Center for Environmental Excellence by AASHTO
Stormwater Management Community of Practice (CoP)

STATE-OF-THE-PRACTICE REPORT: Water Quality Monitoring

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DISCLAIMER

This State-of-the-Practice Report summarizes the discussions of Stormwater Management Community of Practice members who spoke as individual members of the community and did not necessarily represent their agency's views or positions. In addition, the contents of the report do not necessarily represent the views or positions of AASHTO or the Center for Environmental Excellence.

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EXECUTIVE SUMMARY

This Community of Practice (CoP) report includes an overview of the State-of-the-Practice for water quality monitoring to comply with National Pollutant Discharge Elimination System (NPDES) Permits for State Departments of Transportation (DOTs). Not every DOT has monitoring requirements in their NPDES Permit, but some form of monitoring will likely be required in the future. The objective of this report is to provide information on the state of the practice of monitoring for DOTs, and provide information on the elements of an idealized DOT monitoring program. Monitoring in the context of this report refers to sampling of stormwater runoff from DOT facilities, or in the receiving water.

Highways are contributors of runoff to most receiving waterbodies in each state, but in the vast majority of cases, they are not the dominant pollution source in the watershed. Accordingly, DOTs should not be the lead agency to investigate or set priorities for the identification of, or mitigation of receiving water pollution. In addition, DOTs are transportation, not natural resource agencies, and are not staffed or funded to investigate or track overall environmental conditions. Other NPDES permit holders or the regulatory agency should lead receiving water assessment programs.

The DOT program should focus on answering questions that will support more effective implementation of DOT specific BMPs and overall stormwater management programs within the DOT. DOTs agree that basic characterization monitoring is the foundation of an assessment program. Some DOTs may be near to, or have fulfilled the objective of characterizing their runoff. DOT facilities are generally uniform with consistent pollution sources within the right-of-way, but regional differences that include manufacturing and industry particulate emissions, agriculture, the use of traction aides, herbicides and highway construction materials, and natural variations, including climate and geology, may all be unique to the DOT or sub-region within a DOTs boundary. Comparison of DOT monitoring data nationally shows it to be generally consistent (Granato, et.al., 2009), but a basic foundation of local characterization data is useful for the DOT to establish “baseline” conditions for TMDLs, to evaluate “hotspots” and have sufficient information to evaluate the agency’s contribution to receiving water pollution problems.

The CoP recommends the following general elements for a DOT monitoring program. These elements may either be emphasized or de-emphasized depending on state and local priorities, but each element should be included in a comprehensive program to provide a feedback loop for program improvement. For large, geographically diverse states, sub-regional variations are also of interest. Recommended program elements are:

1. Characterization of runoff and identify constituents of concern
2. Identifying new constituents of concern generated within the right-of-way
3. Fill data gaps for DOT stormwater program improvement
4. TMDL compliance and program support
5. BMP performance assessment

Receiving water monitoring is absent from this list of recommended elements. Receiving water monitoring is important to understand how well waters of the US are meeting the objectives of

the CWA. However, the DOT contribution to receiving waters as an overall percentage of the volume of runoff or the fraction of pollutant loading in a watershed is usually very small compared to other permitted and non-permitted sources. The value that a DOT stormwater program can derive from receiving water monitoring data is very limited. Therefore, DOT monitoring resources are best spent on the program objectives listed above.

INTRODUCTION

The Center for Environmental Excellence by AASHTO has established a Stormwater Management Community of Practice (CoP). The purpose of the Stormwater Management CoP is to create a forum where State Department of Transportation (DOT) practitioners can engage in facilitated discussions on emerging issues, research needs, and innovative stormwater quality compliance solutions. The CoP has two primary goals: the first is to extend each state DOT's network and contacts, enabling them to share experiences and engage in technology transfer. The second goal is to develop a State-of-the-Practice Report (this document) on a selected focus topic. The Stormwater Management CoP consists of representatives from 11 state DOTs, and the Federal Highway Administration (FHWA). The Stormwater Management CoP members agreed that water quality monitoring should be the top priority for this report of the CoP.

Water quality monitoring can be a major element of a DOT National Pollutant Discharge Elimination System (NPDES) stormwater program. This report is divided into three sub-topic areas:

1. Current state-of-the-practice of DOT monitoring programs;
2. The study questions that DOT stormwater programs should answer; and
3. The benefits and challenges of group versus independent monitoring.

Current DOT monitoring programs generally reflect NPDES permit requirements. The programs have been developed to meet the requirements of the permit, but not necessarily to provide information that will be most useful to the DOT stormwater program.

Fundamentally, the DOT stormwater monitoring program should be designed to answer management questions that can improve the performance of the stormwater program. Municipal stormwater programs have invested some resources in developing study questions; less effort has been expended in this area for DOTs. Typical MS4 monitoring program study questions may include (RWQCB, 2009):

1. Are the conditions in the receiving waters protective, or likely to be protective of beneficial uses?
2. What is the extent and magnitude of the current or potential receiving water problems?
3. What is the relative urban runoff contribution to the receiving water problems?
4. What are the sources of urban runoff that contribute to the receiving water problems?
5. Are conditions in receiving waters getting better or worse?

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Study questions suitable for DOT monitoring programs will not focus on the receiving water since the DOT is typically a very small contributor of the total pollutant load in a watershed. Understanding the conditions in the receiving water is important, but this information provides little useful feedback to the DOT in support of program improvement. Study questions for DOTs will focus on issues to improve the DOT stormwater program performance including BMP performance, runoff characterization, resource allocation, strategic planning for stormwater management, and filling data gaps.

DOTs may be faced with the question of whether to participate in group monitoring programs, either to satisfy permit requirements or to take advantage of economies of a single coordinated program. In this instance, the DOT must evaluate the value of the information to be collected against the investment made, of the proposed collective program. MS4 monitoring objectives may not always be aligned with DOT program objectives, but there will be instances where participation in a joint monitoring program can be beneficial.

The Purpose of Water Quality Monitoring

Background

Water quality data are used to characterize waters, identify trends over time, identify emerging problems, determine whether pollution control programs are working, help direct pollution control efforts to where they are most needed, and respond to emergencies such as floods and spills. (U.S. EPA, 2012)

Stormwater quality is variable depending on rainfall intensity and regularity, runoff rate, pollutant washoff rate, in-channel flow rate, pollutant transport, sediment deposition and re-suspension, channel scour, and numerous other phenomena that collectively determine the pollutant concentrations, pollutant forms, and stormwater flow rate observed at a given monitoring location at any moment. In addition, the transitory and unpredictable nature of many pollutant sources and release mechanisms (e.g., spills, leaks, dumping, construction activity, landscape irrigation runoff), and differences in the time interval between storm events contribute to inter-storm variability. As a result, pollutant concentrations and other stormwater characteristics at a given location should be expected to fluctuate greatly during a single storm runoff event and from event to event. (U.S. DOT, 2001).

Research (NCDOT/URS Corp., 2010) has shown that average annual daily traffic (AADT) and location in an urban or rural area as the statistically most significant factors in determining pollutant load from highways. Pollution sources within the right-of-way, vehicles, are common to all DOTs. However, operational and environmental differences can influence highway runoff water quality. For example, in the northeast, where coal fired power plants are common, mercury may be elevated and pH relatively low in runoff. Where salt is used to control the buildup of ice, high chloride content is likely. The use of herbicides to respond to local conditions will also influence runoff water toxicity.

DOT monitoring programs should be developed based on maintenance and operation practices as well as to understand the effectiveness of the BMPs the DOTs employ. A comprehensive dataset

for characterization at various locations throughout the state is useful to establish a baseline data set for use in TMDL load allocations and to determine if the DOT is a contributor to a receiving water quality problem. Sometimes specific constituent monitoring may be required if the receiving water is impaired by a pollutant that is not in the DOT characterization monitoring program. Finally, DOTs need reliable information on the performance of the BMPs that they have adopted for general deployment. The data is needed to demonstrate that the BMPs are effective for the constituents of concern for highways. In addition, monitoring may be important in understanding recontamination risk for hazardous material sites where at least some of the pollution has been carried in by runoff.

CURRENT WATER QUALITY MONITORING PROGRAMS

Discussion

Eleven DOTs participated in this Community of Practice: Alabama, California, Colorado, Delaware, Florida, New Hampshire, New York State, Oregon, Virginia, Washington State, and Wisconsin.

Alabama DOT

Alabama DOT (ALDOT) has a state water quality standard for ambient turbidity of 50 Nephelometric Turbidity Units (NTU), in the stream course. There is also a standard that, if the receiving water meets its designated uses, then it meets the water quality standards. Currently, ALDOT does not perform discharge monitoring.

California DOT

California DOT (Caltrans) has completed a comprehensive characterization monitoring program and has developed good understanding of constituents of concern (pollutants) in runoff and the variation across geographic areas in the state, particularly in urban, high-traffic areas. Caltrans generally monitors for a select set of constituent during annual water years. The DOT purchases, owns, and maintains its own monitoring equipment The DOT participates in cooperative efforts with other agencies or municipalities where it shares in the monitoring costs on a case by case basis. Caltrans has a Comprehensive Protocols Guidance Manual (Caltrans, 2003) that contains "monitoring protocols that are used to plan and implement sampling and analysis for chemical and physical constituents, as part of a water quality monitoring program." It includes "supplemental monitoring approaches that can be used to support water quality monitoring, including sediment chemistry monitoring, toxicity testing, use of biological or physical indicators, and visual monitoring." The manual provides detailed guidance for site selection, sample collection, sample handling, laboratory procedures, data collection and analysis. This ensures that data collected through the monitoring program is comparable and has a good level of precision.

Colorado DOT

Colorado DOT (CDOT) has a modest size monitoring program compared to California. Stormwater that runs off highway systems and maintenance facilities is sampled by CDOT staff using auto-samplers, seven of which are currently deployed. The data gathered is included in the DOT's stormwater Annual Report. Projects that discharge to streams with TMDLs and a waste

load allocation assigned to the DOT are monitored for compliance. Basic data analysis is provided in the Annual Report.

Delaware DOT

Delaware DOT (DelDOT) conducts statewide monitoring but does not conduct in-stream ambient monitoring programs because the information would not be useful for the DOT program. Most monitoring is TMDL-driven, particularly for constituents such as total nitrogen, total phosphorus, and fecal coliform bacteria. DelDOT is conducting stormwater quality monitoring pursuant to requirements in the Newcastle County Municipal Separate Storm Sewer System (MS4) Phase I Permit. The DOT also monitors maintenance facilities under the industrial NPDES permit; monitoring is completed semiannually at outfalls at representative industrial sites. The DOT MS4 permit was issued in 2001 and expired in 2006; DelDOT is currently in negotiations for a new permit, adoption of which is expected by summer 2013. The original MS4 Phase I permit required the DOT to conduct wet weather monitoring at five outfalls representing five separate land use categories over a five-year period. DelDOT shared the cost for this monitoring jointly with the Newcastle County government as a co-permittee. The DOT also shared the cost of its Illicit Discharge Detection and Elimination (IDDE) program with the county. This included dry weather screening and monitoring.

DelDOT monitors for issues and best management practices (BMPs) for which the DOT needs more data to help guide its operations and programs. Some of these projects have included:

- Street sweeping waste quality monitoring to develop new methods of disposal and a new street sweeping plan;
- Watershed monitoring for retrofits in small watersheds;
- Biological monitoring and stream characterization (six years) and development of a new retrofit plan;
- BMP performance monitoring, including catch basin inserts, storm filters, proprietary devices, sand filters, and bioretention cells;
- Bacterial monitoring, including a study with watershed partners on dog waste, and effectiveness of public education campaigns;
- Mosquito larvae monitoring to manage problems in stormwater ponds;
- Vehicle wash water monitoring and development of a plan to manage nonstormwater and wash water discharged from DOT sites per a requirement of the regulating agency;
- Sand filter monitoring conducted long-term (4-5 year) to determine effective maintenance protocols; and
- Grass filter strip monitoring to determine ponding improvements and demonstrate pollutant removal effectiveness particularly for compliance with TMDLs.

Current DelDOT research projects include:

- Herbicide use and vegetation control alternatives (e.g., weed barriers and low-growth turf) to reduce pesticide use under guardrails (permit requirement); and
- Turbidity monitoring at construction sites and effectiveness of construction site BMPs in anticipation of the application of numeric effluent limits.

DelDOT will revise its monitoring program to reflect the requirements of the new permit. Major new requirements will include developing a wet weather outfall-monitoring program to provide data on BMP effectiveness. The DOT is charged with identifying locations that require additional controls to protect receiving waters. Other permit requirements will include a new dry weather-screening plan, TMDL monitoring and watershed improvement, and a polychlorinated biphenyl (PCB) monitoring plan. The DOT is retaining a consultant to assist with developing monitoring plans for the new permit. About $750,000 is spent per year on monitoring.

Florida DOT

Primary monitoring requirements for Florida DOT (FDOT) have been specified through the Phase I MS4 permits. FDOT is a copermittee with counties around the state in 15 separate permits. Until recently, the DOT just participated in an ambient monitoring program that was conducted by the co-permittees. The purpose was to assess trends and conditions in receiving waters. The DOT provides funding only for this program.

FDOT was recently issued a new third year permit by Florida Department of Environmental Protection (DEP), which contains new conditions for TMDL implementation, part of which is monitoring program. The program remains in flux; the DEP is currently considering focused monitoring programs for specific impaired areas. FDOT conducts monitoring with other municipalities, mostly for fecal coliform. It is unknown if the DOT will be able to participate in focused ambient monitoring, or whether outfall monitoring will be required to demonstrate compliance in total maximum daily load (TMDL) water bodies.

A separate, non-permit-related study has been underway to establish appropriate event mean concentrations for total nitrogen and total phosphorus from highway runoff from seven or eight stations across the state. Data is being collected using auto-samplers. There has been difficulty getting the number of samples required and separating offsite runoff from FDOT runoff. Natural levels of total nitrogen and total phosphorus are all elevated, so the establishment of a valid background level is important.

New Hampshire DOT

New Hampshire DOT (NHDOT) monitors for three compliance areas: the NPDES permit, construction turbidity, and TMDL compliance.

In 2006, NHDOT conducted a round of bacteria sampling at outfalls. One hundred locations were sampled for bacteria, with no recorded exceedances.

Construction turbidity monitoring is part of the 401 certification for the 404 permit for large projects. These monitoring programs are complicated and involve background sampling from run-on, discharge sampling, and ambient in-stream monitoring.

Sampling for chloride (salt) is required as background information for the development of a TMDL, including ambient in-stream monitoring. The Department of Environmental Services (DES) has taken over this program with conductivity meters in four locations.

New York State DOT

NYSDOT has a program to monitor and inspect outfalls on a five-year cycle for IDDE compliance. No water quality characterization data is obtained from these inspections, and stormwater is not sampled; however, the program does document illicit discharges.

Oregon DOT

Oregon DOT (ODOT) first completed characterization monitoring as part of its first permit in 1990 at two monitoring stations (Portland and Eugene) on freeways. When the DOT's NPDES permit was renewed, the DOT switched from characterization monitoring to monitoring for road waste (catch basins) and water quality treatment facilities. Characterization monitoring resumed in 2009 at three sites, one urban freeway, one rural highway, and one dry side urban site. As the result of the settlement between ODOT and the Northwest Environmental Defense Council (NEDC), which had filed an intent to sue the DOT, alleging violation of its MS4 permit (but not of its monitoring program) an additional site was added. The DOT now monitors four sites:

- High average daily traffic (ADT) urban freeways;
- Metropolitan road (with moderate traffic volumes, below 30,000 ADT);
- Foothills of the Cascades en route to Mount Hood (periodic snow and melt cycle); and
- City of Bend area for dry site monitoring.

The NEDC requested that ODOT conduct characterization monitoring, collecting samples from summer storms (which in Oregon occur during the dry season and are not typically of a size that meet the technical requirements for sampling), and collection of a first flush sample. The runoff is tested for the standard suite of constituents: sediment, nutrients, petroleum hydrocarbons, the four basic metals, bacteria, and pH. Herbicides used by ODOT are included if spraying occurs along the monitored highway.

ODOT is involved in a large Superfund project to clean up the Portland Harbor Superfund Site (U.S. EPA, 2012); a highway with stormwater outfalls traverses the area. The DOT is conducting stormwater monitoring of the highway outfalls for this cleanup project. Along with the standard suite of highway runoff pollutants, testing is done for a large number of toxic chemicals found in the superfund site. While at first targeted at the whole stormwater, the Oregon DEQ has requested that sediments in the storm drain system be tested as well.

ODOT does not do any in-stream monitoring of the impacts from highway runoff discharges.

Research projects have included speciation of dissolved copper in highway runoff, with some samples from MS4 sites and some collected by the researchers in Corvallis, Oregon from a state highway.

A pilot project using sodium chloride as a deicer is in process at a couple of locations in the state. As part of this study, ODOT is developing a monitoring program that may include ambient monitoring with conductivity meters in a small stream that will be receiving highway runoff containing salt.

ODOT monitors in-stream turbidity from construction site runoff to comply with its NPDES permit for discharge of stormwater from construction sites, and turbidity from in-water work as

part of the Clean Water Act Section 401 certification. The DOT is not doing any pre-discharge monitoring of stormwater from construction sites. Visual monitoring in the receiving water allowed, but for in-water work the thresholds for remedial actions are tighter than if turbidity meters are used.

Oregon DEQ defined background monitoring locations for construction stormwater discharge is 30 upstream, with the compliance distance 30 feet downstream; for turbidity monitoring of in-stream work the compliance distance depends on width of stream going from 50-200 feet downstream. A larger stream requires a longer mixing zone. (This is consistent with New Hampshire.) Within the "compliance zone" or mixing zone, turbidity criteria may be exceeded. Beyond the compliance zone, limited increases in NTU are allowed for defined periods.

Washington State DOT

The elements of Washington State DOT's (WSDOT) stormwater monitoring program are required by its NPDES municipal stormwater permit. Objectives of the monitoring program include characterizing untreated runoff from state highways and non-highway transportation facilities (i.e., maintenance yards, ferry terminals, and rest areas), determining BMP effectiveness, and determining the toxicity of stormwater runoff to aquatic organisms. . This rainy season (winter 2012-13) is the first full year of sampling that the DOT has conducted. Permit criteria must be met before an event is considered a qualifying storm, which reduces the number of opportunities to collect data. Currently, the DOT is monitoring at 15 stations across the state.

WSDOT is not pursuing ambient receiving water monitoring (referred to in Washington State as "status and trends" monitoring), as it is not a requirement of the current permit. It is the DOT's opinion that the resource agencies, and not the permittees, should be responsible for monitoring the quality of receiving water bodies, which typically have multiple discharges into them, because the information gained from it is not useful or instructive to determining the overall effectiveness of the DOT stormwater management program.

The monitoring currently underway by WSDOT is being done independently of other permittees. There is potential for a coordinated monitoring program with the other municipal permittees in the state, i.e., cities and counties.

WSDOT must submit a monitoring report annually to its permitting authority. The reporting period is October 1 through the following September 30. The report is due at end of the year and includes monitoring data results.

In August 2012, Phase I and Phase II permits were reissued to cities and counties in the state. The permits require status and trends as well as conventional monitoring, and contain an option to pay into a monitoring fund in lieu of the permittee performing monitoring. Monitoring would be done by the state water quality agency or a contractor retained by the agency.

In the current biennium (2011-2013), WSDOT's budget for stormwater monitoring is a little over $2 million (for two years).

Wisconsin DOT

Two primary U.S. Environmental Protection Agency (EPA)-approved TMDLs for which Wisconsin DOT (WisDOT) is a stakeholder are the Rock River Basin TMDL (DNR, 2013) (3700 square miles in south central part of the state) and the Lower Fox River TMDL (DNR, 2013) (near Green Bay). TMDL waste load allocations were assigned based on general unit loads (no urban area modeling was done) and have not been assigned specifically to the TMDL stakeholders. WisDOT's portion of waste load allocation needs to be computed; there is no blueprint for doing so (e.g., proportional area allocation, proportional load allocation, etc.). The TMDLs will ultimately require a monitoring program, or for the DOT to participate in a monitoring program. Currently, the DOT does not perform any monitoring.

STUDY QUESTIONS FOR A DOT MONITORING PROGRAM

There has been considerable discussion in some states relative to the study questions that should be answered by a municipal monitoring program. Generally, these questions focus on the health of the receiving water, the sources of impairment, and the trends in attainment or lack of use in receiving waters. Typical study questions can include (MRP, 2010, PSSWG, 2010):

- What is the condition of streams in the watershed?
- Is water quality in the watershed getting better or worse?
- Is the water quality safe for beneficial uses (e.g., swim, eat caught fish)?
- What is the contribution of specific source pollutants?
- What practices are being used to restore pollutant loads?
- Where does stormwater impact specific resources or species?
- What are the best impacts?
- What are the synergistic effects of stormwater?

DOT programs are unique in that they typically have a very small portion of impervious area tributary to any receiving water. This does not necessarily mean that their contribution is de minimis; however, the DOT contribution is clearly not the cause of the impairment in the vast majority of the cases. Consequently, the receiving water impairment, and major actions to address the impairment are the responsibility of others. The DOT can benefit from receiving water information and support programs on a watershed basis, but DOT monitoring resources should focus on study questions that provide actionable information to improve the DOT stormwater program.

The CoP developed the following general study questions for DOT monitoring programs:

- Has the DOT runoff been sufficiently characterized in all regions of the State?
- Are there any emerging constituents of concern that should be monitored?
- Are there any program data gaps, such as the quality of meltwater runoff or the impact of the use of traction aids?
- Are there TMDL monitoring obligations to demonstrate waste load allocation (WLA) compliance?
- Are there adequate studies to demonstrate BMP performance?

- What is the contribution of highway runoff to specific stream impairments (tied to TMDL compliance)?
- What are the sources of constituents within the right-of-way (ROW) and the relative contributions if more than one?

DOTs universally consider receiving water monitoring to be less important in the continuous cycle of improvement in the stormwater program. Receiving water monitoring data is useful in a watershed context for the DOT, to refine DOT mitigation to support watershed objectives. However, DOT resources generally should not be used to support receiving water monitoring programs. Such programs should be the responsibility of the regulatory agency or the primary MS4 program in the watershed.

Discussion

Alabama DOT

Alabama DOT (ALDOT) notes that runoff from DOT facilities is different from municipal stormwater runoff, since many of the pollution sources differ. The DOT has few types of land use and runoff. Sample study questions postulated by ALDOT include:

- What are the characteristics of transportation related runoff in Alabama?
- Where transportation facilities discharge to impaired waters, does that discharge contribute to any impairment(s)?
- If yes, which practices could be implemented to effectively address the contribution?

It is important understand what types of runoff leave the DOT right-of-way, and to mitigate transportation-specific runoff with transportation-specific BMPs.

ALDOT would like to develop monitoring questions that better prioritize monitoring data and eliminate study areas that are not impacted by highway runoff.

California DOT

Caltrans has collected runoff data and evaluated compliance based on water quality objectives in receiving waters. In Caltrans' experience, the quality of runoff does not indicate an effect on the receiving water. DOT efforts are best spent focused on key problem areas and constituents rather than on cutting-edge testing, sampling, and analyses for specific pollutants. DOTs are not equipped to implement and assess sophisticated monitoring and analysis, which is more suitable for academia and other specialists that have the funding and resources needed. Determining the effects of pollutants on biota and aquatic animals and monitoring for impacts represents new areas of monitoring for most DOTs. In the past, DOTs focused on water chemistry and sediment. Caltrans has amassed a large amount of characterization data, but the quality of the data is not optimal. Data has historically been collected annually, evaluated in a short period, and assessed—all within two years or less. A longer period (five or more years) is needed to accurately measure trends, observe changes, and develop effective mitigation strategies. Additionally, improved technology and standard operating procedures are needed to collect the most relevant and valuable data.

Caltrans would like to conduct less compliance-based monitoring and reporting, and to focus on building better BMPs. Study questions should support feedback loops that are strong and precise.

Colorado DOT

A good source of transportation-related documents and DOT-related pollutants can found by searching the National Environmental Policy Act (NEPA). Monitoring study questions relevant to CDOT include what types of pollutants in runoff are coming off the transportation system? Is runoff from all areas of the state characterized? If the pollutant(s) are associated with a TMDL, then the DOT needs to develop a compliance strategy. If the DOT is not a source of the TMDL pollutant(s), the DOT should not be involved stakeholder.

Delaware DOT

Monitoring study questions relevant to DelDOT include understanding whether the DOT is a source of bacteria, compared to other land uses in a given watershed. In addition, is the DOT causing or contribution, and how is this gauged?

New York State DOT

New York State DOT (NYSDOT) would like to examine highway runoff characterization data to confirm or refute alleged DOT contributions to listed waterbodies. The DOT does not have a good database of characterization data to make this assessment. Such information would also be useful to serve as the baseline for TMDL compliance with waste load allocations.

Oregon DOT

ODOT would like to develop study questions that explore how data analysis of problem areas and constituents in DOT runoff, e.g., sediment, could be modeled and applied to similar situations in other areas, such as Superfund sites. It is important to focus on identifying actual problem areas that need fixing.

ODOT would like to develop a monitoring program focused on impacts to Endangered Species Act (ESA) streams, and to understand the geographic variation in types and concentrations of highway pollutants within the state. The large differences in land use, geology and climate in Oregon may have a substantial effect on stormwater quality. More information is needed from outside the Portland metropolitan area and the Willamette Valley, particularly from the coast, dry parts of the state, and from low ADT highways.

Another area of interest is the biological impacts of highway runoff from high ADT highways, on fish. As part of that it would be useful to understand the fate and speciation of highway runoff pollutants once they are mixed into the receiving waters.

ODOT is very interested in lifecycle costs and maintainability of structural BMPs, so is developing a test facility aligned with Washington State's Technology Assessment Protocol – Ecology (TAPE) process, but which has a primary focus on maintainability of proprietary treatment facilities.

Washington State DOT

A recent presentation[1] about dissolved metals (e.g., copper) in highway runoff cast a light on National Marine Fisheries Service (NMFS) efforts to determine the cause of pre-spawn mortality in salmonids. The presentation included an item on toxicity testing of diluted and undiluted, untreated runoff from SR-520 (average daily traffic [ADT] 70,000 vehicles) in Seattle. There needs to be more collaboration between DOTs and the entities conducting such research to develop research design that will yield data and information that is actionable and useful to the DOT stormwater management program. Research should be designed to provide evidence of cause and effect for a clear response, consistent with actual ambient water quality in receiving water bodies, in determining effects on organisms.

Runoff characterization has been completed in the western states for the common constituents in highway runoff. Regulatory agencies have grown increasingly concerned with polycyclic aromatic hydrocarbons (PAH) and phthalates in small concentrations, but they are difficult to monitor. Each state should work with its regulator and be informed by national studies to determine whether characterization is necessary, for example, for maintenance facilities and non-highway facilities. BMP effectiveness monitoring has been completed across the country and the performance of many BMPs has been well established, so the focus should be on new, innovative BMPs such as for LID, as well as life cycle costs and long-term maintenance needs.

Wisconsin DOT

WisDOT is examining the monitoring efforts of municipalities to learn how they monitor, e.g., dry weather screening, whether flow observed, pollutant testing, etc. Each municipality determines type of monitoring they do, how it is defined, and the regulator approves it. The DOT has only done one dry weather screening. WisDOT met with the DNR in 2010 to consider rewriting that portion of their cooperative agreement. Due to lack of time, resources, funding, and overall benefit, the issue was tabled, except for monitoring as part of TMDL compliance. The DOT is currently in negotiations with EPA on whether to implement a permit system by rule or keep with its cooperative agreement. Once requirements are known, the DOT can monitor using DOT staff, hire consultants to do the monitoring, or join a consortium of permittees.

Federal Highway Administration

FHWA is interested in researching this topic further and assisting in setting up monitoring protocols.

BENEFITS AND CHALLENGES OF GROUP VERSUS INDEPENDENT MONITORING

Colorado DOT

In Colorado, water quality monitoring is performed independent of any other entity in the state. Many Phase I and II permittees have withdrawn their resources and relied on the Urban Drainage and Flood Control District for monitoring. Challenges with collaborating with other permittees to do group monitoring include each group having different permit requirements. Recently, a meeting was held between the state regulator and Phase II to discuss including new numerical

[1] *www.wastormwatercenter.org/file_viewer.php?id=691*

values to the new Phase II General Permit. No monitoring is being conducted by the DOT for TMDLs. CDOT is an individual statewide Phase I entity but has components of both Phase I and Phase II. So far, no aspects of the DOT program are covered under Phase II.

Florida DOT

Overall, FDOT has had a positive experience working with local partners and joint powers authority (JPA) on programs. For over 20 years, FLDOT has done ambient water quality monitoring in Phase I areas by entering into joint participation agreements with local governments. There are about 15 ambient-type programs statewide. This has been a cost effective approach for the districts. The DOT contributes funding to an ambient monitoring program. Agreements evolve independently and cost share varies among districts and counties. Proportionate shares for the DOT have been very small. The DOT is facing potential new monitoring with TMDL implementation language in the recently issued Phase I permit. The DOT will have to conduct discharge monitoring independently, which will make it costly and difficult to get good monitoring data. FDOT's group monitoring experience has been very good. There is also concern about the direct monitoring of discharge. FDOT is a centralized DOT, with seven district offices and a turnpike enterprise, making it semi-autonomous. There are many different agreements based on different share formulas, e.g., based on load, flow, area contribution, flat fee, etc. In most districts and communities, the cost share for the DOT has been small. For most part, cost effective way for us to meet regulatory requirements for participating in a monitoring program. Challenges have occurred in a small number of agreements, where the DOT's share is disproportionately large compared to its actual contribution. For example, one agreement based the cost share by assessing various copermittees on their number of outfalls, leading to disproportionately large shares. In another area, the DOT has accepted a larger than proportionate share, based on the contribution area, but the municipal county's assumptions were not entirely accurate. In approximately 15 Phase I areas, two are problem cases.

New Hampshire DOT

NHDOT does group in-stream monitoring for a chloride TMDL, which is funded in part by the state regulatory agency. The cost share for the DOT is 10% of the fee, calculated as the DOT's contribution to load calculations. Monitoring is done as the mitigation part of a cooperative monitoring protection plan for the project. The DOT has an MOU with a sister state agency doing in-stream water quality monitoring. The monitoring has not been very expensive.

New York State DOT

NYSDOT does not have a formal monitoring program, conducting project-specific monitoring. One purpose of a monitoring program should be to incorporate more useful data to apportion responsibilities within TMDLs. Areas are currently broken down into "high density, medium density." Impervious areas become significant factors when it comes to TMDL load allocations. The DOT currently has a TMDL for nitrogen.

Oregon DOT

ODOT is developing a test site and program for proprietary systems in coordination with Association of Oregon Counties or Oregon Association of Clean Water Agencies (ACWA). While this will be focused on maintainability issues, quality sampling will be included. A watershed approach to stormwater management would be supported by a coordinated monitoring of ambient conditions, but this has not yet materialized. ODOT feels that it should not be

responsible for ambient stream monitoring, as the DOT is not a resource or land management area. Monitoring for trend analysis within watersheds should be the responsibility of more than just the DOT.

Washington State DOT

WSDOT thinks that group monitoring could be more cost effective than individual monitoring, provided group members have similar goals for monitoring and the data can feed into program effectiveness. Monitoring of the receiving water body should not be the responsibility of an individual permittee. However, there should at least be collaboration and cooperation in monitoring to avoid duplication of effort between entities and to ensure cost-effectiveness. If BMP effectiveness were the objective, multiple permittees sampling the same type of BMP would be duplicative and inefficient. Collaboration would result in various entities selecting different BMPs and in providing information that is more comprehensive.

WSDOT has a very large, expensive monitoring program as specified in its MS4 permit. There is a need to reduce scope and costs while still addressing regulatory monitoring objectives. In March 2014, the permit will be up for renewal, presenting an opportunity to address this issue.

There is a common perception that all runoff from highways cause significant water quality impacts; thus there is a need for DOTs to demonstrate that this is not accurate – the significance of impacts varies widely based on location and other factors, and stormwater treatment efforts need to be focused where the impacts and potential for environmental benefit are the greatest. Group monitoring could help to support this objective.

Future Research Needs

Listed below are synopses of suggested research needs statements to improve the implementation and performance of DOT stormwater monitoring programs. Full draft research needs statements for these suggested topics are provided in Appendix B.

- *BMP Effectiveness Evaluation for DOTs* – DOTs nationally have conducted studies on BMP performance. The objective of this study would be to determine the applicability of these studies to other regions in the US. The project will also explore the feasibility and desire to create a separate highway clearinghouse or database to compile all highway BMP performance studies.

- *Identification of Constituents of Concern for Highways* – Many NPDES Permits require DOTs to identify constituents of concern from highway and support facilities. Constituents of concern for DOTs are known or emerging potential pollutants that are generated within the right of way, that the DOT can potentially control through BMPs. The source of some constituents may not be completely understood, or the relative load of the constituent from various sources within and external to the right of way may not be known. It is also important to understand the mobility of the pollutant within the environment, changes, if any, it may undergo when mixing with the receiving water, and the potential beneficial use impairments. These questions are especially important for emerging pollutants for which there may be limited information or data.

- *Development of a Model Monitoring Program for a DOT* – This project would develop monitoring program study questions for DOTs and a framework for a national model monitoring program. Elements of the framework would include sample site collection, number of representative sites, sampling and laboratory protocols. There is a wide variation in how much sampling DOTs do as a requirement of their NPDES permits. The project would also develop recommendations for obtaining TMDL baseline data, and determining hotspots locations.

ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this report:

AASHTO	American Association of State Highway and Transportation Officials
ACWA	Association of Clean Water Agencies
ADT	Average Daily Traffic
ALDOT	Alabama Department of Transportation
BMP	Best Management Practice
Caltrans	California Department of Transportation
CDOT	Colorado Department of Transportation
CoP	Community of Practice
DelDOT	Delaware Department of Transportation
DEP	Department of Environmental Protection
DES	Department of Environmental Services
DNR	Department of Natural Resources
DOT	Department of Transportation,
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
IDDE	Illicit Discharge Detection and Elimination
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NEDC	Northwest Environmental Defense Council
NEPA	National Environmental Policy Act
NHDOT	New Hampshire Department of Transportation,
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
NYSDOT	New York State Department of Transportation
ODOT	Oregon Department of Transportation
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
pH	A measure of acidity/alkalinity
ROW	Right-of-Way
SR	State Route
TAPE	Technology Assessment Protocol – Ecology
TMDL	Total Maximum Daily Load
WisDOT	Wisconsin Department of Transportation
WLA	Waste Load Allocation
WSDOT	Washington State Department of Transportation

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APPENDIX A: General Water Quality Program Monitoring Elements

Regulatory

- Regulatory requirements for monitoring
    - DOT-specific NPDES Permit
    - EPA Region-specific Permit
    - EPA Construction General Permit
    - Statewide Construction General Permit
    - Statewide Industrial General Permit
    - Local (County, City) Permit

Characterization

- Beneficial uses of the receiving water
- Types of constituents (pollutants) to monitor for
    - Nutrients
    - Metals
    - Organics
    - Sediment/particles
    - Trash/litter
    - Toxics
    - Pathogens
    - Temperature
    - Salt
- Characterize and quantify stormwater loads
- Source identification: Determine sources of specified pollutants
- Evaluate performance of source controls and BMPs
- Identify chemical, physical, and biological impacts

Logistics/Parameters/Protocols

- Funding and staffing resources needed to monitor
- Monitoring parameters and methodology
    - Methods used to obtain data
    - Data quality objectives
    - Equipment types to use for monitoring
    - Location: ideal sites to monitor
    - Timing and frequency: when and how often to monitor
    - Best method to use for test site selection and sampling analysis
- Sampling: how to collect samples; under what conditions
- Analysis of data; laboratory methods used
- Evaluation of other permittees' stormwater management programs for effectiveness and comparison to DOT

Data Collection

- Documentation requirements
- Tracking of monitoring data over time for each monitoring location
- Recording of monitoring results

Data Reporting

- Reporting of monitoring results
- When to report, how often, and to whom
- Method used for dry-weather field screening
- Assessment of water quality impacts
- Increase or decrease of stormwater pollutant loadings discharged from DOT
- Usefulness of data to assess effectiveness of stormwater management program in reducing stormwater pollutant loadings
- Usefulness of data to assess effectiveness of specific BMPs
- Usefulness of data to prioritize stormwater retrofitting projects for implementation

Quality Control and Safety

- Quality controls to consider/put in place
- Safety measures to consider/put in place for technicians doing the monitoring

APPENDIX B: Research Needs Statements

- BMP Effectiveness Evaluation for DOTs
- Identification of Constituents of Concern for Highways
- Development of a Model Monitoring Program for a DOT

Title: BMP Effectiveness Evaluation for DOTs

Background:

DOTs routinely complete BMP effectiveness studies as a part of their research to improve their stormwater program. Many of the effectiveness studies duplicate research in other parts of the country with few apparent significant deviations. Local performance data for BMPs is preferred, but may not provide additional value in many instances. In addition, the body of BMP research specific to DOTs is not available for review in a single location, but rather is kept with various agencies and may exist in gray literature format.

Research Objective:

The purpose of this research is to determine the conditions under which BMP effectiveness studies can be translated from one geographic area to another without a significant loss of accuracy in the prototype study outcome. This research will define the critical independent variables in BMP effectiveness studies, and identify the conditions that it is appropriate to translate effectiveness studies to other geographic locations, or, if appropriate, other design configurations. A second objective of this research is to determine a uniform effectiveness assessment study protocol for DOTs so that research data is comparable nationally. Finally, the study will investigate the feasibility of establishing a research study clearing house to facilitate the exchange of BMP research information.

Specific Tasks:

Task 1 – Literature Review, Compilation of Data and Survey of State Practices and Experience

The literature review and the data compilation will focus on the following areas

- Compilation of existing DOT BMP research studies;
- Review of assessment protocols;
- Review of existing study clearinghouses, such as the International BMP Database

Task 2 – Develop Effectiveness Assessment Model Program and Basis for Translation

Work under this task will develop a model BMP effectiveness study framework to standardize the assessment of BMP performance. The work will specifically focus on ensuring that results from research studies are consistent to allow comparison between studies. This will aide in refining translators for variations in location. For example, the performance of vegetated swales likely varies with climate and soils. Comparison of effectiveness studies done with comparable protocols from various regions in the US will allow an assessment of potential differences and the development of performance translators.

Task 3 – Assess Feasibility and Provide Recommendations for Establishing a Study Clearinghouse

There has been a substantial amount of research completed by DOTs on the performance of BMPs in the highway environment. Many of these studies are published, some existing in gray literature, but none are centrally located and indexed to facilitate research by BMP, constituent of concern and climate region. The purpose of this task is to determine if it is advantageous to develop a clearinghouse for research studies, and if so, an outline of the form the clearinghouse should take.

Cost: $125,000

Time Required: 18 Months

Submitted By: Center for Environmental Excellence by AASHTO Stormwater Management Community of Practice

Title: Identification of Constituents of Concern for Highways

Background:

Many NPDES Permits require DOTs to identify constituents of concern from highway and support facilities. Constituent of concern are known or emerging potential pollutants that are generated within the right of way. The source of some constituents may not be completely understood, or the relative load of the constituent from various sources within and external to the right of way may not be known. It is also important to understand the mobility of the pollutant within the environment, changes, if any, it may undergo when mixing with the receiving water, and the potential beneficial use impairments. These questions are especially important for emerging pollutants for which there may be limited information or data.

Research Objective:

The purpose of the research is to develop a standardized approach for determining constituents of concern for DOTs. The framework will allow for a universal application, but will be developed considering DOT facilities and land uses. The research will also document the mobility of the constituent, and its fate in the environment. The a procedure will be developed to assess the relative contribution of the constituent from various sources in the environment, and to determine the potential impact on receiving water beneficial uses.

Specific Tasks:

Task 1 – Literature Review, Compilation of Data and Survey of State Practices and Experience

The literature review and the data compilation will focus on the following areas

- Highway characterization data, selected from a broad range of geographic conditions and traffic levels;
- Source studies for known pollutants, in highway runoff;
- Emerging constituents of concern in highway runoff;
- Methods to assess impact to beneficial uses.

Task 2 – Method to Determine Highway Runoff Constituents of Concern

A framework will be developed that can be applied by the DOT to determine a “suite” of constituents of concern the will be the focus of the DOT’s stormwater program. The framework will provide a stepwise procedure for DOTs to assess their characterization data, as well as emerging constituents of concern to develop a final “list” for the stormwater program.

Task 3 – Evaluation of Sources, Fate and Transport of Constituents of Concern

This task will develop as standardized procedure to assess the relative sources of the identified constituent. This will allow DOTs to develop effective BMPs that target the source and allow a basis to establish a target effluent concentration using MEP technology. A method to determine the fate of the constituent in the environment will also be developed, potential transformations and ultimately, impact of the constituent on the beneficial uses in the receiving water.

Cost: $125,000

Time Required: 18 Months

Submitted By: Center for Environmental Excellence by AASHTO Stormwater Management Community of Practice

Title: Development of a Model Monitoring Program for a DOT

Background:

Many NPDES Permits require DOTs to monitor receiving waters to characterize runoff from DOT facilities, assess the effectiveness of BMPs, and for compliance with TMDLs. Monitoring programs require considerable time and resources to implement. The objectives of DOT monitoring programs may not be well defined, and the data may not be used fully to provide feedback to improve the performance of the stormwater program.

Research Objective:

A primary purpose of this research is to develop monitoring program study questions. The study questions should define the most important data gaps and data needs to improve the performance of the DOTs stormwater program. There is also a need to examine sampling protocols to determine the most appropriate approach for DOTs, as well as to establish a consistent recommendation nationally to ensure that data across the US is comparable.

Specific Tasks:

Task 1 – Literature Review, Compilation of Data and Survey of State Practices and Experience

The literature review and the data compilation will focus on the following areas

- Current DOT monitoring programs;
- Study questions for DOT monitoring programs;
- Protocols for BMP effectiveness testing;
- Sampling protocols by constituent.

Task 2 – Develop Model Program Study Questions

Work under this task will develop study questions that are appropriate for a DOT stormwater program. This task will also explore the conditions under which (if any) a DOT should participate in receiving water sampling and analysis. The study questions should ensure that the data provided by the monitoring program is of value to the DOT in improving the performance of the overall stormwater program. Study questions for DOT participation in TMDLs should also be provided.

Task 3 – Develop Model Monitoring Program

This task will develop a framework for a standard monitoring program. The framework will include sampling site selection, sampling protocol, appropriate detection limits (for example, is the same level of sensitivity of analysis appropriate for answering the study question), and suggested constituents for a baseline program. The framework will also define feedback loops for the monitoring data to evaluate the potential for changes in the DOTs stormwater program.

Cost: $125,000

Time Required: 18 Months

Submitted By: Center for Environmental Excellence by AASHTO Stormwater Management Community of Practice