022

Right-of-way is limited for DOTs for the construction, operation and maintenance of treatment BMPs. In addition, outfalls are small and spatially varied, making maintenance of treatment BMPs expensive and hazardous. Local agreements with adjacent MS4 programs can move treatment responsibilities off-site, where economies of scale can be realized in the design, operation and maintenance of stormwater systems.

Panel members:

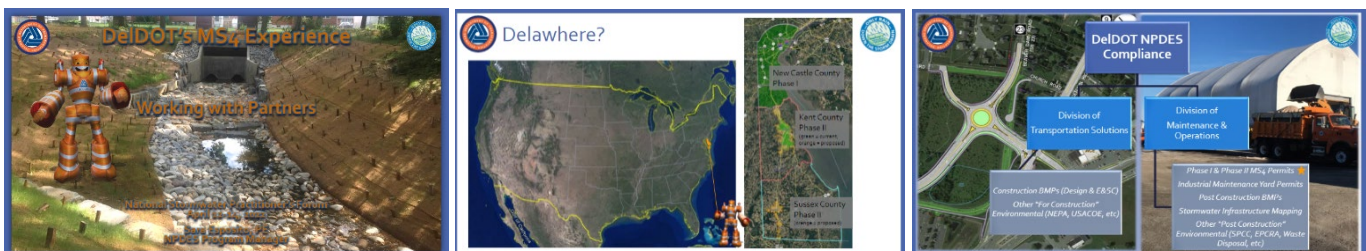
- Alissa Salmore, Idaho Transportation Department, Moderator
- Sara Esposito, Delaware DOT
- Eileen Dunn, Arizona DOT

The topic of the panel session was case studies of cooperative agreements between DOTs and MS4 programs in various states. The case studies analyzed the costs and benefits of cooperative implementation programs for meeting MS4 Permit requirements, including agreement types, potential partners, cost/billing mechanisms, maintenance plans, and ownership/operation for post-construction BMPs.

1:00 pm – 1:05 pm – Alissa Salmore – Welcome and introduction/overview of panel.

1:05 pm – 1:20 pm – Sara Esposito – Case study from Delaware.

Sara Esposito: DeIDOT's MS4 Experience



Phase I Permit

- Individual Permit
- All of New Castle County (NCC), excluding:
 - Newark & Middletown (Ph II)
 - Wilmington (separate Ph II)
- Co-permits:
 - DeIDOT/NCC listed as principal permittees (pop. 560,000+)
 - 5 municipalities listed as co-permittees (pop. 1,200 - 6,500)

Phase I Permit

Best Management Practice (BMP-1)	New Castle	DeIDOT	NCC	Wilmington	Other Municipalities
Hold annual meeting and prepare meeting notes	X	X	X	X	X

Minimum: 10x10 ft.
Principal Permittees: Local, Onstream annual meeting, prepare meeting notes, and include Permit in Annual Report.
Co-permittees: Local, Annual annual meeting and prepare meeting notes.

Phase II Permit (Current)

- General Permit
- Urbanized areas of Kent County, Delaware (pop. 75,000+)
- Other Phase II's include:
 - Newark (pop. 13,500)
 - Middletown (pop. 21,700)
 - Dover (pop. 12,300)
 - University of Delaware

Phase II Permit (Proposed)

- Coverage: Expand Kent County limits. Add western portion of Sussex County.
- Original Phase II's dubbed Tier I
- New Phase II's dubbed Tier II. Includes Waiver for Smaller Municipalities (population & discharge based).
- Limits based on an Urbanized Area determined from the 2010 Census
- DNREC is not proposing for Kent and Sussex Counties to be included even though over 60% of the Urbanized Area is Non-Municipal. DeIDOT is expected to have coverage in the Non-Municipal Areas, though we are pushing back.

Working with Partners

- Phase I - Principal permittees
- Both DeIDOT and NCC have same consultant (KCI) for permit oversight
 - Coordination & Annual Reports
 - Mapping (Blue/Red/Yellow + DeIDOT Gray + Non-DeIDOT)
 - IDDE
 - Share costs
 - PCB Investigations
 - Water Quality Improvement Plan
 - Divide Tasks
 - Water Quality Improvement Projects
 - Public Education & Outreach
 - Annual Meeting & Public Seminars
- Statewide:
 - MxS Consortium - Quarterly meetings for all M&S permittees
 - Infrastructure Mapping

Working with Partners IDDE

Shared costs (50/50) when investigations overlap

Also 50/50 cost share on wet weather monitoring for stream restorations

A STORM DRAIN ISN'T THE PLACE FOR WASTE.

NO PLACE FOR PET WASTE

Water Pollution is a Crime. Don't Stand For It. STOP IT!

Call or text 302-STOPP-IT to report illegal dumping.

Storm drains lead to our water supply. So don't pollute them.

Call or text (302) STOPPIT

Working with Partners - IDDE

- Shared costs (50/50) when investigations overlap, i.e. restaurant dumps kitchen grease in private inlet that connects to DeIDOT infrastructure
- Looking to revamp in future, current arrangement for cost share is only if problem is initially found outside of DeIDOT right-of-way, i.e. if restaurant dumped kitchen grease directly into DeIDOT infrastructure, the county would not be cost-sharing, even though they have authority over the restaurant.
- Even if we aren't cost-sharing, we have a great working relationship, and the county will issue Notice of Violations, fines, etc to assist.

Working with Partners Water Quality Improvement Plans

ROAD CLOSED

WORK ZONE

Water Quality Improvement Plans

- This Phase I Permit: Christina River and Dragon Run watersheds
- Develop plan to reduce at least 3% of effective impervious area by 2027
- Christina River: 197.44 acres & Dragon Run: 10.75 acres
- Split with New Castle County (No Formal Cost Share MOA)
- Currently have spent \$2.6 million for 50 acres; Another 150 acres in works
- Estimating \$25-\$30 million dollars to implement the two WQIPs (DeIDOT \$10-\$15 million) → Tracking slightly less
- Next Phase I Permit → Implement the two WQIPs; plan two more watersheds (White Clay & Blackbird Creek)?
- Upcoming Phase II Permit → 1 Watershed Pollution Reduction Plan (similar, but no numeric requirement)

Water Quality Improvement Plans

WQIP Completed Project Summary

Christina River Watershed	Total Impervious Area	Effective Impervious Area	% of Effective Impervious Area	% of EIA Required for Watershed	Acres Completed	Acres Remaining
Christina River	286,402	227,522	8.02	2.24%	1,528	2,752
Dragon Run	198,776	127,812	6.43	3.24%	3,288	3,268
City of Wilmington	514,776	264,712	5.14	0.75%	15,114	0.00
Unincorporated ¹	810,000	410,000	50.00	61.87%	89,712	221,288
Total Watershed	1,809,954	7,485,120	41.44	100.00%	84,642	221,448

1. City of Wilmington has completed 1.8 acres of impervious area and has agreed to share the remainder of Phase II in an agreement with DNREC and NCC.

2. Includes operational BMPs which are included in co-permittees' annual reports.

Dragon Run Watershed	Total Impervious Area	Effective Impervious Area	% of Effective Impervious Area	% of EIA Required for Watershed	Acres Completed	Acres Remaining
Dragon Run	148,712	85,152	57.32	0.52%	0.000	1,200
Unincorporated ¹	650,000	300,000	46.15	61.87%	0.000	18,712
Total Watershed	800,712	385,152	48.23	100.00%	0.000	19,912

Working with Partners - Water Quality Improvement Plans

- 50/50 partner on development of two watershed improvement plans.
- Split all non-municipal required credits
- County owns subdivision open space for most communities built prior to 1990, plus county parks. Many of these areas receive DeIDOT stormwater flow.
- Most identified WQIP projects located in these areas
- DeIDOT has taken lead on several projects, but NCC will have maintenance responsibility post construction

Robscott Manor

- 12 DeIDOT outfalls from a subdivision into a New Castle County Park
- Approximately 1,700 foot length
- Approx. 280 acres of drainage
- Incised / eroding stream to a floodplain restoration with passive park amenities.
- Initiated 2019, Construction 2022
- Construction cost estimate \$1.9 mill
- Approx. 59 acres effective impervious acres removed
- \$32,200 / EIA removed

Robscott Manor

Before

Robscott Manor Park Stream Restoration Virtual Workshop Rendering

Robscott Manor

Before

Robscott Manor Park Stream Restoration Virtual Workshop Rendering

Varlano Park

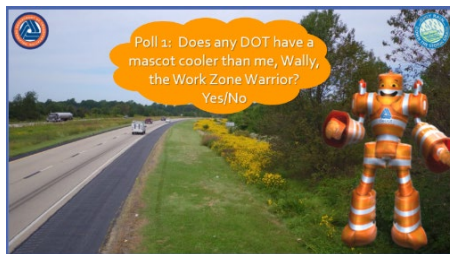
- DeIDOT outfall from a Subdivision into a New Castle County Park
- Approximately 250 foot length
- 48" diameter pipe with a 29 acre drainage area
- Scour pool 4' deep with 12" high banks to a 4' to 7' high incised channel
- Average sediment load of 33 cu/yd
- Initiated 2013, Constructed 2018
- Construction cost \$583,120
- 12.9 effective impervious acres removed
- \$427,500 / EIA removed

Varlano Park

- DeIDOT outfall from a Subdivision into a New Castle County Park
- Approximately 250 foot length
- 48" diameter pipe with a 29 acre drainage area
- Scour pool 4' deep with 12" high banks to a 4' to 7' high incised channel
- Average sediment load of 33 cu/yd
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- Construction cost \$583,120
- 12.9 effective impervious acres removed
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Varlano Park

- DeIDOT outfall from a Subdivision into a New Castle County Park
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- Initiated 2013, Constructed 2018
- Construction cost \$583,120
- 12.9 effective impervious acres removed
- \$427,500 / EIA removed



1:20 pm – 1:35 pm – Eileen Dunn – Case study from Arizona.

Eileen Dunn: Collaborative Agreements for MS4s

2022 National Stormwater Practitioners Forum
Collaborative Agreements for MS4s:
Case Study from the Arizona DOT

Partnering: ADOT's Definition

- Partnering is defined as a formal process of collaborative teamwork that allows groups to achieve measurable results through agreements and productive working relationships.

Partnering: Framework Principles

The 4 C's

1. Communication
2. Commitment
3. Cooperation
4. Continuous Improvement

Partnering: Why 4 C's

1. **Communication:** Creates an open, honest respectful dialog
2. **Commitment:** Establishes rules, an escalation process, and protects all stakeholder's interests, generates buy-in
3. **Cooperation:** Working together, joint problem solving
4. **Continuous Improvement:** Iterative process, celebrate successes

Partnering: Why, When, Who

The Other Stuff to Consider

1. Funding Sources, Project complexity & size, Post construction management agreements
2. Political landscape, Having adequate accounting structures,
3. Contractors, Other Gov Orgs, Private ...

Partnering: MS4 Case Study

1. Collaborative Project for a Public Service Message
2. It was resource efficient, & built long-term internal relationship
3. Realized greater ROI w/ internal partner

Needs & Challenges

Needs:

- MS4 Permit Requirement
- Transportation Specific Message
- Leverage Resources
- Larger Audience

Challenges:

- Limited Funds
- Multimedia PSA expensive if contracted
- Transportation oriented
- Who makes a good partner

The Answer: Joint Internal Effort !

Two Divisions - One Message

Why:

Efficiency, Shared Resources,
Easy to transfer money and resources through:
Joint Project, Sub-Program, In-kind

3 Important Points To Take Away:

1. Joint Project for a Public Service Announcement
2. It was resource efficient, & built long-term internal relationship
3. Realized greater ROI w/ internal partner

ADOT ARIZONA DEPARTMENT OF TRANSPORTATION

The Partners

1. Water Resources, *MS4 Stormwater Program*
Eileen Dunn, Water Resources Manager, and Laura Nordan, MS4 Program Coordinator
2. Communications, *Adopt a Highway Program*
Mary Currie, Program Manager

ADOT ARIZONA DEPARTMENT OF TRANSPORTATION

The Message: *Stash Your Trash!*

Stash Your Trash_30 (Limp4)

ADOT ARIZONA DEPARTMENT OF TRANSPORTATION

Summary: *Things to celebrate!*

- ADOT used it to kick off Stormwater Week
- It got people talking about the message both internal and external (the public) to ADOT!
- We have developed an internal long-term relationship across traditional boundaries

ADOT ARIZONA DEPARTMENT OF TRANSPORTATION

The End

Thank you for listening & thanks to our sponsors!

My contact information:
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ADOT Water Resources Manager
edunn@azdot.gov
602-245-0725

The PSA: <https://vimeo.com/385281659>

Adopt a Highway Program:
<https://azdot.gov/business/programs-and-partnerships/adopt-highway>

1:35 pm – 2:00 pm – Facilitated Q & A session

Questions:

It was noted that Arkansas has Phase II coverage for whole state, and is co-permittee on a phase I.

Ans: Delaware has 9 total co-permittees in their phase I and Phase II permit areas.

Question: Are there any quantifiable metrics of the success of the AZ partnership program?

Ans: No.

Question: You have grated basins also with side openings. Is this a problem for gross solids entering the system (Delaware)?

Ans: No.

Question: NH is covered under a Phase II general permit. Do co-permittees have multiple discharge locations in Delaware?

Ans: Yes.

Question: Who takes care of each outfall then?

Ans: They are all DeIDOT or municipal. They have separated which is which responsibility for each outfall.

Question: What is stormwater week?

Ans: In Arizona, it is a public outreach campaign, it was started by the City of Phoenix, and AZDOT has joined to promote it.

2:30 pm – 4:00 pm – Table to Table Break Outs Collaboration

- BMP Inspection
- TMDLs
- Audits
- Offsite Mitigation

Break Out: BMP Inspection (temporary and permanent)

Who inspects (CGP based requirements)?

- Contractor / DOT MS4
- DOT separate group has oversight of contractor
- In California the project owner is CGP permittee
- DeIDOT ESC liaison keeps on site map up to date
 - Co-permittee with contractor under CGP
- Maryland uses an online update system for SWPPP/ maps
 - CGP permittee implements

Who develops the SWPPP?

- California: contractor
- Colorado: joint (CDOT/contractor)
- Ohio: contractor

BMP Inspection - Post Construction Permitting

- Delaware has an annual BMP inspection
- Pennsylvania: 3-year condition assessment
- New Hampshire: annual in urban areas
 - other outside urban areas (600 inspection)
- Maryland inspects every three years in permitted area
 - 8500 inspection every 3 years
- Ohio: inspected annually

How do you assess BMP condition?

- Number scale 1-5
- Letter scale A-D
- Maintenance/ no maintenance needed
- Good/ fair/ poor plus six condition assessment

Record inspection results on paper or electronic?

- Paper - 2
- Electronic - 10
 - apps (custom)
 - ERSI
 - Survey 123/ ARC with dashboard
- Few systems with automated work orders generated from inspection report
- Inspection and Maintenance manuals
 - most have

Percent failing BMP's:

- 1 to 2% failing
- 30% needs major maintenance

Break Out: TMDLs

DOTs may not be a source of the TMDL target pollutant (ex. E coli)

DOT is generally always a minor percent of the waste load

- How to get an “exemption”
- Still stuck on paying money to install BMP's
- DOT monitoring = legal risk, cost prohibitive, especially if pass through pollutant
- Others should monitor watershed health

Action/ Reduction Plan

- Watershed approach
- Pollutant of concern approach

How are loads allocated to DOTs?

- DOT negotiates with regulator
- MOU with regulator regarding TMDL process
- DOT to get seat at table when setting WQ standards and modeling requirements
- DOT research on its own loading rates
- Set baseline expectations

Planning?

- Inventory land ownership in state for potential partner for SW facilities (ex. DOT with Department of Lands and Department of Parks)

Multiple goals:

1. Storm water quality (TMDL)
2. Future capacity
3. Money to partner for their Land Management need
 - “Turnkey” facility - private partner, design/ build - install on private land
 - DOT gets credit

Break Out: Audits

Enforcement:

- process
- escalation
- mechanisms

Sources:

- IDDE
- CGP

Documentation

E-versions

Failure Points

Contracts

Specifications

Where it shows

Build on the ground

Design phase

Break Out: Offsite Mitigation

What is offsite mitigation defined as?

- Permit Aspect:
 - Outside project limits
 - Outside contract plant of development

How far off site is acceptable?

- Define “same watershed”

When is offsite required? (MEP?)

- Banking: In place

Treatment required when:

- Area requirement
- Type of project/ impact

Impact / Treatment

- Multi-objective credit with off-site mitigation
- Long term maintenance partnering

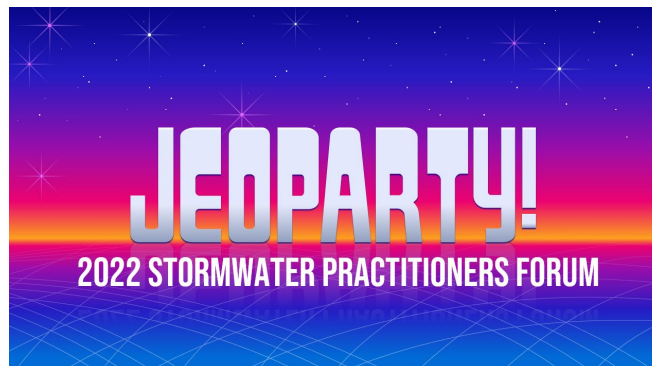
Downsides third party:

- Third party trusted to maintain
- Benefit not necessarily permanent (overtaken by project at mitigation site)

Upside:

- Fewer, Larger BMP's
- Collaborative
- Out of kind mitigation

4:00 pm – 5:30 pm – Team Building Exercise – Stormwater “Jeopardy”



BMPs	WATERSHED IMPAIRMENTS	MAINTENANCE AND OPERATIONS	PAST PRACTITIONERS MEETINGS	EMERGING CONTAMINANTS	SEDIMENT CONTROL
\$200	\$200	\$200	\$200	\$200	\$200
\$400	\$400	\$400	\$400	\$400	\$400
\$600	\$600	\$600	\$600	\$600	\$600
\$800	\$800	\$800	\$800	\$800	\$800
\$1000	\$1000	\$1000	\$1000	\$1000	\$1000

ACRONYMS	THE CSP	MONITORING	MORE CWA	SEDIMENT	MORE ACRONYMS
\$400	\$400	\$400	\$400	\$400	\$400
\$800	\$800	\$800	\$800	\$800	\$800
\$1200	\$1200	\$1200	\$1200	\$1200	\$1200
\$1600	\$1600	\$1600	\$1600	\$1600	\$1600
\$2000	\$2000	\$2000	\$2000	\$2000	\$2000



Day 3 – Wednesday - April 13, 2022

Session 4 – Innovative and Emerging Stormwater Management Practices

This session highlighted advancements in understanding and application of the state of practice for managing stormwater. Topics included construction stormwater management, post-construction stormwater management, and innovative tools for stormwater program management. Applied research and advancements based on experience were areas of focus.

Panel members:

- Barry Fagan, Volkert, Inc., Moderator
- Mike Perez, Auburn University
- Ronald Poe, Nebraska DOT
- Bill Hunt, N. Carolina State (pre-recorded presentation)

The panel session discussed the current and developing state of practice for stormwater management in three general areas. They included emerging and innovative BMPs such as low impact development and green infrastructure, PFC, real-time control, enhanced construction site controls, and environmental commitment tracking and programmatic guidance resources.

8:00 am – 8:05 am – Barry Fagan – Welcome and introduction/overview.

8:05 am – 8:25 am – Mike Perez – Overview of research and application of construction stormwater management BMPs.

Mike Perez: Innovative & Emerging Stormwater Management Practices

The presentation consists of 48 individual slides, each illustrating a different aspect of stormwater management. The slides are organized into a grid and cover the following topics:

- Renovating & Emerging Stormwater Management Practices:** Includes a map of Alabama and a list of BMPs.
- Stormwater Research Facility:** Shows various testing and training equipment.
- Inlet Protection Channel:** Displays different types of inlet protection structures.
- ALDOT Inlet Protection Research:** Focuses on specific inlet protection designs.
- Construction Stormwater Needs:** Discusses the need for improved BMPs.
- Stormwater Research Facility (NCAI):** Shows a large-scale testing facility.
- Stormwater Research Facility (Transportation):** Focuses on BMPs for the transportation sector.
- Flow & Sediment Introduction:** Illustrates how BMPs manage flow and sediment.
- ALDOT Inlet Protection Details:** Provides technical drawings of inlet protection.
- RIP RAP Ditch Check – No Choker:** Shows a ditch check with rip rap.
- RIP RAP Ditch Check – Geotextile Choker:** Shows a ditch check with a geotextile choker.
- Silt Fence Ditch Check:** Shows a ditch check with a silt fence.
- Silt Fence Ditch Check – Sediment Deposition:** Shows sediment deposition in a ditch check.
- Sediment Barrier Test Apparatus:** Shows a test apparatus for sediment barriers.
- Baseline: Standard ALDOT Installation:** Shows a standard ALDOT installation.
- RIP RAP Ditch Check – Geotextile Choker (LASER):** Shows a ditch check with a laser level.
- Modified Silt Fence Ditch Check:** Shows a modified silt fence ditch check.
- ALDOT Ditch Check Details:** Provides technical drawings of ALDOT ditch checks.
- Modified Silt Fence Installation – Mobile, AL:** Shows a modified silt fence installation in Mobile, AL.
- Installation Enhancements:** Lists four key enhancements:
 - Increase T Post Spacing → 0.85' to 1.25' (1.25')
 - Reduce T Post Spacing → 3.0' to 3.5'
 - Reduce Post Height → 32" to 28" (28")
 - Reinforce → Direct Ditch to 1/4" (1/4")
- Trench Offset:** Shows a trench offset installation.
- Dewatering & Overflow Weir:** Shows a dewatering and overflow weir.
- Iowa DOT In-Channel Sediment Basins:** Shows in-channel sediment basins.
- Basin Design:** Shows a basin design diagram.
- ALDOT Silt Fence Detail:** Provides technical drawings of an ALDOT silt fence.
- Slash Mulch Sediment Barriers:** Shows slash mulch sediment barriers.
- Field Monitoring:** Shows field monitoring equipment.
- In-Channel Sediment Basin:** Shows an in-channel sediment basin.
- Experimental Evaluations:** Shows experimental evaluations of BMPs.
- DO Current Techniques Work? / What are Other State DOTs Doing?:** Compares current techniques with other state DOT practices.
- Infiltration Swales:** Shows infiltration swales.
- Vegetative Establishment Inspections:** Shows vegetative establishment inspections.
- Combined Comparison - Sedimentation:** Compares sedimentation rates for different BMPs.
- Floculant in Construction Stormwater Applications:** Discusses the use of floculants.
- Research Goal: Develop Guidance:** Lists research goals for developing guidance.
- Dosage Test: Supernatant:** Shows a dosage test for supernatant.
- Case Study:** Shows a case study of a stormwater management project.



10-acre outdoor lab at Auburn University. This presentation is a compendium of findings from some of their projects.

Alabama stormwater report card gave a D+, nationwide it is a D.

Site now occupies about 10 acres total for construction BMP research. Look at innovated practical Construction BMP practices.

Test BMPs at full scale, under field conditions. Look at points of failure and then ways to improve the practice.

Were able to double the impoundment on riprap ditch check by wrapping it in filter fabric.

Have made advancements in silt fence check dams. Create an impoundment, create storage, and control outflow.

Made improvements to ALDOT silt fence installation standard plan. Modified the trench, and the strength of the posts. Added a dewatering overflow weir to keep fence from failing from impounded water.

Industry is pushing to use green materials – looking at using slash mulch for barriers for stormwater

Project to look at sediment basins in Iowa. Poor sediment removal with the standard installation. This type of basin is used in channels in Iowa as well. Enhancements: Skimmer, lined basin with geotextile, baffles, enhanced removal from 70% to 96%.

Evaluated floc logs for ALDOT. Nationwide, 39% of DOTs use flocculants. DOTs don't understand dosing, how long they last, are their implications for pollution from the flocculant through residuals, what types of flocculants. Research shows that lower concentrations of flocculants (than manufacturer spec) can provide excellent results. Residual flocculant in water correlates to sediment removal – easy fast field test.

Upcoming projects: Infiltration swale, vegetative establishment inspections (for NOT filing), product evaluation to improve manufacturers products. Also provide training and outreach, including installation training, inspection training.

Questions:

Question: Have you reviewed engineered soil mix:

Ans: Looking at this for post construction infiltration devices. In OR, the contracting community has problems finding the right mixes.

Question: What flow through rates do you have on your silt fence?

Ans: ALDOT uses a non-woven fabric. Manufacturers have a high flow rate for the fabric, but it is based on clean water. With sediment flow, the rate is reduced by a factor of about 100.

Question: Have you tested Jute matt downstream from a floc log?

Ans: Have looked at using granular floccs in association with Jute. Have not looked at using jute downstream to capture the floccs that are formed.

Question: How can we get a copy of your studies?

Ans: We disseminate studies through TRB, and generally publish.

Question: Have you tried testing on compost filter logs?

Ans: Looked at them as check dams. The materials with high flow through rates are not as effective as those that impound water.

Question: You showed using mulch as a temporary measure. This is steering away from plastics. What is the push for this?

Ans: Some DOTs are trying to eliminate plastics as a potential source of microplastics in stormwater. There are also wildlife entrapment and entanglement issues.

Question: In the new CGP from EPA, there is a visibly clear discharge standard for construction stormwater discharge. Is this realistic to have in a permit?

Ans: Not without the use of flocculants. Flocculants allow you to reduce turbidity. This will need to be a new standard to achieve a visibly clear discharge goal.

8:25 am – 8:45 am – Ronald Poe – Overview of the accountability, transparency, and management of Nebraska’s environmental compliance oversight database.

Ronald Poe: Nebraska Stormwater Program: Accountability and Transparency

Nebraska Stormwater Program
Accountability and Transparency

NEBRASKA
Good Life. Great Journey.
DEPARTMENT OF TRANSPORTATION

NEBRASKA
the good life
Home of the Cornhusker State

Visit Nebraska.
Visit Nice!

Nicer than Iowa!

- Nebraska Facts
 - Cattle outnumber Nebraskans 4:1
 - Arbor Day is a state holiday
 - Still reminisce about the glory days of the 90's and think next year Husker football will be back on the map
 - Minimal regulatory involvement
 - 2015 EPA Audit of MS4 program
 - 2022 EPA Audit of construction programs

NDOT Districts

NEBRASKA DEPARTMENT OF TRANSPORTATION
NDOT MS4 Program Organizational Chart

NDOT Director

Stormwater Management Division (SMD) / Construction Management Division (CMD)

Construction Management Division (CMD)

Division	Sub-Division	Staff
Stormwater Management Division (SMD)	Stormwater Management	Stormwater Management
	Stormwater Management	Stormwater Management
	Stormwater Management	Stormwater Management
	Stormwater Management	Stormwater Management
Construction Management Division (CMD)	Construction Management	Construction Management
	Construction Management	Construction Management
	Construction Management	Construction Management
	Construction Management	Construction Management

Stormwater Program History

- 2003 Program began
 - Stormwater Permits for all projects
 - SWPPPs required
 - Inspectors
 - Build an MS4 program
 - Write our own Permits from Day 1
 - No regulatory guidance
- 2015 EPA MS4 Audit
 - Programmatic Review
 - SOPs & Programmatic Documents
 - Inspectors of Construction Sites and Maintenance Facilities
 - Interviewed staff

Stormwater Program History

- 2017 Consent Decree
 - Financial Penalty
 - Rebuild and implement all SOPs and programmatic documents
- 2019 Consent Decree Terminated
- 2021 Construction Site Audit
- 2022 January initial "Findings" were received

Stormwater Program

Current Process

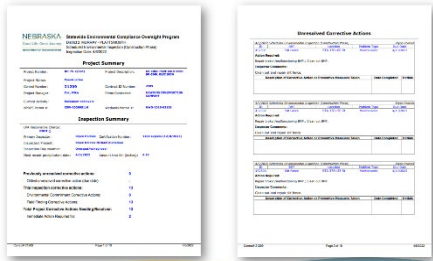
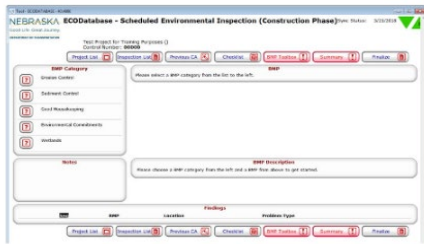
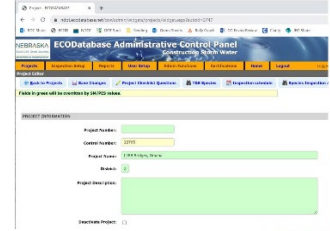
- Projects are inspected every 14 days and after 0.25" rain events
 - Inspection Reports tell the project story
 - NDOT documents inspections in ECOD
 - Contractor Rep is required to attend
 - RDCU Provides Oversight Inspections
- Staff and Contractor Training
 - E&SC Training – Online and in-person
 - Environmental Roundtables
 - AGC BMP Demonstrations
- Program Transparency
 - Annual Updates to NDOT Management and NDEE
 - Stormwater education includes PHWA and Resource Agencies



ECODatabase (ECOD)

Communication tool to improve accountability

- Paper inspections prior to ECOD
- Utilized by all construction staff and RDCU
- Reports auto-emailed and available online
 - Contractor
 - District Management
 - PHWA
- Reminders sent for past due reports
- Documents due dates/completion dates for Corrective Actions



ECODatabase (ECOD)

- Benefits
 - Speed and accountability
- Lessons learned if you want to build a software solution:
 - Develop programmatic goals before developing software
 - Program should determine the tools
 - Stormwater team, not software developers
 - If you can dream it, they can build it
 - Serviceability of the product
 - Can the vendor maintain your system?
 - Data storage
 - Server space and sync challenges

ECODatabase (ECOD) Replacement

- Challenges with ECO Database
 - 15 years old – Developed before wide-spread cellular and internet service
 - Web-based Headquarters module with client installed on machines
 - Too much data
- 2021- 2022- Planning Meetings/Process Mapping
 - User Input and Wishlist
- 2023 – Possible new/upgraded system in place



Rebuild Current System



Off-the-shelf Software



App Development

Drones

- Pilot Project in 2022
 - How can we utilize this technology for stormwater inspections?
 - Can we provide another use for data being collected?
 - Can they make our team more efficient?
 - Can they improve measurements for E&SC?



Five Pillars of Stormwater Management



Contact Info

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NEBRASKA
 GOVT. AGEN. DIVISION
 DEPARTMENT OF TRANSPORTATION

Accountability and transparency of the Nebraska Stormwater Program. NDOT had minimal regulatory oversight. In 2015 had the first EPA audit. There was a second EPA audit in 2021.

Eight Districts centrally managed from HQ. They have a technical advisory group, made up of Division Heads and above. This group sets policies for the DOT and the Stormwater Program. Stormwater is in the Environmental Section.

The program was started in 2003 (stormwater program). The DOT was given one year to build a stormwater program by the NDE and EPA. The DOT was given broad latitude and has written their own permit.

In 2015, EPA did an audit. NDE was unaware. PG Environmental was the audit contractor for EPA. The audit did not go well and resulted in a consent order in 2017. Had to rewrite their SOPs, and in 2019 the consent decree was closed.

In 2021, EPA did a construction site audit. EPA received a complaint at a construction site. The initial findings show common BMP failures and inspection lapses. NDOT Provided the findings to staff as feedback.

New CGP was released in January 2022. Projects are now inspected every 14 days or after a .25" rainfall event. Mandates staff and contractor training. Contractor must be along during DOT staff inspections of E&SC. They have created new environmental specifications that require inspections by the contractor and provide a problem resolution pathway.

NDOT Meets annually with NDE and include FHWA in the review.

NDOT created an Eco database. This database is a communication tool to improve accountability. All inspection reports are placed in the database, and it tracks training and certifications as well as distributing reports to all interested parties. FHWA has access to the database as well as District Management. The database also sends reminders to staff if deadlines are missed, and documents due dates for corrective actions logged by inspections.

The database is web based. The system can be used offline when the internet is not available. Other environmental commitments are built in, such as NEPA requirements for a project.

The benefits of the database include speed and accountability. To develop the software, make sure you have your programmatic goals outlined, make the system maintainable and expandable. The database needs a lot of storage and starts to run slowly as the memory requirements increase.

Looking now for a replacement for the database. Will be a web-based module that is cloud based. May be an off the shelf application or a new custom software or rebuild the current system. Must have a new system in place by 2023. Will likely be an off the shelf product.

NDOT is now assessing incorporating drones into stormwater inspection. May or may not pursue this based on preliminary assessment.

NDOT uses the five pillars of stormwater management: Communication, work, water...

Questions:

General Comment: MassDOT is using drones, which helps compared various times of the project and the project receiving water condition.

Maryland is piloting the use of drones. They have found that it is significantly faster (more than 2x) in terms of the amount of area that is inspected. The cameras have very high quality.

Question: This program is a good example of how and audit can change a program. How has it worked at the state level with the regulator?

Ans: The communication between NDOT and NDE has been positive and improved the program. They have established some MOUs that were needed.

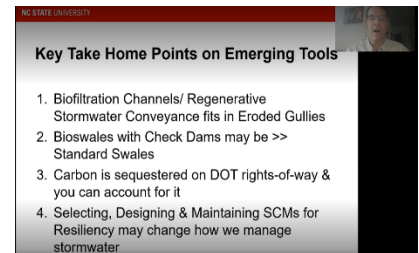
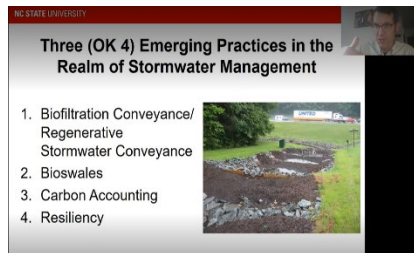
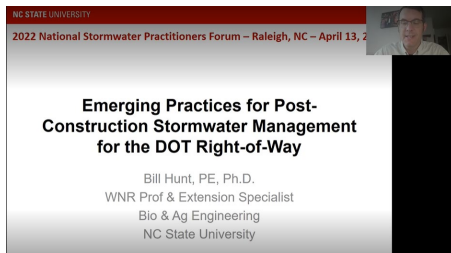
Question: Colorado is also doing some drone studies. Asked that other DOTs evaluating this technology informally share results.

Ans: NCDOT has used NC State for drone evaluation and can provide their findings.

DelDOT uses an off the shelf software for program tracking that they are happy with.

9:05 am – 9:30 am –Bill Hunt, prerecorded content:

[Bill Hunt: Emerging Practices for Post-Construction Stormwater Management for the DOT ROW](#)



Overview of emerging post-construction practices including those that utilize natural materials and process in the transportation environment.

9:30 am – 10:00 am – Break

10:00 am – 12:00 pm – Table to Table Break Outs Collaboration
Table Reporting/Sharing and Group discussion

- Permit Negotiations
- NPDES Permit Reporting Compliance
- Talking Trash
- Construction to Maintenance Handoff

Breakout: Permit Negotiations/Renewals

Frustrations:

- Turnover of personnel at regulator
- Lack of understanding of DOT operations by regulator
- Apply municipal NPDES template to DOT
- Focusing on one pollutant based on bad science – anti degradation does not allow a needed reset
- Defining MS4 Boundaries
- DOTs required to follow local MS4 ordinances or permit requirements within their boundaries
- Provide comments on the draft permit – receive no response
- EPA may “overrule” state, all negotiated items for naught
- Intent does not match permit language
- EPA permit writer’s guidance is old (2011)
- Outside parties (NGO’s) drive some permit provisions

Solutions:

- Have a DOT water attorney present at start of negotiations
- Have a liaison position in the regulatory agency, funded by the DOT
- Establish ground rules at start of the negotiation process. Agree before a draft permit is released for public comment

- Use a blue-ribbon panel for tough tech issues
- Follow other permit negotiations in you state to stay apprised of potential new provisions
- Meet regularly with regulator to forestall major problems in your program
- Come prepared with data (show practices/BMPs are that ineffective) better ways to spend money
- Offer what you are already planning to do or already doing (negotiation strategy)
- Always assume staff changes
- ID your key points ahead of time, know what is off the table to avoid wasting time/goodwill
- Have regulator help you to get support for requirements/funding
- Be aware of what is happening in other states (MEP)

Build coalitions with other MS4 on big issues

Breakout: NPDES Permit reporting compliance

- Delegated states
- Non delegated
- Due every five years, some more

Stumbling Blocks:

- Too much documentation
- Standards of operation
- Report as needed
- Open communication: with public, other agencies, municipal
- Education: public, expectations
- IDDE - prioritize these items with consultants

Breakout: Talking Trash

- California zero trash mandate
- Caltrans is finding it difficult to comply
- Very visible and public facing issue
- Pavement additives/ markings
- Trash assessments (gal/ ac/ year)
- Trash/ pollutants drive assessment and monitoring
- Annual trash report to legal division
- Trash capture devices
- Funding an issue - competing priorities
- Street sweeping option
- Need more efficient mechanical roadside trash pickup means

Breakout: Construction Maintenance

Verification:

- As-builts (1 1/2 out of 14)
- (1 - no certification)
- (5 - specific SWM)

Timeframe:

- No closeout until as-built - 3 DOTS
- As-built during inspection process - 1 DOT
- 7 in field "red" line versus digital

Hand-off:

- Good protocol versus Wild West (4)
- Knowing what's coming in
- Maintenance on hook for 70% vegetation coverage (4)
- Long duration before acceptance (vegetation - maintenance)
- Separate landscape contract versus penalties/ shut down

Technology:

- Paper (2) vs. automated (1 done, 4 in process) vs. traditional digital (4)

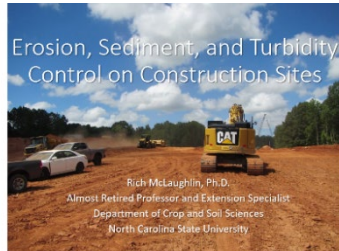
Inspections:

- Specific BMP inspectors
- Pre-con for BMP's/ Environment (6)
- Regulator at inspection (1)
 - some at end
 - mix of consultant vs. in-house

Day 3 Lunch Presentation and Introduction of Field Tour

12:00 pm – 12:45 pm - Dr. Richard McLaughlin, N. Carolina State University.

Rich McLaughlin: *Erosion, Sediment, and Turbidity Control on Construction Sites*



Water Quality is Important to Me!



Presentation Outline

- Chemically assisted erosion control
 - Potential types
 - What's been done
- Chemically assisted turbidity control
 - Sediment control basics
 - Chemical options
 - Dosing options
- Environmental Impact Potential
 - General toxicity overview
 - Scenarios for dosing losses
- A couple of other studies



Mulch Effects

Authors	Year	Material	Slope (%)	Erosion Reduction Relative to Bare Soil (%)
Mannering et al.	1963	Wheat straw	5	22,400 kg/ha = 100 11,100 kg/ha = 75-90
Benik et al.	2003	Straw, Blankets	20	60-98
Dougherty et al.	2010	Blankets Hydromulch Straw	7	58 53 66
Hayes et al.	2005	Straw	50	83
Faucette et al.	2005	Compost, hydroseed	10	95-99
Sutherland & Zekes	2007	Coir blanket Coir mesh	9	>99 92-99
Sidhu et al.	2015	Hydromulch	33	98

Mulch reduces erosion by roughly 90%

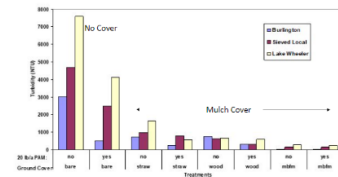
PAM on Bare Soil (no mulch)

- Polyacrylamide on bare soil compared to bare soil alone

Authors	Year	Rate (kg/ha)	Slope (%)	Erosion Reduction (%)
Chen et al.	2016	80 (mixed into soil)	67	19-40
Ao et al.	2021	10	25	>90
Prats et al.	2014	50 dry	45	0
Kebede et al.	2020	20-60 dry	10	12-90 (rate dependent)
Lu et al.	2020	10-50 dissolved	20	44-85 (rate dependent)
Hanagan et al.	2002	80 dissolved	32	83-92
Shoemaker et al.	2012	15-39 dry or semi-dissolved	33	Dry: 70-97 Semi: 35-78 (69-76 dried)

PAM alone has highly variable effects on erosion

Rainfall Simulator: PAM (22 kg/ha) Reduces Turbidity for Most Groundcovers



Best Option: Add flocculant to erosion control



More Mulch/PAM Tests



PAM Effects by Cover: Usually Large Turbidity Reduction

Cover	Sites	Erosion Rate Reduction
Straw	3	45-78%
Excelsior	2	51-69%
Wood Hydro	1	98%
Flexterra	1	20%

Tests Conducted at Different Scales



PAM With Mulch

- All done at NCSU

Authors	Year	Rate (kg/ha)	Slope (%)	Erosion Reduction vs. Cover Alone (%)
Hayes et al.	2005	10.5	20-50	Rate too low – no effect
Babcock et al.	2011	37 dry and dissolved	50	49-56 (straw or excelsior)
Babcock & McLaughlin*	2013	37, 74 dry 37 dissolved	20	37 dry – worse 37 dissolved, 74 dry, 50-90%
Lee et al.	2017	22.4 dry	50	No effect
Kang et al.*	2014	30 dry or dissolved	10	>90% dissolved-dry

*Rainfall simulator studies
#Runoff PAM concentrations peaked 13-17 mg/L, then dropped to <1 mg/L; granular=dissolved

Final Results: Erosion

Treatment	Total sediment loss (kg ha ⁻¹)				
	Site 1, Kingston	Site 2, West Jefferson	Site 3, Garway	Site 4, Apex	Site 5, Holly Springs
Straw			3.855a	51bc	30b
Straw+PAM			1.261ab	29c	29b
S3M1	No Differences		959bc	N/A	35b
BFM			1,931ab	N/A	N/A
FGM			333c	164ab	N/A
WFM			N/A	237a	120ab
WCB			N/A	221ab	210a

PAM=Polyacrylamide, FGM=flexible growth media, S3M1=stabilized mulch matrix, BFM=bonded fiber matrix, WFM=wood fiber mulch, WCB=70:30 wood fiber/cellulose blend.

Summary of Ground Cover Studies at NCSU

- Not much difference between mulches (straw is fine) for erosion or grass growth
- Applying polyacrylamide often reduces erosion
- Weather makes or breaks your grass establishment, especially rainfall patterns. Supplemental watering recommended!

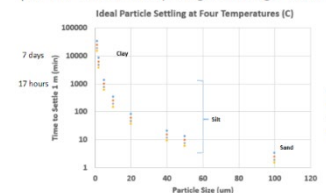


What To Do About Turbidity?

- Filter:** often impractical because effective filters require maintenance (e.g. backflushing).
- Infiltrate:** ideal solution (no runoff!) but often soil properties or high groundwater prevent it.
- Chemically Assisted Settling:** effective, may not require much change, inexpensive.



Why is Chemical Treatment Needed (or we need really large storage basins!)

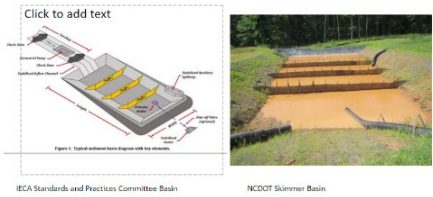


First Step: Source Control



Water conveyances will be stabilized (they can be main source of sediment)

Best Practices for Sediment Control In Place



ICCA Standards and Practices Committee Basin NCDOT Skimmer Basin

Chemicals Available

- **Coagulants:** alum, gypsum, ferric compounds
 - Overcome clay surface charge
 - Doses are in the pounds per 1,000 cu ft range
- **Flocculants:** polyacrylamide, chitosan, others
 - Bind suspended solids together into flocs
 - Doses in fractions of oz per 1,000 cu ft

Early Turbidity Control Experiment

- Gypsum found to work when manually spread on basin
- Senior design student built a powder dispenser using 12V motor
- Capacity issue: could only treat about 1/3 of basin volume
- Humidity issue: gypsum turned to solid in summer...



Flocculants

- Available in solid forms such as (co)chloride blocks, tablets, granular, and sticks.
- Designed to be placed in flowing water to dissolve the polymers.
- May be dissolved in a concentrated solution and dispensed through a variety of mechanisms.



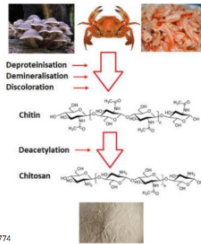
PAM Forms

Polyacrylamide	Structure of Repeat Unit
Anionic Polyacrylamide (APAM)	$\left(\text{CH}_2 - \underset{\text{OH}}{\underset{\text{COO}^- \text{Na}^+}{\text{C}}} \right)_n$
Neutral Polyacrylamide (PAM)	$\left(\text{CH}_2 - \underset{\text{OH}}{\underset{\text{H}}{\text{C}}} \right)_n$
Cationic Polyacrylamide (CPAM)	$\left(\text{CH}_2 - \underset{\text{OH}}{\underset{\text{NH}_2^+ \text{Cl}^-}{\text{C}}} \right)_n$

Acutely toxic in unbound form
<http://polymerdatabase.com/polymer%20classes/Polyacrylamide%20type.html>

Chitosan Polymer

- Derived from chitin, which is derived from crab/shrimp shells primarily
- Acutely toxic in unbound form (not in muddy water)



<https://www.lirechopen.com/chapters/75774>

Passive Dosing: Add flocculant to ditches/diversions



Add flocculant to ditches/diversions



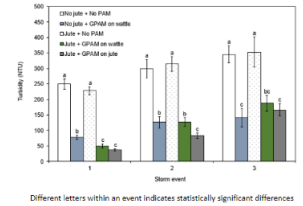
Examples: Add flocculant to ditches/diversions



Testing Flocculation Methods



Results: Turbidity Reduction Regardless of Introduction Method



Passive Dosing Tests: PAM on Check Dams

• All done at NCSU

Authors	Year	Number of Check Dams	Slope (%)	Turbidity Reduction Relative to No PAM (%)
Kang et al.	2013	3 (excelsior wattle, rock, rock w/ blanket)	5-7	>75
Kang et al.	2014	3 excelsior	7	>66 (>88 basin exit)
Kang et al.	2014	3 excelsior, with or without jute blanket	7	58-67 (Particle size > 10X)
McLaughlin et al.	2009	Various (construction site)	Various	64-76 (storm weighted average)

Field Tests: Check dam + pipe + PAM block



Option: Add flocculant to slope drains (esp. block forms)



Option: If a storm drain system is in place, put flocculants in there (again, block forms)



Option: If a storm drain system is in place, put flocculants in there



Tiered Sediment Basin – if you have the slope

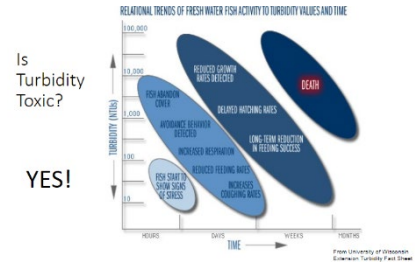


What About Acrylamide?

- PAM contains <0.05% free acrylamide
- Acrylamide neurotoxicity: RfD 0.0002 mg/kg/day, or 0.014 mg/day for 70 kg person.
- Water treated at 1 mg/L has 0.0005 mg acrylamide.
- Need to drink 28 L/day...to reach the No Effect level.
- Fish LC₅₀ values >100 mg/L
- PAM unlikely to release much acrylamide

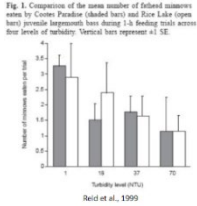
Acrylamide in the Environment

- Quickly degraded in soil (half life of 1-2 days)
- Degrades in water in 2-12 days (quicker if previously exposed).
- Non-toxic at doses expected with PAM treatment (ppb).



Is Turbidity Toxic?
YES!

Turbidity Effect on Bass Feeding



Conclusions

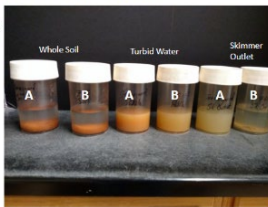
- Toxicity: exposure x dose.
- Turbidity and suspended solids are toxic to aquatic organisms.
- Flocculants are not toxic at doses needed to treat turbidity.
- Treating runoff with flocculants probably reduces its toxicity (by removing sediment).

Chemical Treatments Conclusions

- Polyacrylamide can be used along with ground covers to reduce erosion and improve runoff water quality
- Construction site runoff is likely to be very turbid even with all sediment controls in place
- Passive treatment of runoff can reduce turbidity if properly installed and managed
- Pumped muddy water can easily be treated to greatly reduce turbidity
- Risks of chemical treatments are very low, particularly compared to the potential sediment impacts.

Careful How You Get Your Sample

- Products may work on a soil sample but not on the muddy water



UAVs For Conducting Inspections

- Autonomous (pre-programmed) UAV inspections conducted using **Mavic Pro Platinum (MPP)** UAV, while manual UAV inspections used **Phantom 4 RTK (PRTK)** UAV.
- Elevation, camera angle tested for ability to detect issues
- Compared to traditional on-foot inspections



Mavic Pro Platinum – consumer grade UAV



Phantom 4 RTK – geolocation using Real Time Kinematic sensor

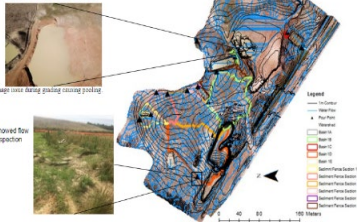
Example: Sediment Control Devices within the Borrow Pit

- Five basins (1A-1E)
- Seven sediment fence outlets (SF1-SF7)



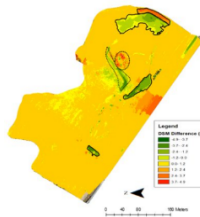
Basins and sediment fence (SF) outlets were located and watersheds determined.

Some Observations



Elevation Changes between 01.28.20 to 03.09.20

- Both excavation (green) and stockpiles (red) can be seen and volume estimated
- Standing water in low spots interferes with estimate (can't tell how deep)
- Overall estimate of borrowed material similar to truck count estimate.



Summary: UAV Uses on Construction Sites

- Photos from UAVs can show issues on-foot inspection might miss
- A hybrid approach probably makes the most sense for efficiency (time)
- Flow direction as well as topographic and volume changes can also be documented

Dust Control on Haul Roads

- Typically use water, frequently applied to the road (continuously).
- Could added chemical dust control products reduce that to much less frequent applications?



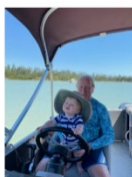
Dust Collectors



Conclusions

- Calcium chloride worked for extended periods, with dust reductions in the 30-50% range.
- This is similar to another study
- Some agencies recommended incorporating the calcium chloride into the road surface, which may improve on our results (surface applied).
- Neither "glue" type product worked very well at the recommended rates – perhaps higher rates would do better.
- During warm, dry periods water effects disappear in hours or less.

Questions?



12:45 pm – 5:00 pm – Classroom and Field Site Tour – North Carolina State University, Sediment and Erosion Control Research and Education Facility. **Need Classroom Discussion** slides? **Field picture**

Day 4 – Thursday, April 14, 2022

Session 5 – Asset Management

DOTs have an extensive stormwater system as a part of their transportation network. The stormwater system generally has been constructed of various materials with varying lifespans. The system age can vary greatly within a state. Asset management programs help a DOT plan effectively for identifying systems that must be replaced, facilitating retrofit of stormwater controls, and ensuring public safety. There are a variety of asset management systems currently in use. This panel will provide an overview of several systems.

Panel members:

- Andy McDaniel, N. Carolina DOT, Overview and Moderator
- James Murphy, Nevada DOT

The topic of the panel session was to provide case studies of asset management systems used by DOTs across the country, followed by a Q&A to discuss the benefits and drawbacks of such systems for a stormwater application.

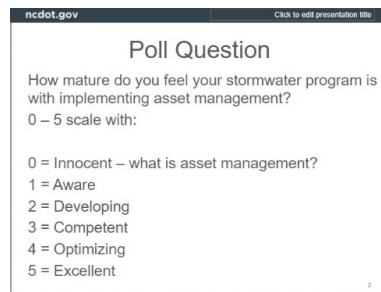
8:00 am – 8:05 am – Andy McDaniel – Welcome and introduction/overview.

Andy McDaniel – Where is your program on its asset management journey?

Andy McDaniel: Asset Management



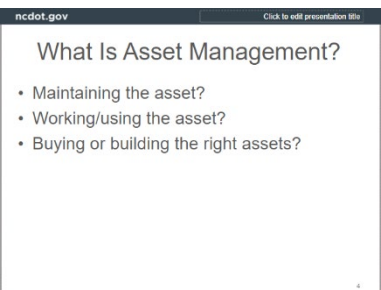
Slide 1: Where is your program on its asset management journey? Andy McDaniel, PE, April 14, 2022, 2022 National Stormwater Practitioners Forum. The slide features the North Carolina Department of Transportation logo and a row of small images showing various infrastructure projects.



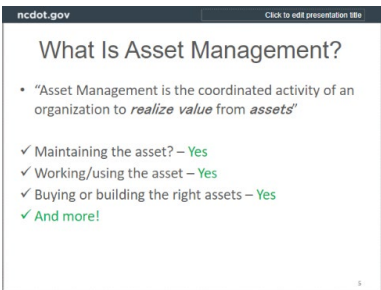
Slide 2: Poll Question. How mature do you feel your stormwater program is with implementing asset management? 0 – 5 scale with: 0 = Innocent – what is asset management? 1 = Aware, 2 = Developing, 3 = Competent, 4 = Optimizing, 5 = Excellent.



Slide 3: What Are Assets? "An asset is an item, thing or entity that has potential or actual value to an organization" (ISO 55000). Assets include People, Physical, Financial, and Intangibles. The slide includes an image of a group of people in a meeting.



Slide 4: What Is Asset Management? Maintaining the asset? Working/using the asset? Buying or building the right assets?



Slide 5: What Is Asset Management? "Asset Management is the coordinated activity of an organization to realize value from assets". Maintaining the asset? – Yes, Working/using the asset – Yes, Buying or building the right assets – Yes, And more!



Slide 6: Asset Management Standards. ISO 55000: Overview, principles and key terms in Asset Management. ISO 55001: AM: management systems - requirements. ISO 55002: Guidance for implementation of ISO 55001 (revised 2018).

4 Fundamentals of Asset Management

Value:	Alignment:	Leadership:	Assurance:
<ul style="list-style-type: none"> Assets exist to provide value to the organization and its stakeholders. 	<ul style="list-style-type: none"> Asset management translates the organizational objectives into technical and financial decisions, plans and activities. 	<ul style="list-style-type: none"> Leadership and workplace culture are determinants of realization of value. 	<ul style="list-style-type: none"> Asset management gives assurance that assets will fulfill their required purpose.

Asset Management System

What Does An Asset Management System Do?

A framework of governance and coordination, for a defined scope of application, enabling:

- Control
- Directional alignment
- Cross-disciplinary collaboration
- Optimization
- Continual improvement

Its not a software tool!

Asset Management Alignment

Asset Management Policy

Asset management Policy represents the 'rules of the game' for asset management.

The Policy documents:

- Guiding Principals
- Non-negotiable commitments

... for how asset management will be done in delivering the organization's mission.

Asset Management Objectives & Strategies

Documents the more negotiable business case intentions, e.g. how much, by when, by what methods, are will going to implement the AM Policy. Includes the rules for developing Asset-specific Management Plans.

Asset-Specific Management Plans

Documents:

- What needs to be done
- Timeframe (when it needs to be done by)
- Resources (who will do it)

Shift Gears And Talk About NCDOT's Stormwater Asset Management Program

NPDES Permit Background

- BMP I&M requirements began in 2005
 - Maintain a BMP I&M manual
 - Implement a BMP I&M Program
 - Evaluate I&M needs for new BMP types
 - Training

NCDOT's Asset-Specific Management Plan for SCMs

- Mainly center around our I&M Manual and our Stormwater Control Management System database
- Mostly focuses on Operations (OpEx)
- Not a lot of documentation on Capital Expenditures (CapEx)
 - Acquisition
 - Replacement
 - Disposal
 - Modifications/upgrades

BMP I&M Manual

- Fifteen Chapters
 - General I&M Chapters (1-4)
 - Biosetback basin
 - Filtration basin
 - Infiltration basin
 - Detention basins Dry and Wet
 - Hazardous Spill Basin
 - Stormwater wetland
 - Swale
 - Level Spreader
 - Permeable Pavement
 - Preformed Sucker Hole
- Individual BMP Chapter Contents
 - BMP Overview
 - BMP Components Description
 - I&M Procedures
 - Inspection Checklists
 - BMP Naming Convention

Illustrations Depicting Major Components

Note: Most stormwater controls are not located adjacent to a water body, as the above diagram depicts, but rely on water conveyance such as ditches, pipes, and buffers to transport treated runoff to the nearest river, lake, or stream.

Illustrations Depicting How It Works

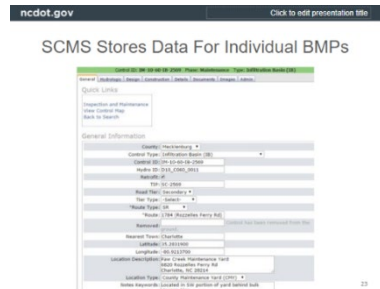
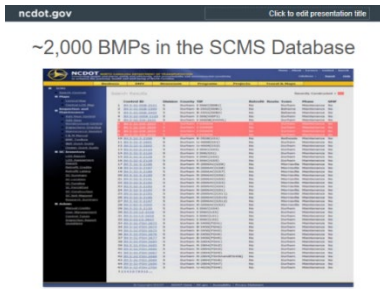
1) Pollutants are filtered out as stormwater passes through the filter media to the collection basin.

Level of Service Ratings

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

Stormwater Control Management System

- SCMS - authenticated web-based application



Challenges

- NCDOT's asset management system was traditionally decentralized and lacked strong vertical alignment – although this is improving in recent years
- The lack of an asset management policy results in uncertainty regarding priority in an environment of competing priorities

Challenges

- Silos (a.k.a. cylinders of excellence) still exist without a wholistic approach to maximizing value asset can bring to the organization
- BMP Asset Management Plans focus on an OpEx Plan but do not include a CapEx plan to address: acquisition (i.e. hand over), replacement, disposal, modifications & upgrades

Take Home Points

- Asset management is about realizing optimal value from assets, not just maintaining them
- There are internationally recognized standards for asset management (ISO 55000)
- Committed leadership => AM policy => AM objectives & strategies => AM plans are all necessary in that order
- Everyone in the DOT has a role to play
- Asset management doesn't happen overnight, it's a journey

Poll Question:
How mature do you feel your stormwater program is with implementing asset management?

Scale	Description	Definition
0	Innocent	The organization has not recognized the need for this requirement and/or there is no evidence of commitment to put it in place
1	Aware	The organization has identified the need for this requirement, and there is evidence of intent to progress it
2	Developing	The organization has identified the means of systematically and consistently achieving the requirements, and can demonstrate that these are being progressed with visible and measured plans in place
3	Competent	The organization can demonstrate that it systematically and consistently achieves relevant requirements set out in ISO 55000
4	Optimising	The organization can demonstrate that it systematically and consistently optimising its Asset Management practice, in line with the organization's objectives and operating context
5	Excellent	The organization can demonstrate that it employs the leading practices, and achieves maximum value from the management of its assets, in line with the organization's objectives and operating context

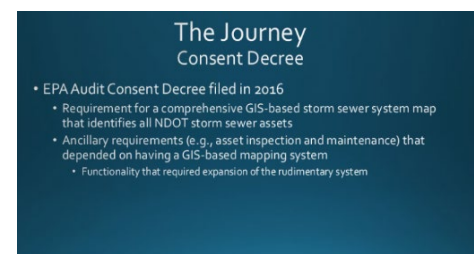
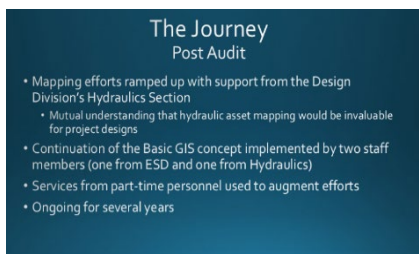
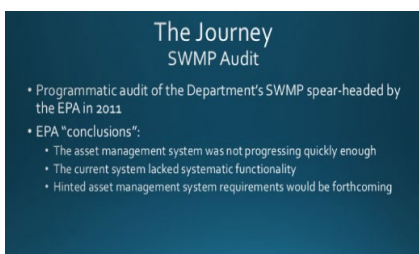
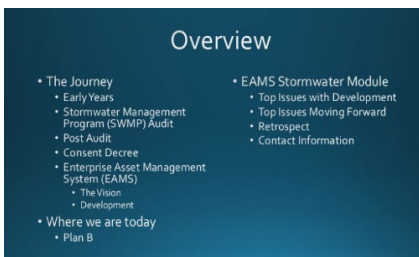
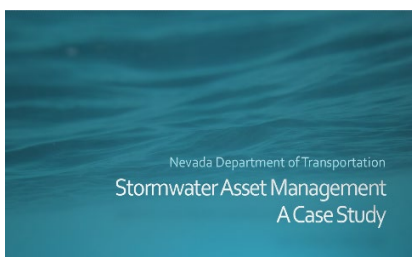
Thank You!



Did a poll on asset management for those present in the room: 43% we're competent' and 40% were 'developing'

8:05 am – 8:20 am – James Murphy – Overview of the Nevada's recent asset management system.

James Murphy: Stormwater Asset Management: A Case Study



The Journey EAMS

- The Department executed a consultant agreement in 2017 to develop an enterprise asset management system
- Several individual modules for specific asset management (bridge, pavement, maintenance, and stormwater)
- Designed to meet the asset management needs of the Department
 - GIS-based
 - Readily adaptable and configurable
 - Desktop/web-based and mobile applications

The Journey EAMS – The Vision


- All storm sewer system assets mapped; pertinent attribute information included
- Inspection records
- Criteria for assessing maintenance needs
- Work order development and tracking for maintenance tasks
- Stormwater and Maintenance modules "linked" together

The Journey EAMS – Development

- Individual modules developed separately, but with some overlap
- Bridge and pavement modules were addressed first as "low hanging" fruit
- Maintenance module was next and subsequently released in FY 2020
- Stormwater module development ongoing

Where We Are Today Plan B

- Numerous issues with EAMS that continue to delay deployment of the Stormwater Module
- Continuation of the Basic GIS concept (with enhancements) in the interim
- Maintenance and Stormwater Modules working independently



Where We Are Today Plan B

Mapping Resource



Where We Are Today Plan B

System of Record for Inspections



EAMS Stormwater Module Top Development Issues

- Accurate Asset Inventory
 - Change management process currently in place
- Rushed Development
 - Sole focus to meet Consent Decree requirements rather than bigger picture business needs
- Technology Delivery Model
 - The waterfall approach not conducive for adapting to change
- Mis-Alignment
 - Lack of a well-defined business process
- Experience and Capability of the Development Team

EAMS Stormwater Module Top Issues/Questions Moving Forward

- EAMS is not built with "commercially off the shelf" (COTS) software
 - Changes cannot be readily performed and require program coding.
- Sufficient technology support??
 - The technology needs to be adaptable and fluid. Stormwater management is not static. Can IT staff keep up with the needs?
 - Field equipment capabilities to implement mobile technology
- Department support and funding?
 - Will this limit program evolution?

EAMS Stormwater Module Retrospect

- Management/Leadership support!!
- Embrace the Agile – Scrum technology delivery methodology
 - Allows for quicker system evolution and adaptation to changing requirements
- Environmental Scoping
 - Engagement (or enhanced engagement) with key stakeholders
 - Consult out RFP development if needed
- Build the program using COTS technology-based system

EAMS Stormwater Module Retrospect

- Use in-house staff capabilities and hire consultants as needed to build the system
 - Keeps technology in-house and provides flexibility to scale out and meet deadlines
- Strategic Plan and Performance Measures
 - Understand where technology is headed and ensure alignment with strategic plans
- Ensure the system is architecturally sound (solid foundation from the ground up)
- Dedicated resources from cradle to grave

EAMS Stormwater Module Contact Information

Cricket Von James IT Manager Nevada Department of Transportation Environmental Division cronjames@dot.nv.gov	James Murphy Program Manager Nevada Department of Transportation Environmental Division jmurphy@dot.nv.gov
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8:45 am – 9:30 am – Facilitated Q & A session

Questions: For NVDOT: Is the regulator satisfied with the progress of your asset management program?

Ans: They are not monitoring that closely, and NDOT is meeting the requirements of the Consent Decree. If NDOT does scrap the current system, they will work from in house resources and use a commercially off the shelf system.

Question: The consent decree required an asset management system?

Ans: They must satisfy the current permit and consent decree.

Question: How do you set your levels of service minimums in NCDOT?

Ans: The regulator has not set any performance thresholds. The performance thresholds are negotiable, and a team decision based on the resources that you have, what can you achieve. Bottom line is compliance risk – you can't be out of compliance. Dashboards make some of this information public. That may help drive resource allocation.

Question: If NDOT had known that the EAMS was going to be so difficult to develop, would you have pushed back harder on it in the Consent Decree?

Ans: Probably, we were confident we could get something done, but EPA was very set that they wanted this system. There was probably not much leverage to push back on the requirement. There was not a direct link from an EAMS to the CWA per se, but since EPA wanted it, we needed to comply.

Question: How do you schedule your inspections?

Ans: This is still being developed. There is disagreement as to when the assets should be maintained. We are trying to build consensus on this. Right now, we are working off benchmarks – inspecting and maintaining a certain percentage of assets each year.

9:30 am – 10:00 am – Break

Session 6 – Emerging Contaminates

Emerging contaminants are an important issue for the MS4 Stormwater Program. Such contaminants are defined as chemicals not previously known in the environment or acting in new ways such as synergistically or having new pathways to stormwater. Emerging contaminants can reduce the certainty of permit compliance as well as the certainty of program implementation costs. Accordingly, they represent a substantial unquantified risk to MS4 program managers. Proactive efforts can reduce the risk and uncertainty as well as future program costs. This session will discuss various approaches for addressing emerging contaminants that can be used by DOT stormwater professionals

Speaker:

- Scott Taylor, Michael Baker International
- Interactive group discussion

10:00 am – 11:00 pm – Emerging Contaminates

- Scott Taylor, MBI

Overview and group discussion

This session discussed the concept of Emerging Contaminants, such contaminants in the DOT environment, and methods for DOTs to lessen or mitigate their impact. The short presentation was followed by a discussion with the audience to brainstorm approaches to addressing emerging contaminants of significance to DOTs.

Scott Taylor: *Emerging Contaminants and DOTs*

Emerging Contaminants and DOTs

What is our Endgame?

Practitioners Meeting
Raleigh, NC

April 2022
Scott Taylor, P.E., FASCE, D.WRE

Michael Boland
INTERNATIONAL We Make a Difference

What is an Emerging Contaminant?

- **Common view:** Chemicals and compounds not previously known to occur in the environment
- **Better view:** Chemicals known to exist, but we just never looked for them



We Make a Difference

The Known Chemical Universe

- As of 2020, there are over 159M chemicals indexed by the CAS (12,000 added daily)
- About 35M are commercially available
- Of these, about 249,000 are inventoried or regulated by governments worldwide
- This means:
 - Chemical by chemical approach of evaluating risk for existing and new chemicals and compounds is not practical
 - Environmental data needed to evaluate chemicals is very limited



We Make a Difference

Why do we have emerging contaminants?

- We monitor for a chemical or compound after we 'discover' a problem. But we don't look for problems. We look for known chemicals.



We Make a Difference

- Synergistic and latent effects and bioaccumulation all confound efforts to assess water and habitat quality and understand the cause of impairments

- Most Monitoring is a self-fulfilling prophecy

From Daughton, USEPA

The Problem with Monitoring Programs

- Monitoring programs sample for chemicals we know are there, and we also know, within a range, what their concentration will be
- The impacts of these chemicals on the environment are generally known. But synergistic effects have received less study
- Current monitoring approach results in emerging contaminants
- With a proactive monitoring approach, then there are no emerging contaminants, just emerging impairments

- Toxicity (acute and chronic)
- Bioaccumulation
- Hydromodification (sediment)
- Eutrophication
- Sanitary quality
- Gross pollutants



From Daughton, 2009

A Proactive Roadway Monitoring Example

- SR 241 in Orange County
- Developed a 'proactive' monitoring program and implemented it for 3 years.
- Some interesting findings:
 - New AC is highly toxic to aquatic life, but quickly (within about a year) becomes virtually non-toxic
 - Highway runoff contains measurable concentrations of palladium and platinum, used in catalytic converters
 - Zinc concentrations are high at CSP pipe outlets
 - Plasticizers high at HDPE outlets



We Make a Difference

Some known truisms

- Many pollutants persist in the environment
- Many are very soluble
- Take years for problems in receiving waters to manifest
- Take more years for us to recognize a problem and find the cause
- Our treatment BMPs can remove trash, sediment and pollutants attached to sediment
- Infiltration does not remove all pollutants
 - Not a feasible BMP in all areas
 - Soluble pollutants may contaminate groundwater



We Make a Difference

Two things are needed

- Control the known problems
- Control the unknown problems



We Make a Difference

Known 'emerging' problems for DOTs

- Salt
- Microplastics
- Trash
- PFAS
- PAHs
- GPPD
- Copper (solved?)
- Zinc
- Pesticides – kind of a special case



We Make a Difference

Group Discussion Questions

- How can DOTs best address known emerging contaminants?
 - Economical
 - Practical
 - Safety
 - Socially acceptable
- How can DOTs proactively address future emerging contaminants?
 - We know they are coming. How do we prepare. How do we break the current cycle?

We Make a Difference

Potential Tools and Other Things to Consider

- Extended Producer Responsibility
- Green Chemistry
- Product Substitution
- TSCA
- Chemical pathways to the environment
- Is the use of chemical proxies in monitoring a good approach?
- Who does the needed research to look for problems?
- Who pays?
- What is the stormwater endgame – the plan for compliance?

We Make a Difference

SELDM: Stochastic Empirical Loading and Dilution Model

The Stochastic Empirical Loading and Dilution Model has been developed by the USGS to facilitate analysis of MS4 discharges on receiving waters. The model is well suited for use by DOT practitioners to assess the impacts of runoff from highways on the water quality of state receiving waters. The model can be especially useful in assessing DOT contributions to TMDL load allocations.

Speaker:

- Gregory E. Granato, Hydrologist – U.S. Geological Survey, New England Science Center

The overall topic of the presentation was an overview of the use of the SELDM model. The presentation was geared to the stormwater program manager, to facilitate understanding of how the model can be used to improve stormwater program implementation and performance at a DOT.

11:00 pm – 12:00 pm – Greg Granato - SELDM: Stochastic Empirical Loading and Dilution Model.

Gregory Granato: Introduction to SELDM

USGS
science for a changing world

U.S. Department of Transportation
Federal Highway Administration

Introduction to the Stochastic Empirical Loading and Dilution Model (SELDM)

2022 National Stormwater Practitioners Forum
Raleigh North Carolina April 11 – 14, 2022

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of Transportation
Federal Highway Administration

The HRDB interface can be used to obtain water-quality data statistics, and runoff-coefficient values

Highway-Runoff Database Main Menu

Highway-Runoff Database: A Data Warehouse and Preprocessor for the Stochastic Empirical Loading and Dilution Model (SELDM)

Version: 1.1.0 Dilution

- Select and Export Data for a Water-Quality Constituent in Tab-Delimited Format
- Select and Export Data for a Water-Quality Constituent in Conserved Data Program Format
- Select Paired Water-Quality Constituent Values for Regression Analysis
- Generate Statistics for Water-Quality Data
- Select and Export Runoff-Coefficient Information
- Exit Highway Runoff Database

Prepared by the U.S. Geological Survey
in cooperation with
The Department of Transportation
Federal Highway Administration

The HRDB has 415 different water-quality constituents, counts may indicate importance

Constituent	Number of EMCs
TSS	3,800
TZn	3,400
TCu	3,300
TPb	3,200
TP	3,100
TKN	2,600
TCd	2,100
TOC	2,000
FZn	1,900
FCu	1,800

The HRDB is large but we need more data.

- 17 States
- 37 Datasets
- 242 Sites
- 6,852 Events
- 107,260 EMCs
- 414 Water-quality properties or constituents

Last software version: <https://doi.org/10.5066/954V1.3J3>
Last data version: <https://doi.org/10.5066/97862E132>

Development of SELDM

Beware over confident modelers

- Essentially, all models are wrong, but some are useful
- Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful

George Box

Complex watershed models can provide order-of-magnitude errors

Increasing performance

Increasing data availability (increasing cost)

Increasing model complexity

Watershed models

- Fully Calibrated
- Semi-calibrated
- Uncalibrated

Cooperative Research Center for Catchment Hydrology, 2005

There is some balance between the complexity of the model & the amount & type of data needed

Uncertainty

Model Complexity

Total Uncertainty

Point of Minimum Uncertainty

Model Framework Uncertainty

Data Uncertainty

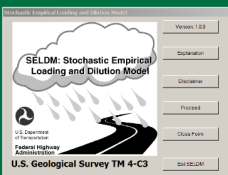
EPA/100/R-05/003

Susan Jones & Pat Cazenias Proclaimed

- I. Make it easy to use
- II. Make it acceptable to regulators
- III. Make it acceptable to Fish & Wildlife Service
- IV. Make it technically sound
- V. Put it in the public domain
- VI. Give it a very cool or totally nerdy name

SELDM is the Stochastic Empirical Loading and Dilution Model

- Stochastic—Uses Monte Carlo methods to create a sample of events representing combinations of flows loads and concentrations
- Empirical—Based on data and statistics rather than pure theory
- Loading—Provides storm and annual loads
- Dilution—Mixing of upstream and highway runoff indicates chance of exceeding a target value



SELDM uses a simple mass balance approach to calculate flows, concentrations, and loads by storm and by year



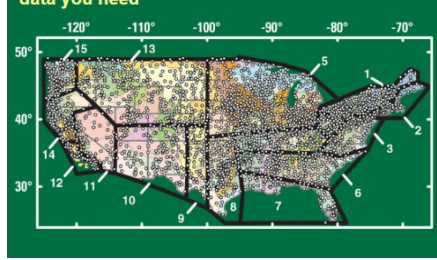
SELDM was tested and/or reviewed by 43 professionals from USGS, USEPA, USFWS, and 16 state agencies



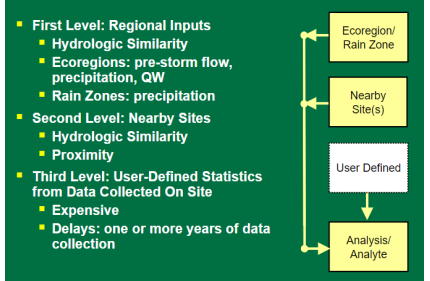
SELDM its inputs and applications are documented in 32 peer-reviewed publications



We filled SELDM with many of the statistics and data you need

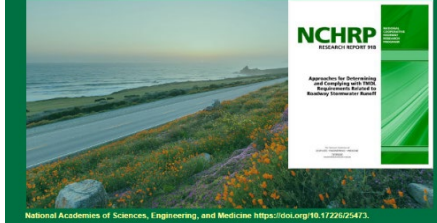


Supports the Environmental Decision-Making Process



Information Need 1 TMDLs

SELDM is the recommended method in NCHRP Report 918: Approaches for Determining and Complying with TMDL Requirements Related to Roadway Stormwater Runoff



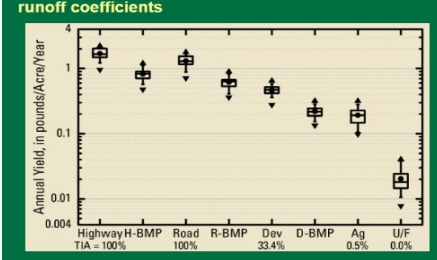
MA DOT used SELDM & GIS to calculate loads for 89 coastal bays and reduced EPA highway-runoff estimates of TN from 9.1 to 4.4 percent of impervious area loads

- Used MA data for total nitrogen from the Highway Runoff Database vs NURP data
- Using SELDM & GIS was less expensive and faster than complex watershed models
- Loads were much less than initial regulator estimates
- Approach accepted by EPA

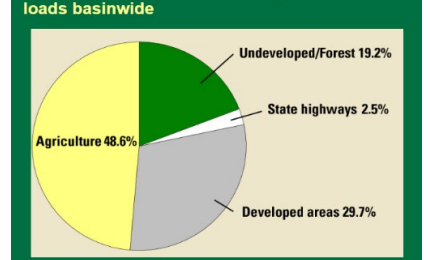
We did an analysis of phosphorus loads in the Willamette R. in Oregon



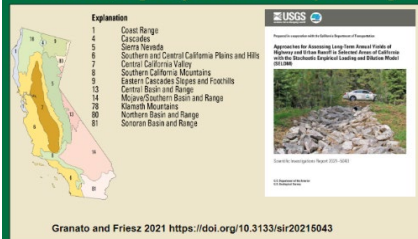
Pavement yields are largest because of the larger runoff concentrations and the larger impervious-area runoff coefficients



Although highway yields predominate, they are a small percentage of the average of the annual loads basinwide



For CalTrans we simulated ecoregion and basin-specific highway and urban yields for 53 constituents; highways were a small percentage



We did a case study to look at nitrogen in highway and urban runoff to the Narragansett Bay, which has large highly-developed tributaries in Rhode Island and Massachusetts

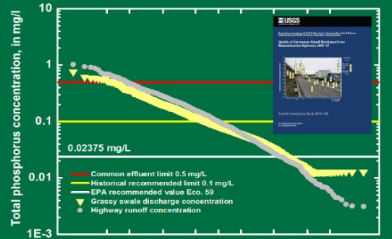


The simulated long-term average annual load from 10 river-basin tributaries is about 27 tons from highways and 675 tons from other developed areas

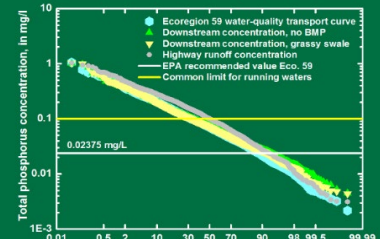
River	Area, in square miles	Highway	ODA	Highway	ODA	Sum	Percent
Blackstone	475	2.38	138	7.36	209.32	216.68	3.40
Taunton	366	1.86	116	5.76	175.95	181.71	3.17
Pawtucket	232	1.32	62	4.08	94.04	98.12	4.16
Threemile	85.3	0.56	30.5	1.73	46.26	47.99	3.60
WoonMoshassuck	74.5	0.9	37	2.78	56.12	58.90	4.72
Ten Mile	55.4	0.55	29.9	1.7	45.5	45.5	3.61
Palmer	48.8	0.18	8.41	0.56	12.76	12.76	4.20
Quequechan	30.2	0.38	9.37	1.18	14.21	14.21	7.67
Hunt	22.7	0.23	9.03	0.71	15.7	15.7	4.93
Barrington	9.72	0.19	5.12	0.59	7.71	7.71	7.06
Sum	1,400	8.55	445	26.5	675	702	3.77

Information Need 2 Water-Quality Impact

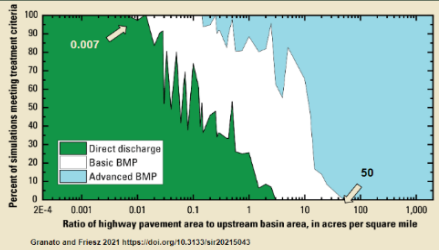
SELDM generated 1,648 storms in 29 years



The effects of total phosphorus in Highway runoff is small for most storms



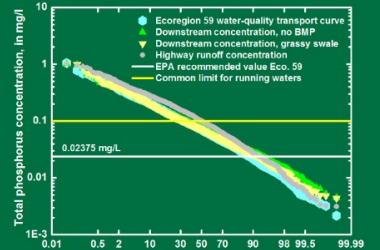
USGS in cooperation with NCDOT ran ~75,000 simulations to build a decision-support catalog



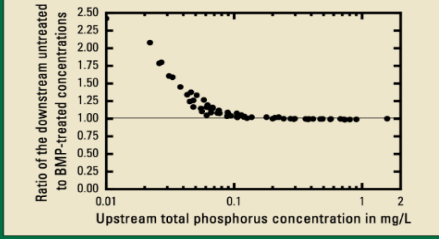
Information Need 3 Quantification of Common Sense



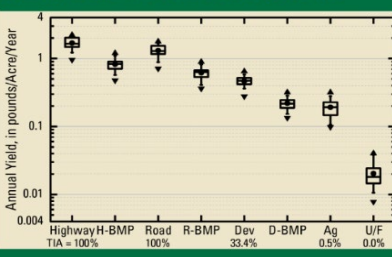
Do water-quality standards apply to natural stormwater?



Natural basins exceed criteria & treating runoff in urban areas does not change downstream quality



Treated developed areas are 10 X and treated highway areas are 40 X forest yields ...



Information & Training Sponsored by FHWA (Thanks Susan!)

SELDM Web Page <https://www.usgs.gov/SELDM/>

The YouTube channel has more than 52 videos including software demonstrations, training modules on theory and practice, webinars & more

You decide how involved you may want to be. You can get a general feel by watching the videos or become a SELDM modeler by being more active

Any Questions? <https://www.usgs.gov/SELDM/>

Session 7 – Winter Best Management Practices

DOTs must ensure the safety of the traveling public during winter by controlling snow and ice. The most common method of control is through the use of salt. Salt application to roadways has been shown to negatively affect receiving waters. Use of other deicer agents, such as beet juice and proprietary formulations may also be problematic, by adding BOD or other pollutants to meltwater. The panel will discuss permitting strategies for authorizing the use of salt on highway, experience with methods of managing and reducing salt use, and practical and regulatory issues with salt and alternative deicers.

Panel members:

- William Fletcher, Moderator, Ohio DOT, Retired
- Mark Hemmerlein, New Hampshire DOT
- Henry Barbaro, Massachusetts DOT
- Tracey Harmon Scott, Virginia DOT

The overall topic was a discussion of current deicers used by DOTs, their pros and cons, and a discussion of methods to reduce environmental impact of deicers while maintaining the safety of the traveling public. Emerging deicer products were discussed.

1:00 pm – 1:05 pm – William Fletcher – Welcome and introduction/overview.

1:05 pm – 1:20 pm – Mark Hemmerlein – Regulatory framework for state snow and ice control operations.

Mark Hemmerlein: *Incorporating Chloride Control Measures into Permits*

Incorporating Chloride Control Measures into Permits
 Things to look out for:
 National Stormwater Practitioners' Forum

Clean Water Act

- › Discovery
- › Consolidated Listing Mythology
- › Section 303 Impairment List
- › Total Maximum Daily Load Study
- › TMDL Implementation Plan
- › Waste Load Incorporation into Section 402 Permits
- › Load Incorporation into Section 319 Grants

Discovery

Consolidated Listing Mythology
 Be leery of chloride surrogates

Section 303 Impairment List
 Click to add text

Total Maximum Daily Load Study

Ensure the study is limited to the waterbody and not the watershed.

Need about 10 years' worth of data due to variable winter severity

Make sure the Waste Load and Load Allocations are based on real data

TMDL Implementation Plan

- Divided among State, Municipal and Private sectors
- Accounts for DOTs salt use efficiencies
- Level of Service & Safety
- Economically feasible
- Serves as a bridge between the numeric allocations to Control Practices

Waste Load Incorporation into Section 402 Permits

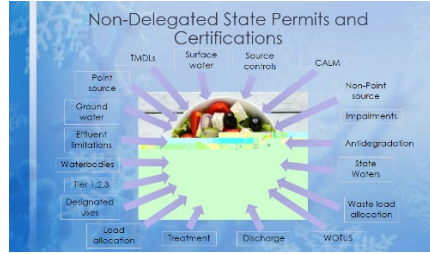
- Authorization does not require counting grains of salt (i.e., not numeric Waste Load Allocation based)
- Control Measures are limited to Point Source Discharge
- Know your Point Source Discharge
- Check the 303 List to ensure the permit is correct
- Control Measures are DOT based

Loads Incorporation into Section 319 Grants

- Funded Measures are limited to Non-Point Source Discharge
- Should cover most of DOTs' discharges from rural highways
- Control Measures are DOT based

Clean Water Act (Structured)

- Discovery
- Consolidated Listing Mythology
- Section 303 Impairment List
- Total Maximum Daily Load Study
- TMDL Implementation Plan
- Waste Load Incorporation into Section 402 Permits
- Load Incorporation into Section 319 Grants



1:20 pm – 1:35 pm – Henry Barbaro – MassDOT’s snow and ice control operations, reporting and its implementation of various salt-reduction measures.

Henry Barbaro: *MassDOT Winter Salt Reduction: A Case Study*

MassDOT Winter Salt Reduction: A Case Study

Henry Barbaro,
MassDOT Stormwater Program
henry.barbaro@state.ma.us

April 14, 2022
National Stormwater Practitioners Forum
Raleigh North Carolina

Environmental Review / Reporting

Massachusetts Environmental Policy Act (MEPA)

MassDOT Snow & Ice Control Environmental Status and Planning Report (ESPR) – every 5 years (since 1980’s)

- Posted for Public/Agency Review

Annual S&I Environmental Report
Posted for Public Review

Regulations and Agency Scrutiny

MEPA Review on Major Road Projects (e.g., EIR Documents)

MS4 Permit: Salt Reduction Plans for Chloride Impaired Waters

Salt Remediation Program: Private & Public Water Supplies

Mitigation Measures – Beginning in 2011

- Pre-treatment / Pre-wetting
- Closed-loop Controllers
- Pavement Friction Sensors/Meters
- RWIS Stations w/ Cameras
- Segmented Plow Blades
- Vaisala Road Surface Sensors

Mitigation Measures – Beginning in 2011

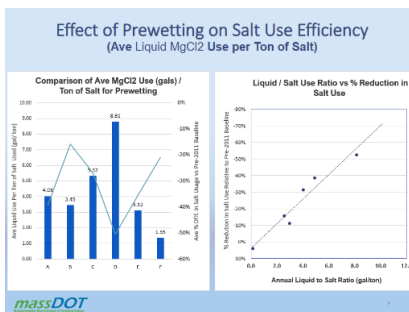
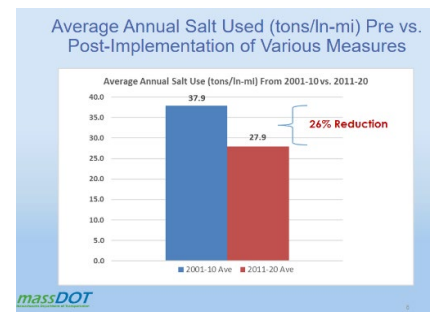
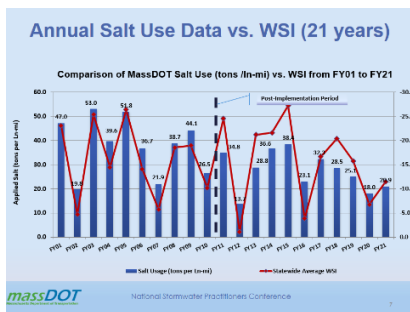
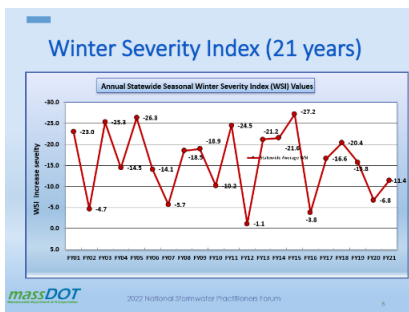
- Pre-treatment / Pre-wetting
- Closed-loop Controllers
- Pavement Friction Sensors/Meters
- RWIS Stations w/ Cameras
- Segmented Plow Blades
- Vaisala Road Surface Sensors

Mitigation Measures (cont.)

High Arch Gambrel Salt Sheds

Winter Sanding

Traction Control or Waterfront Real Estate ?



Increasing Environmental Concerns

- 24 Chloride Impaired Waters: 18 more since 2016 Despite recent MassDOT Salt Use Reductions
- > 12 Major Municipal Water Supply Wells Average Na Concentrations above 100 mg/L
- Over 30 Areas of Critical Environmental Concern

Meanwhile Salt is Practically Dumped on Secondary Roads & Parking Lots

Excess Salt on low volume road and parking lots

massDOT

Next Era of Technologies & Mitigation Practices

Pretreated Salt • Phase Out Use of Conventional Dry Salt (i.e., pretreated or pretreated with liquids)	Data Driven Operations / Automation Adjust Applications by Pavement and Weather Sensors	Geothermal Heating
Enhanced Video Training / Operator Certifications	Alternative Pavement /Friction Enhancements	Enhanced Plow Blades / Equipment

massDOT

MassDOT Snow and Ice Control Program

2017 Environmental Status and Planning Report
EEA# 11202

• [Henry Barbaro MassDOT](mailto:henry.barbaro@state.ma.us)
henry.barbaro@state.ma.us

• <https://www.mass.gov/doc/massdot-snow-and-ice-control-environmental-status-planning-report-2017/download>

Questions ?

massDOT

1:45 pm – 2:05 pm – Tracey Harmon Scott– Environmental considerations for anti-icers and de-icers.

Tracey Harmon: Environmental Considerations for Anti-icers and Deicers

Environmental Considerations for Anti-icers and Deicers

Tracey Harmon
VDOT Environmental
National Stormwater Practitioners' Forum
April 14, 2022

VDOT

Topics

- Anti-icing/Deicing Alternative Comparisons
- Chloride TMDLs - Accotink Creek, VA
- Virginia's Salt Management Strategy
- Managing Expectations
- Balance

VDOT

Chloride Deicers

	NaCl	CaCl ₂	MgCl ₂
Soils	• Soil structure • Heavy Metals	• Soil structure • Heavy Metals	• Soil structure • Heavy Metals
SW	• Low flow/spring thaw • Drinking water • Heavy Metal contamination	• Low flow/spring thaw • Drinking water • Heavy Metal contamination	• Low flow/spring thaw • Drinking water • Heavy Metal contamination
Surface Water	• Small waterbodies • High ratio of paved areas • Stratification/anoxia	• Small waterbodies • High ratio of paved areas • Stratification/anoxia	• Small waterbodies • High ratio of paved areas • Stratification/anoxia
veg	• Osmotic stress • Nutrient imbalance • Spread of salt-tolerant, non-natives	• Osmotic stress • Leaf scorch • Ca = macronutrient	• Osmotic stress • Leaf scorch • Mg = key plant physiology
Wildlife	• Salt toxicosis (birds) • Animal/bird strikes	• Little/no adverse effects	• Little/no adverse effects
Autos & Highways	• Corrosion of metals & rebar • Scaling	• Corrosion of metals & rebar • Scaling	• Corrosion of metals & rebar • Scaling

VDOT

Non-Chloride Deicers

Deicer	Properties	Corrosiveness	Toxicity
Acelates	Potassium Sodium Calcium Magnesium	• Corrosive to galvanized steel • Reactive to concrete	• Moderate BOD • Moderate toxicity
Formates	Sodium Potassium	• Corrosive to galvanized steel • Reactive to concrete	• Moderate BOD • Moderate toxicity
Potassium succinate		• Not corrosive • Minimal to no reactivity	• Moderate BOD • Moderate toxicity

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Natural Alternatives

- Cinders ??
- Beet juice ??
- VA – § 3.2-3607.2. Sale of deicing agents.

Beginning December 31, 2013, it is prohibited for any person to offer for sale any deicing agent containing urea or other forms of nitrogen or phosphorus intended for application to parking lots, roadways, and sidewalks or other paved surfaces in the Commonwealth. The provisions of this section shall not (i) restrict the continued sale by retailers of any deicing agent from any existing inventories in stock on December 31, 2013, or (ii) prohibit the offer for sale or sale of any deicing agents containing urea to any municipal corporation or political subdivision for the purpose of applying such deicing agents pursuant to subsection B of § 15.2-1123. 2011, cc. 341, 353, 2013, c. 706.

• “Everything is a pollutant!” 😞

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Chloride Concentration Concerns

Great Lakes

- 1800s estimated ~ 1–2 mg/L
- Present day > 10 mg/L in Lake Michigan, Erie, and Ontario

Lake Michigan

- Water volume of 4.918 trillion m³
- ~ 5 million metric tons of salt to raise salinity by 1 mg/L.
- Based on the estimated annual loading of road salt, could be accomplished in 2–3 yrs
- From 1980 to 2020, increased from ~ 9 to ~ 15 mg/L
- = annual increase of 0.125 mg/L
- ~ 0.625 million metric tons of chloride added to Lake Michigan per year.

VDOT

Freshwater Salinization - Drinking Water

- Major contributor in the urban environment and documented in Fairfax County, Virginia streams
- Sodium concentrations at Fairfax Water's intake in the Occoquan Reservoir show an increasing trend

Figure 3. Trends in sodium levels of the drinking water intake on the Occoquan Reservoir.

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USGS Monitoring

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USGS Monitoring

Specific conductance (SC)

- Varied spatially due to:
 - Geology
 - Anthropogenic disturbance (high impervious cover)

Figure 1.1 Conductance (Specific Conductance) and Specific Conductance (Specific Conductance)

- SC inversely related to streamflow

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USGS Monitoring

- EXCEPT
 - Winter months following road deicing applications!!
 - Values increased by several orders of magnitude
- 2% per year observed over 10-year period at nearly all monitoring stations
- Increasing trends were observed during winter and non-winter months
 - suggests that deicing salts are stored in the environment and released year-round

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USGS

WaterQualityWatch™ - Continuous Real-Time Water Quality of Surface Water for the United States

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Accotink Creek (Fairfax Co.)

- Biological monitoring → Aquatic Life Use not supported (Impaired)
- Most probable stressors:
 - Chlorides
 - Hydromodification
 - Habitat modification
 - Sediment

Figure 0.1 Location of the Report Region in Accotink Creek Watershed

VDOT

VIRGINIA

“This is not something I would wish on my worst enemy”: The aftermath of I-95 nightmare and how Virginia can prevent future incidents

Sen. Kaine, Delegate Aird among thousands of motorists stuck in 1995 catastrophe

Transportation officials apologize for I-95 disaster, will review actions taken

I-95 Shutdown: Virginia lawmaker proposes bill that would prevent future traffic disasters



VIRGINIA

Gov. Youngkin declares state of emergency ahead of winter weather

Richmond District VA refreeze Monday


National Guard works with partners on winter storm response






Balance

Tradeoffs


Won't get fooled again: VDOT crews to salt down I-95 ahead of potential weekend snow

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WORK ZONES ARE A SIGN TO SLOW DOWN



2:05 pm – 2:30 pm – Facilitated Q & A session

Questions: I heard that salt is stored in the environment (soil), then released throughout the year.

Ans: Yes, the salt soaks into the ground, so shallow groundwater around highways is very high, sampling has shown up to 500mg/l next to a highway. That migrates to a nearby stream as base flow, so there is a storage and lag mechanism.

Question: What is the level of salt that impacts rebar in roads or in groundwater?

Ans: Oregon did not use salt due to corrosive effects on bridges and rebar in concrete. Now they coat the concrete to limit the intrusion of salt into the concrete. MA/NH deals with this in design, coating rebar with epoxy and covering rebar with additional concrete.

Question: A congressional mandate is to produce a study assess pollutant loads from roads, and this may lead to TMDLs.

Ans: Can push back using the ribbon analogy. DOTs are a very small part of the watershed.

Question: I appreciate that you explained the TMDL process and that the regulator can short cut them and should not. We found waterbodies on the list for chloride in MN that had no data to support them being on there. MN has 40 TMDLs for salt. Compliance with them (the TMDLs) is activity based to meet the WLA. It is very difficult to meet a WLA for chloride.

Question: Chloride maps are not only indicative of DOT use. The fracking industry and other industrial uses may put salts into the environment. It is good to check the data source for the map development.

OR DOT does use abrasives, but they have successfully installed sediment basins to collect the abrasives in the runoff.

Closing:

2:30 pm – 3:00 pm – Scott McGowen and Andy McDaniel

DOT Input, Forum Highlights and Future Needs

- PDH credits were given by FHWA for this Forum.
- There is a public website of this 2022 Practitioners Forum.
<https://nconnect.sharepoint.com/sites/NationalStormwaterPractitionersMeeting>
- The conference booklet is available, along with electronic copies of the presentation. There are also recordings from the Oct 2020 virtual forum. This website will also have the proceedings from this forum. Included in the proceedings will be attendees with email address.
- There will be another virtual forum this fall (2022). Due to be held in November and will be open to all Practitioners.

Virtual Forum Potential Topics:

1. How to build relationships and partnerships within the DOT and interagency.
2. Handoff from project delivery to construction to maintenance. Best practices to achieve these handoffs efficiently and effectively
3. Reserve time to talk with states in a common EPA region. Perhaps a table topic or breakout. Include an EPA rep?
4. Invite EPA to the summary of the meeting to hear the conclusions – esp. the EPA liaison.
5. Impact of stormwater on hydromodification and techniques to mitigate
6. Looking at DOT stormwater management as a wholistic or system approach as opposed to project by project. Also: offsite mitigation and the benefits.
7. Discuss specific metrics for projects by DOT for stormwater.
8. More in depth discussion on a watershed approach. What are the opportunities and triggers for going offsite? Discuss an offsite policy for mitigation.
9. Hear examples from DOTs on cooperative and interagency agreements related to stormwater. For training, maintenance, construction, DEQs, municipal coordination etc.
10. Communication to executive leadership: Tips on how to explain the program and get leadership to understand needs. How to communicate the different program aspects like between MEP and TMDLs
11. Creation of a uniform BMP rating system that would be common amongst the states. Keep asset management as a general topic.
12. Breakout sessions – there are things from that topic list, and the ones that we did talk about.
13. What is the life cycle of a BMP – how long do they last?

State DOT Host for next in-person Forum: Looking specifically for the middle portion of the country. Perhaps think of a pooled fund meeting system such as Clear Roads. Currently 36 states meet using this tool. Each state pays dues to the Clear Roads program.

Every practitioner should get involved nationally. Work with EPA, NCHRP studies, we need to show interest to keep the focus on stormwater programs. Attend TRB, become a friend of AKD50, the standing committee on hydrology, hydraulics, and stormwater.