

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

**STATE-OF-THE-PRACTICE REPORT:
Post-Construction BMPs**

June 2010

Prepared for



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CENTER FOR ENVIRONMENTAL EXCELLENCE BY AASHTO STORMWATER MANAGEMENT COMMUNITY OF PRACTICE

STATE-OF-THE-PRACTICE REPORT: Post-Construction Best Management Practices

June 2010

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 the state of the practice, emerging issues, research data needs, and innovative stormwater quality compliance solutions. The CoP has two primary goals, the first of which is to extend each state DOT's network and contacts, enabling them to share experiences and engage in technology transfer. In this regard, the program is a continuation of efforts that were initiated June 2008 at the First National AASHTO Stormwater conference held in San Diego, California and the Second National AASHTO Peer Exchange meeting that was held in Denver, Colorado, April 2010. 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 16 state DOTs, the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA). The Stormwater Management CoP members agreed that post-construction stormwater controls in highway system management should be the top priority for this phase of the CoP.

BACKGROUND

The goal of the federal Clean Water Act (CWA) was "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The act was implemented through the United States Environmental Protection Agency's (US EPA's) National Pollutant Discharge Elimination System (NPDES), which requires the control of stormwater runoff water quality discharged by municipal separate storm sewer systems (MS4s) using best management practices (BMPs). The US EPA is currently collecting information for a proposed new rulemaking that may change the geographic and technical permit coverage and introduce more prescriptive requirements for post-construction BMPs in MS4 NPDES permits.

Stormwater runoff from existing and new development/redevelopment, including transportation facilities and highways, can result in impacts to receiving water quality. State and federal laws and regulations have increased the need for DOT practitioners to focus on developing effective post-construction stormwater controls as part of their stormwater management programs. Among the many laws and regulations that have prompted the need for DOTs to focus on post-construction stormwater controls are:

* This state-of-the-practice report summarizes the discussions of CoP members who spoke as individual members of the community and does not necessarily represent their agency's views or positions. In addition, the contents of this report do not necessarily represent the views or positions of AASHTO or the Center for Environmental Excellence, FTA, or FHWA.

- National Pollutant Discharge Elimination System (NPDES) regulations under the CWA;
- Requirements of a Total Maximum Daily Load (TMDL) (a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards);
- Water quality mitigation under Section 401 of the CWA;
- State regulations, including post-construction development requirements as part of Construction General Permits;
- Local regulations that require coordination with other agencies and municipalities;
- The proposed US EPA National Rulemaking (to establish specific requirements to control stormwater discharges from new development and redevelopment);
- Protection of water quality associated with compliance with the Endangered Species Act; and
- Other mandates (e.g., protection of groundwater or aquifers and protection of environmentally sensitive areas and outstanding or high quality waters).

Many states and jurisdictions have adopted advanced stormwater requirements for new and redevelopment projects. For transportation agencies in those states, stormwater practices related to post-construction runoff control calls for implementing approved stormwater treatment systems on all new projects where feasible. Effectively controlling post-construction runoff using specific structural and non-structural post-construction treatment measures (best management practices or BMPs) and sound roadway maintenance stormwater practices and compliance are necessary to reduce the generation of pollutants from highways and related facilities. DOTs are challenged with stormwater management and protecting water quality while meeting primary goals of DOTs, including but not limited to, moving goods throughout the nation, safety of public motorists and DOT staff, operation and maintenance, and other needs within the traveled rights-of-way.

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

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

STATE-OF-THE PRACTICE: POST-CONSTRUCTION BMPS

California Department of Transportation (Caltrans)

Caltrans has developed a BMP toolbox with a list of approved treatment controls, including vegetated strips and swales, infiltration trenches and basins, media filters, extended detention basins, multi-chambered treatment trains (MCTTs), wet basins, traction sand traps, gross solids removal devices (GSRDs), and dry weather diversion. More information on the post-construction stormwater devices approved for use by Caltrans can be found at http://www.dot.ca.gov/hq/oppd/stormwtr/Final-PPDG_Master_Document-6-04-07.pdf.

Potential revisions to the Caltrans BMP Toolbox include the following post-construction and emerging BMPs:

- Biofiltration retention systems
- Alternative infiltration trench structures (“milk crate” technology)
- Non-vegetated filter strips (arid region options)
- Linear filtration alternatives (filter swale, bioretention trench, linear sand filter, ecology embankment)
- Soil amendments (compost incorporation)
- Improved detention basin outlet control devices

Some of these BMPs would have limiting siting criteria, and others would be used more generally. All would be considered permanent post-construction BMPs and would have the ability to attain credit towards meeting a future hydromodification requirement.

Caltrans is challenged with addressing treatment BMP requirements, TMDL requirements, and planning for a future hydromodification requirement. The Caltrans Hydromodification Design Guidelines and Risk Assessment is a process by which Caltrans plans to meet the criteria for treatment and hydromodification so that when planning for BMPs, both requirements would be satisfied.

Resources:

- Caltrans tracks post-construction stormwater treatment technologies, and information, which is contained in the *Caltrans Treatment BMP Technology Report* (CTSW-RT-09-239.06, April 2010) and is available on the Caltrans Stormwater Management Program website at <http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-09-239-06.pdf>
- Through its Monitoring and Research Program (Applied Studies), Caltrans gathers information on the performance of stormwater controls (BMPs) and the characterization of discharges from its operations, facilities, and storm drain systems for various facilities.
- Caltrans has initiated studies and projects that will ultimately help to refine the framework of the Stormwater Program. All Final studies have been posted on the Caltrans Stormwater Management Program’s website at <http://www.dot.ca.gov/hq/env/stormwater/ongoing/index.htm>.

Delaware Department of Transportation (DelDOT)

Post-construction BMPs are required in Delaware in accordance with the state required Delaware Sediment and Stormwater Regulations (DSSR), which is in the process of being rewritten and is expected to be promulgated early next year. DelDOT is currently required to have BMPs for water quality that fulfill 80% total suspended solids (TSS) removal for any new impervious areas, as well as water quantity for any drainage area that is 10% or more additional runoff as compared from the pre- and post-2-year storm events. DelDOT is also required to comply with TMDLs for the Inland Bays watershed.

The new regulations for water quality will require DelDOT to infiltrate up to the 1-year storm event and supply additional BMPs if needed for TMDL compliance. Water quantity will be addressed by unit discharge rates. There is discussion on developing a mitigation and offset program for areas that cannot meet the water quality/TMDL compliance.

Allowed BMP use is designated by fellow state agency DNREC (Division of Natural Resources and Environmental Control), from which DelDOT is delegated for erosion, sediment and stormwater.

DelDOT prefers not using structural BMPs, but they currently have in their inventory sand filters and StormTech units. Approved BMPs include wet ponds, dry ponds (for quantity only), infiltration basins, infiltration trenches, bioretention, bioswales, filter strips, and underground infiltration (perforated pipes in a stone trench).

Additional research is being conducted on the actual removal efficiencies of selected BMPs.

Resources:

- Division of Soil & Water Conservation – Delaware’s Sediment and Stormwater program: <http://www.swc.dnrec.delaware.gov/Pages/SedimentStormwater.aspx>
- Stormwater Treatment Structures Endorsed by DNREC, Sediment & Stormwater Program: http://www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/New/SWM_Structures_01-05.pdf
- Natural Resources and Environmental Control Division of Soil and Water Conservation – Sediment and Stormwater Regulations: <http://regulations.delaware.gov/AdminCode/title7/5000/5101.shtml>

Florida Department of Transportation (FDOT)

Current Florida treatment requirements target capture of 80% of suspended sediments using a treatment volume storage approach. Targeting anti-degradation, annual nutrient loadings analysis is required when permitting in verified nutrient impaired basins.

FDOT stormwater post-construction stormwater controls include wet ponds, dry detention ponds, infiltration basins, wetland treatment, pervious pavement, and exfiltration trenches. Stormwater regulations in Florida are imposed from multiple stormwater management districts reflecting local water quality conditions of concern.

FDOT is actively involved in research developing stormwater harvesting, different types of pervious pavement, managed aquatic plant systems for wet ponds.

Partnerships are a very common practice with FDOT, as they help defray the cost of land. Golf courses are a common area of development for post-construction stormwater controls.

Though not post-construction, FDOT completed a study on runoff and nutrient loading from nitrogen and phosphorus from the use of fertilizers.

Illinois Department of Transportation (IDOT)

IDOT does not construct post-construction BMPs unless requested by the local agency and jurisdiction for which the road is being improved. If a treatment BMP is constructed, it is with the requirement that the requesting agency also maintain it. IDOT is covered under a Phase II NPDES permit.

IDOT is concerned about groundwater pollution from the use of full depth permeable pavements, should they ultimately be developed for highway use. A concern for IDOT is road salt, which, in groundwater and drinking water, is becoming a problem in the upper Midwest. Another concern is nutrients, which are highly soluble and can migrate into the water table. Research is needed into control practices that can reduce or eliminate constituents such as total dissolved solids (TDS) and nitrogen that are highly soluble in stormwater and could impact groundwater resources (especially in Karst areas).

New Hampshire Department of Transportation (NHDOT)

NHDOT's post-construction BMP requirements primarily originate from project 401 certification requirements. NHDOT has a post-construction stormwater program as a part of the NPDES permit, but it does not dictate specific treatment control requirements. The DOT currently has about 150 stormwater treatment structures, most of which have been built to fulfill conditions of the project 401-certification process.

Inspection of treatment BMPs requires two persons for safety, and maintenance is a challenge. NHDOT mostly uses dry extended detention, which was the BMP of choice back in the 1990s and early 2000s. They have recently begun to build wet extended detention and gravel wetlands.

A sample 401 certification can be found in the appendix to this report.

New York State Department of Transportation (NYSDOT)

NYSDOT has strict requirements for post-construction treatment practices. The State Pollutant Discharge Elimination System (SPDES) General Permit for Construction Activity sets criteria based on a scope of work as to what activities require post-construction practices and which require long-term erosion and sediment control practices only. Most of the DOT projects fall under the requirement to have post-construction practices and include five types: ponds, wetlands, infiltration systems, filter systems, and open channels (such as dry swales and wet swales). Grass channels do not qualify as a treatment BMP.

NYSDOT uses the state Stormwater Management Design Manual, which contains design criteria for all of the accepted BMPs. The DOT has its own Highway Design Manual with

guidance that streamlines or translates the state standards with details showing key items needed to construct the various practices to help designers standardize. Appendix B of Chapter 8 (Highway Drainage) is the DOT's main tool for BMP design.

The DOT is moving toward the implementation of green infrastructure. The state regulator is developing manual revisions that should be released this spring. Revisions will include changing the approach to how the DOT plans and designs projects, maintains natural areas, minimizes impervious surface areas, and documents their decision-making process. The DOT also has an Environmental Procedures Manual for stormwater management that is being revised to include an update of their state stormwater permit process and their NPDES process for construction projects on tribal lands. One of NYSDOT's regions wrote a maintenance manual that has been informally adopted by other DOT regions, but the DOT wants to revise it to include more emphasis on inspection requirements. The DOT also has guidance for construction inspectors, as well as inspection forms, certification forms, etc. The DOT has a SWPPP template that is being revised to coincide with the requirements in their new permit, which was recently issued (January 2010). The DOT has specifications for proprietary products, but they are outdated. The DOT is looking to revise these specifications to develop a performance approach.

The state regulatory agency is interested in incorporating effluent limit guidelines (ELGs) for post-construction practices. The state manual was written by the Center for Watershed Protection, and it is based on a removal effectiveness of 80% for TSS and 40% for total phosphorus. The DOT has an interest and concern, particularly in the area of design, for knowing whether those performance standards would really be seen if effluent monitoring was done.

Resources:

- NYSDOT Highway Design Manual, Chapter 8 (Highway Drainage), Appendix B: NYSDOT Design Requirements and Guidance for State Pollutant Discharge Elimination System (SPDES) General Permit GP-02-01: https://www.nysdot.gov/divisions/engineering/design/dgab/hdm/hdm-repository/chapt_08b.pdf
- NYSDOT Environmental Procedures Manual: <https://www.nysdot.gov/divisions/engineering/environmental-analysis/manuals-and-guidance/epm/chapter-4> (scroll down to Chapter 4.3 and attachments)
- NYSDOT Construction Inspection Manual: <https://www.nysdot.gov/divisions/engineering/environmental-analysis/manuals-and-guidance/epm/chapter-4> (this link goes to an Engineering Bulletin issuing the chapter on E&SC & Stormwater management)
- NYSDOT Region 8 O&M Manual for Stormwater Facilities: https://www.nysdot.gov/divisions/engineering/environmental-analysis/repository/nysdot8storm_a.pdf
- Research Study, Stormwater Management Practices (Closed Drainage) Studies, Final Report, December 2007: <https://www.nysdot.gov/divisions/engineering/environmental-analysis/repository/c-01-74.pdf>

- New England Transportation Consortium Research Study – Ability of Wood Fiber Materials to Attenuate Heavy Metals Associated with Highway Runoff, July 16, 2008 (NETCR65 Project No. 03-1): <http://www.netc.umassd.edu/netcr65.pdf>
- New England Transportation Consortium Research Study – Measuring Pollutant Removal Efficiencies of Stormwater Treatment Units, September 27, 2005 (NETCR54 Project No. 03-4): http://www.netc.umassd.edu/netc03_4.pdf
- New York State Stormwater Management Design Manual – <http://www.dec.ny.gov/chemical/29072.html>

North Carolina Department of Transportation (NCDOT)

NCDOT operates over 500 post-construction structural BMPs or structural stormwater control measures (SCMs). NCDOT is required to design, construct, inspect, and maintain these devices through state regulations and NCDOT's statewide NPDES stormwater permit.

SCMs are required in both sensitive water areas as well as urbanized areas. The NC Division of Water Quality (DWQ), the delegated authority for administration of the NCDOT NPDES permit, has required and approved a stormwater BMP Toolbox for the NCDOT that defines the control measures and design requirements to be used in the highway environment.

Current requirements for treatment are based upon control and treat volumes for new built upon area to the maximum extent practicable (MEP). Designated project categories require a stormwater management plan (SMP) that defines and documents the stormwater mitigation strategies for the project. The SMPs are used by DWQ to determine if NCDOT has achieved water quality objectives.

NCDOT currently has seventeen types of stormwater control measures that use varying unit operation processes in the treatment of stormwater. Some of the SCMs used include filtration basins, infiltration basins, bioretention basins, dry detention basins, wet detention basins, stormwater wetlands, swales, level spreaders with constructed and natural filter strip, buffers, preformed scour holes, stream bank drop structures, and proprietary devices. NCDOT is also exploring environmental site design and regenerative stormwater conveyance systems that have been practiced by Maryland State Highway Administration.

NCDOT manages SCMs through a web-based system known as Stormwater Control Management System or SCMS. SCMS provides the necessary tools to manage the workflow and maintain documentation on the design, construction, inspection, and maintenance of the SCMs. NCDOT has implemented a process where employee performance reviews are based upon the level of service maintained on SCMs. NCDOT appraises employee performance using an Organizational Performance Dashboard in specific practices, such safety and environmental sensitivity. The appraisals use a system of measurements, expectations, and targets.

NCDOT continues to support research on SCMs. Current objectives are focused on load removal performance that meets instream water quality objectives and performance of open graded friction courses.

NCDOT sizes for an 85-90 percentile design storm. Roadside environmental engineers are responsible for maintaining the stormwater controls.

NCDOT has formed partnerships with communities for replacing a bridge in the downtown area. Through an agreement with the city, NCDOT transfers maintenance of the stormwater control devices to the city. In some instances, they have communal drainage.

NCDOT recently completed an exhaustive study on stormwater controls for bridges. Retrofit costs were compared to regular costs, along with inspection, routine maintenance, and infrequent maintenance costs associated with these stormwater controls. The cost information is expected to be available this summer.

Nutrient management plans are required by state regulations and are incorporated into their NPDES permit, as there are a few nutrient sensitive watersheds with stringent nitrogen and phosphorus water controls.

NCDOT has a requirement for ten-foot safety benches for wet ponds. They often clog up with phragmites, cattails, and other debris that can prevent fish from getting in to kill the larvae. In some instances, they have had to reduce the benches down to five feet.

Resources:

- NCDOT Organizational Performance Dashboard:
<https://apps.dot.state.nc.us/dot/dashboard/>

Oregon Department of Transportation (ODOT)

ODOT has requirements for post-construction BMPs that are driven less by their NPDES permit (which is outdated by ten years) and more by compliance with the Endangered Species Act (ESA) and by 401-certification when projects impact wetlands or waterways. The requirements for stormwater treatment were developed in a collaborative process that involved ODOT, DEQ, NMFS and FHWA. Products of the collaboration include definition of the types of actions that trigger the need for post-construction stormwater controls, treatment expectations, how much stormwater the DOT treats, and guidance on selection of BMPs. The interagency team identified and evaluated water quality BMPs. The BMPs are rated based on pollutant removal processes, with the highest rating, “preferred,” given to those capable of attacking multiple pollutants at the same time. The area subject to treatment for a project, called the “Contributing Impervious Area,” includes all ODOT impervious surface within and draining into the project area, but excludes sources outside of the ODOT right-of-way (ROW). This information is codified in several places. The first resource is the Geo/Environmental Section’s technical bulletin on stormwater management (Technical Bulletin 09-02(b)). The other is the programmatic biological opinion for projects with 404 permits, referred to as “Standard Local Operating Procedures for Endangered Species (fourth iteration)” (SLOPES IV), which includes stormwater management requirements.

ODOT has developed a hydraulics manual. It is being updated to incorporate more low impact development (LID) techniques. The chapter that gives design guidance on the various types of BMPs is under development. The primary focus for treatment techniques is, where appropriate, to aim for either infiltration into the soil or at least filtering all or most of the stormwater through some sort of media, using compost-amended soil or other media. Those BMPs that do so are generally rated as “preferred.” The DOT is working on specifications for these BMPs. The DOT has a consultant under contract to put together guidance for LID techniques for the highway environment, specifically looking at guidance on infiltration practices.

Research on BMP maintenance is a primary need for ODOT. As with other DOTs, ODOT Maintenance faces financial challenges. New water quality treatment facilities present a problem for Maintenance, because there is no additional funding provided for their maintenance. ODOT designers develop maintenance manuals and review the facilities that are being put in with maintenance staff. An effort is underway to identify particular maintenance issues with BMPs to help improve design and the operations and maintenance manuals.

ODOT is doing some of its own BMP research as part of the agreement to avoid potential litigation on their NPDES permit. ODOT is working with the United States Geological Survey (USGS) to set up a testing program for monitoring the performance of selected post-construction BMPs. ODOT is also funding a research project on the use and effectiveness of incorporating ground-up fishbone meal to remove dissolved metals, particularly, dissolved copper, which is a major pollutant of concern.

Oregon is not a delegated state, and post-construction treatment is not triggered by a general construction permit.

Resources:

- The ODOT Stormwater Management Program – Project Development web page describes how ODOT provides post-construction treatment and includes links to ODOT Technical Bulletins and the Hydraulics Manual.
http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/storm_management_program_pd.shtml
- ODOT Geo/Environmental Technical Bulletin 09-02(b): Stormwater Management Program is directly available at: [ftp://ftp.odot.state.or.us/techserv/Geo-Environmental/Hydraulics/Technical%20Bulletins/Stormwater%20Management%20Technical%20Bulletin/ge09-02\(B\)%20\(2\).pdf](ftp://ftp.odot.state.or.us/techserv/Geo-Environmental/Hydraulics/Technical%20Bulletins/Stormwater%20Management%20Technical%20Bulletin/ge09-02(B)%20(2).pdf)
- SLOPES IV and supporting documentation can be found on the ODOT website at: ftp://ftp.odot.state.or.us/SLOPES_IV/
- The ODOT Hydraulics Manual can be found at: http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/hyd_manual_info.shtml#Directives_Technical_Bulletins

Texas Department of Transportation (TxDOT)

TxDOT's most prescriptive post-construction requirements are driven by the Edwards Aquifer Rules, which apply to an eight-county region in central Texas and require the removal of 80% of the incremental increase in the annual mass loading of TSS.

- The "Edwards Aquifer Technical Guidance on Best Management Practices" is available at http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-348
- An overview of the Edwards Aquifer program is available at http://www.tceq.state.tx.us/nav/util_water/eapp.html

Texas 401 certification requirements may also require the implementation of post-construction TSS controls, but are less prescriptive. The 401 certification requirements for most projects generally involve the implementation of post-construction TSS control from a pre-approved list that includes vegetative filter strips and, in some cases, grassy swales and compost. Some larger projects require individual 401 certification. Texas Commission on Environmental Quality (TCEQ) may add more stringent, project-specific requirements in these cases. Bridge deck runoff is exempt from post-construction 401 certification requirements.

- TCEQ's 401 Certification requirements (including descriptions of approved controls) can be found at:
http://www.tceq.state.tx.us/permitting/water_quality/wq_assessment/401certification/401certification_definition.html

TxDOT MS4 programs address two categories of post-construction controls: structural and non-structural. Structural and/or non-structural controls are selected based on local water bodies and on project needs/constraints. Structural controls may include vegetated filter strips and swales (a practice validated by Texas research – see below). Non-structural controls include street sweeping, litter collection, inlet stenciling, vegetation management, etc. Research on Permeable Friction Course (PFC) continues to demonstrate persistent water quality benefits, and the final report is anticipated in early 2011. TCEQ has approved PFC for use over the Edwards Aquifer, and the DOT is incorporating it into their MS4 program as well. TCEQ has not yet approved PFC for use in the 401 Certification program.

Resources:

- Stormwater Quality Benefits of a Permeable Friction Course
<http://www.cwr.utexas.edu/reports/2008/rpt08-3.shtml>
- Porous Friction Course: A Laboratory Evaluation of Hydraulic Properties
<http://www.cwr.utexas.edu/reports/2008/rpt08-6.shtml>
- Stormwater Quality Documentation of Roadside Shoulders Borrow Ditches
<http://www.cwr.utexas.edu/reports/2005/rpt05-2.shtml>
- Characteristics of Composts: Moisture Holding and Water Quality Improvement
<http://www.cwr.utexas.edu/reports/2003/rpt03-9.shtml>
 - o See also http://www.epa.gov/osw/conserve/rrr/greenscapes/projects/tx_road.htm
- Characterization of Stormwater Runoff from a Bridge Deck and Approach Highway, Effects on Receiving Water Quality in Austin, Texas
<http://www.cwr.utexas.edu/reports/2005/rpt05-13.shtml>
- Approved Product List for erosion control and revegetation products
ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/bus/maintenance/erosion_intro_08.pdf
- Non-Proprietary Underground Stormwater Quality Structures
<http://tti.tamu.edu/documents/0-4611-1.pdf>

Virginia Department of Transportation (VDOT)

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

Washington Department of Transportation (WSDOT)

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

WSDOT has experimented with compost amended vegetated filter strips. They found that the use of compost amendments helps retain water, and they can get some credit for flow control, as well as water quality treatment by using them, since they are known and approved for use by the state water quality agency. WSDOT has also developed a BMP called the Media Filter Drain (formerly known as the Ecology Embankment), which is a long, linear BMP consisting of a mix of materials that removes pollutants including dissolved metals from runoff.

The HRM also includes LID BMPs, such as infiltration trenches and basins, and natural and engineered dispersion areas; and uses them when soil and geologic conditions allow.

WSDOT has been building and operating post-construction BMPs for several decades. WSDOT has over 2,500 stormwater BMPs on the highway system, but have always been challenged to secure funding for maintenance. Limited maintenance funding is focused on flow-based BMPs to ensure conveyance. More research is needed on BMP maintenance needs, schedules, costs, etc.

Resources:

- Link to WSDOT Highway Runoff Manual (HRM):
<http://www.wsdot.wa.gov/publications/manuals/fulltext/M31-16/HighwayRunoff.pdf>
 - o WSDOT developed the Media Filter Drain BMP, which has received General Use Approval from their state water quality regulator; the description begins on page 5-65.
 - o WSDOT uses a Compost Amended Vegetated Filter Strip, which has also been approved – the Vegetated Filter Strip BMP description begins on page 5-30. This section includes a reference to a separate section in the HRM that deals with Soil Amendments, starting on page 5-186.

- WSDOT's detailed compost specification is found in the DOT's "Standard Specifications for Road, Bridge and Municipal Construction," available at <http://www.wsdot.wa.gov/publications/manuals/fulltext/M41-10/SS2010.pdf>
 - o The compost specification is in Section 9-14.4(8), starting on page 9-83. For their Compost Amended Vegetated Filter Strip, the DOT normally uses the "Fine" compost.

Wisconsin Department of Transportation (WisDOT)

WisDOT has post-construction performance standards established through administrative code. By design, highway reconstruction projects have a 40% TSS removal requirement and an 80% TSS removal requirement for new construction (i.e., new alignment). Swales are the primary method for achieving the TSS reduction. Swales that meet certain design parameters achieve an 80% TSS reduction by design. Additionally, new construction must maintain or reduce the peak discharge as compared to the pre-development site conditions for the 2-year, 24-hour design storm.

For the most part, WisDOT develops maintenance agreements where any permanent BMPs installed are turned over to the local unit of government for maintenance. WisDOT does not have a maintenance workforce; all maintenance work is contracted out to the counties.

Wisconsin Administrative Code Trans 401:
<http://www.legis.state.wi.us/rsb/code/trans/trans401.pdf>

ADDITIONAL RESOURCES

Following are information and links on various projects undertaken by the National Cooperative Highway Research Program (NCHRP).

Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra-Urban Areas, NCHRP 25-31

Purpose of Work: The objective of this research is to develop guidelines for evaluating and selecting hydraulic modifications to existing drainage infrastructure in order to reduce pollutant loads and concentrations in ultra-urban areas.

Status: August 2010 completion data.

Evaluation of Best Management Practices for Highway Runoff Control, 2006, NCHRP Report 565

Purpose of Work: This report focuses on improving the scientific and technical knowledge base for the selection of BMPs through a better understanding of BMP performance and application. This report documents an extensive program of research on the characterization of BMPs and stormwater, and the influence of factors such as land use practice, hydraulic characteristics, regional factors, and performance evaluation. An attached CD contains three additional volumes and a spreadsheet model. The additional volumes are the User's Guide for BMP/LID Selection, Appendices to the User's Guide, and Low Impact Development Design Manual for Highway Runoff Control.

Status: The final report #565 can be found at <http://www.trb.org/Main/Public/Blurbs/158397.aspx>

Stormwater Treatment with Vegetated Buffers, NCHRP 25-25, Task 53

Purpose of Work: The use of vegetated buffers, filter strips, and grass swales as primary water quality treatments for stormwater runoff is gaining momentum; however, to date, these vegetative stormwater treatments have not yet achieved the same level of acceptance by some state regulatory agencies as other post-construction water quality BMPs. This is due in part to a general misconception or lack of understanding of the performance capabilities of these applications. The focus of this project is to provide data demonstrating the proven performance capabilities of vegetated buffers, filter strips, and grass swales as post-construction, primary stormwater treatments. This research was done to help facilitate gaining acceptance of or credit for their use from regulatory agencies.

Status: The final report is available and linked to the Center for Environmental Excellence <http://environment.transportation.org>

Measuring and Removing Dissolved Metals from Stormwater in Highly Urbanized Areas, NCHRP 25-32.

Purpose of Work: Dissolved metals in stormwater are becoming more of a concern to regulatory agencies, particularly in highly urbanized areas where land values and lack of available space limit the treatment options. A number of currently available BMPs are effective in removing dissolved metals, but the effectiveness of these treatments relies on the availability of sufficient space to accommodate them. DOTs need effective treatments to meet the requirements of environmental regulatory agencies in highly urbanized areas. The object of this research is to develop accurate and scientifically defensible testing protocols that can provide reliable and repeatable measures of dissolved metals content in stormwater and develop conceptual design specifications for at least two cost-effective stormwater treatment practices that could be used to effectively remove dissolved metals in highly urbanized areas.

Status: In contract negotiations, the study has an 18-month timeline

International Stormwater BMP Database

WERF, ASCE-EWRI, USEPA, FHWA, and APWA have formed a coalition of organizations to fund and manage the International Stormwater Best Management Practices Database. The work will consist of entering currently available and newly developed data sets, keeping the web site and database up to date, providing data analysis and developing protocols for integrating low impact development techniques into the database.

Status: The work is ongoing, and the database is currently accessible through the website at <http://www.bmpdatabase.org>

SUGGESTED RESEARCH AND FUTURE TOPICS

Following are research and data needs, as well as topic focus areas suggested during the CoP conference call for future discussion as a part of the CoP. Topics, research ideas, and emerging BMPs related to post-construction BMP issues are listed in no particular order of priority.

Permeable Friction Course

Introduction

The permeable friction course (PFC) is an approximately two-inch thick layer of porous asphalt placed on a conventional asphalt concrete or Portland cement concrete structural section to improve driver safety in wet weather. In addition, some reduction in noise level has been observed. Implementation of PFC has been widespread in the southern and western portions of the US, as well as in many countries in Europe and Asia.

Research conducted for TxDOT and NCDOT indicate a substantial water quality benefit from PFC. Runoff water quality discharged from PFC pavements has been shown to be roughly equivalent to that achieved by treating highway runoff with a sand filter system. This level of treatment is sufficient to meet stormwater requirements in many jurisdictions and for many receiving water conditions.

Benefit to DOT

The use of PFC may allow DOTs to comply with stormwater treatment requirements by incorporating the treatment within the pavement itself. Consequently, additional ROW would not be required for managing water quality, and no separate BMP maintenance is required. Since DOTs have widely implemented PFC based solely on the safety and noise considerations, the water quality benefits are in many cases essentially cost-free. PFC is also an attractive option in that it can be easily retrofit to existing roadways.

Research Needed/Next Steps

A variety of research questions could be addressed to increase the applicability of PFC and to document the water quality improvement.

- 1) Use of PFC in curbed sections: Most of the research that demonstrates the water quality improvement has been conducted on highways with rural cross-sections (no curb or gutter). Additional research is needed on whether accumulation of pollutants adjacent to a curb would negate the water quality benefits. In addition, there is a need to develop a standard configuration (e.g., pave all the way to the curb, end the pavement at the edge of the gutter, etc.) and to determine the impact on flooded width of the roadway and spacing of inlets. Estimated research cost: \$300,000
- 2) PFC mix design: Many DOTs still use older mix designs known as Open Graded Friction Course (OGFC). These pavements may not have sufficient permeability and porosity to provide an initial or long-term water quality benefit. In addition, many pavements include recycled materials such as crumb rubber. Investigation is needed to better understand how these materials affect permeability and porosity and to ensure that there is no leaching of pollutants from these materials. Estimated research cost: \$500,000
- 3) Cold weather use: DOTs in locations with multiple freeze/thaw cycles per year have been reluctant to use or evaluate PFC because of concerns related to service life of the overlay, deicing, and damage from snowplows. Some research has been conducted in

northern states recently (e.g., Indiana DOT), but additional research to address these concerns is warranted. Estimated research cost: \$500,000

- 4) Full depth porous asphalt: A suggested future research topic is full-depth infiltration/permeable pavement in the highway environment. DOT's have traditionally shied away from this configuration because of concerns about the durability of the pavement section. However, recent EPA stormwater requirements have included volume reduction requirements and there is every indication that EPA will adopt similar requirements nationwide. Consequently, DOTs may need to revisit this configuration in an attempt to infiltrate more runoff. Estimated research cost (initial): \$500,000

Media Filter Drains (Linear Filtration Devices)

Introduction

The Media Filter Drain (previously known as the Ecology Embankment or Bioslopes) is a technology developed by WSDOT to improve runoff quality in a linear, small footprint facility that is appropriate for the constrained ROWs associated with highways. It consists of a trench excavated parallel to the roadway that is backfilled with engineered media and an underdrain. Research by WSDOT has demonstrated improved water quality and a reduction in stormwater runoff volume. Similar systems have also been used internationally. For instance, in Scotland, most roadways are bordered by a "filter drain", which is an excavated trench filled with gravel and an underdrain. Some improvement in water quality has been demonstrated by this configuration, and it is used to limit moisture accumulation in the roadway base material.

Benefit to DOTs

The benefit of media filter drains to DOTs is the ability to provide stormwater treatment in a footprint that is suited to the linear constraints of transportation systems. Relatively high levels of treatment are possible, and it should be feasible to develop specialized filter media to meet more restrictive requirements associated with TMDLs or other site-specific needs.

Research Needed/Next Steps

- 1) Media formulation: There is a need to identify materials that will effectively reduce the concentrations of dissolved constituents, particularly metals and nutrients. These constituents are often addressed in TMDLs and conventional stormwater treatment controls; consequently, their control is a priority. The NCHRP should have a project start in the summer of 2010 (Project 25-32) to identify materials that exhibit substantial removal of dissolved metals. In addition, ODOT has a project under construction that will evaluate media filter drains with different materials, such as pulverized fish bone. Additional research in this area is not a priority until the results of these ongoing studies are available.
- 2) Design guidelines: A number of questions related to the design of the filter drains need to be resolved. First is the location of the drain relative to the pavement and the impact it might have on moisture levels in the highway base material (pavement life), and slope stability. Secondly, additional research needs to be conducted on the safety issues related to the choice of backfill materials. Since the filter drains are installed within the clear recovery zone, the trench backfill must be sufficiently strong to support the weight of vehicles where no guardrail is present. Since volume control of highway runoff may be required in the future, configurations should be developed that maximize infiltration. This technology shows promise in helping to address runoff water quality and quantity

mitigation that could otherwise be a substantial challenge on highways with significant longitudinal slopes. Estimated research cost: \$750,000

- 3) Maintenance requirements: Most of the media filter drains have been in operation for a relatively brief period; consequently, little is known about the long-term maintenance requirements. If replacement of the media is required, or if the trench must be excavated to re-establish infiltration into the surrounding soils, the cost could be prohibitive. This research is best conducted by WSDOT where systems have been in place for some time. ODOT is also in the process of evaluating media filter drain maintenance requirements. Estimated research cost: \$300,000

Batch Detention

Introduction

The concept behind batch detention is that the outlet for an extended detention or flood control basin is fitted with an automated valve system to control the timing and rate of runoff release rather than the conventional method of using a passive orifice or weir. An automated system is easily operated using a solar panel, deep cycle battery and motor operator, so installations in remote locations are facilitated. The use of batch detention has a number of advantages, in that it substantially improves the water quality performance of the basin, it allows the basin to act as a hazardous material trap for spills, it is well suited for retrofitting existing flood control facilities to provide a water quality benefit, and it can be used to meet hydromodification requirements. TxDOT has retrofitted two facilities for batch detention in the Austin area and has documented the water quality improvements.

Benefit to DOT

Batch detention has several potential benefits to DOTs. Since conventional extended detention ponds are easily and inexpensively (materials for the TxDOT retrofit were only about \$1,500/site) retrofit, this technology provides a convenient mechanism to improve the water quality performance of these devices when additional treatment is needed because of TMDLs or more restrictive treatment requirements. Secondly, its ability to act as a hazardous material trap makes batch detention attractive for use on major highways. Finally, its ability to retain water longer in detention facilities increases the amount of infiltration, which reduces the volume discharged. This may assist in complying with potential future requirements for runoff volume reduction.

Research Needed/Next Steps

TxDOT has already demonstrated the proof of concept for this treatment technology. There are two main areas where future research would be helpful.

- 1) Commercialization of technology: The next step needed for widespread adoption of this technology is to develop reliable systems that can operate for extended periods without undue maintenance and in a variety of climatic conditions. Estimated research cost: \$100,000
- 2) Development of linked systems: Flood control systems in a watershed are conventionally designed and operated independently, without regard to their location in the watershed. This can actually lead to greater flood depths in downstream receiving channels than if no detention basins had been constructed. By linking the automated valves to a central controller/decision support system (by cell phone, WiMAX, or other technology) the

discharge of the basins can be optimized to comply with water quality, hydromodification requirements or flood control requirements on an event-specific basis and address the interaction of multiple-basin discharge. Estimated research cost: \$750,000

Use of Proprietary Devices

Introduction

A variety of proprietary products on the market are small footprint, below grade vaults. Some of these are swirl concentrators, while others are little more than boxes with a series of baffles. These products remove pollutants primarily through sedimentation, but are often too small to achieve substantial reduction or to meet regulatory performance thresholds. A survey of proprietary devices has been conducted by several DOTs, including Massachusetts DOT, Texas DOT, and Caltrans (California DOT).

Benefit to DOTs

These types of products are popular for use in highway widening projects in existing urban areas, which lack sufficient ROW to incorporate public domain controls. Maintenance requirements may be a substantial drawback. Most require vacuum trucks to remove accumulated pollutants and retained stormwater at frequent intervals

Research Needed/Next Steps

The NCHRP currently has a project on ultra-urban BMPs (25-31), which is scheduled for completion this summer. No additional research is recommended until the final report is made available for review.

Soil Amendments

Introduction

Soil amendments such as compost have been investigated to retain runoff, promote vegetation growth and remove particulates by a number of DOTs including Caltrans, WsDOT and TxDOT. The reduction in runoff volume is a particularly important element, considering the new nationwide rules on volume control currently being evaluated by EPA. TxDOT research indicates that areas where vegetation coverage is near 100% in the existing condition showed little benefit from the addition of compost into the soil. Other research in Texas and other locations has demonstrated a substantial improvement in the rate of vegetation establishment in disturbed areas. A potential issue is that many compost formulations contain a substantial amount of phosphorus that will leach into the discharge during storm events.

Benefit to DOTs

Most highways (particularly in rural areas) have vegetated clear recovery zones that effectively operate as vegetated filter strips (biofilters in some terminology). Improving the vegetation coverage, pollutant removal, and volume reduction potential is a cost-effective way to meet stormwater treatment requirements in many areas.

Research Needed/Next Steps

Additional research would be helpful in the areas of pollutant removal documentation, soil amendment specification, configurations of placement, and volume reduction.

- 1) Quality improvement: The improvement in runoff quality resulting from the application of soil amendments as permanent post-construction BMPs has been investigated in only a few locations. More research nationwide would be helpful in demonstrating the performance to regulatory agencies. One focus should be on establishing the benefit in areas with sandy soils that do not support full-vegetated coverage under natural conditions. Estimated research cost: \$500,000
- 2) Amendment specification: A second area of research is the improvement in specifications for soil amendments. For instance, compost has many potential sources including dairy waste, feedlots, chicken litter, biosolids, and yard trimmings. The chemistry of these composts differs substantially and care should be taken to develop specifications that limit the leaching of nutrients, while still providing the benefits of vegetation establishment and runoff volume reduction. Estimated research cost: \$300,000
- 3) Configurations of placement: Research could also evaluate different configurations of placement of soil amendment and its effectiveness for water quality. This research can consider practices by ODOT (and other DOTs) on application and configurations of soil amendments. This includes different configurations, such as placing compost on the surface of steep embankments (including on the top of stone-covered slopes); soil amendment mixed with the native shoulder soils along the width of the shoulder; and linear application of amended soil along the highway adjacent to pavement. This research could evaluate configurations that could look at stability, safety and soil amendment quantity, width, and depth. Estimated research cost: \$150,000
- 4) Volume reduction: Very little work outside of WSDOT has been done on documenting the runoff volume reduction achieved with soil amendments. Given the EPA focus on this issue, much more work is needed in areas with different rainfall characteristics to document the degree of runoff reduction. Estimated research cost: \$750,000

ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this report:

AASHTO	American Association of Highway and Transportation Officials
BMP	Best Management Practice
Caltrans	California Department of Transportation
CoP	Community of Practice
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DOT	Department of Transportation
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GSRD	Gross Solids Removal Devices
IDOT	Illinois Department of Transportation
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System
NHDOT	New Hampshire Department of Transportation
NCHRP	National Cooperative Highway Research Program
NPDES	National Pollutant Discharge Elimination System
NYSDOT	New York State Department of Transportation
ODOT	Oregon Department of Transportation
OGFC	Open-Graded Friction Course
O&M	Operation and Maintenance
PFC	Permeable Friction Course
ROW	Right-of-Way
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TxDOT	Texas Department of Transportation
VDOT	Virginia Department of Transportation
WSDOT	Washington State Department of Transportation

RESOURCES

NPDES State Stormwater Rules and Regulations

Individual state NPDES permit links are provided here to assist DOTs in researching BMP requirements when evaluating requirements for their own program. Not all states are listed since some DOT programs are co-permittees under multiple Phase I or Phase II permits.

Alabama	http://www.adem.state.al.us/alEnviroRegLaws/files/Division6Vol1.pdf
Alaska	http://www.dec.state.ak.us/WATER/wnp spc/stormwater/sw_industrial.htm
Arizona	http://www.azdeq.gov/environ/water/permits/stormwater.html
Arkansas	http://www.adeq.state.ar.us/water/branch_permits/general_permits/stormwater/pdfs/arr040000.pdf
California	http://www.waterboards.ca.gov/water_issues/programs/stormwater/gen_caltrans.shtml
Colorado	http://www.cdphe.state.co.us/wq/PermitsUnit/PERMITs/GeneralPermits.htm
Connecticut	http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654
Delaware	http://www.swc.dnrec.delaware.gov/Pages/SedimentStormwater.aspx
District of Columbia	http://ddoe.dc.gov/ddoe/cwp/view,a,1209,q,495848.asp
Florida	http://www.dep.state.fl.us/water/stormwater/npdes/MS4_3.htm
Georgia	http://www.georgiaepd.org/Documents/regcomm_wpb.html
Hawaii	http://hawaii.gov/health/permits/environment/index.html
Idaho	http://www.deq.state.id.us/water/permits_forms/permitting/overview.cfm#federal
Illinois	http://www.dot.state.il.us/desenv/environmental/stormwater.html
Indiana	http://www.in.gov/idem/4896.htm
Iowa	http://www.iowadnr.gov/water/stormwater/who.html
Kansas	http://www.kdheks.gov/stormwater/
Kentucky	http://www.water.ky.gov/permitting/wastewaterpermitting/KPDES/storm/
Louisiana	http://www.deq.louisiana.gov/portal/tabid/243/Default.aspx
Maine	http://www.maine.gov/mdot/environmental-office-homepage/surface-water-resources
Maryland	http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/storm_gen_permit.asp
Massachusetts	http://www.mass.gov/dep/water/wastewater/stormwat.htm
Michigan	http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3713---,00.html
Minnesota	http://www.pca.state.mn.us/water/stormwater/stormwater-rules.html
Mississippi	http://www.deq.state.ms.us/MDEQ.nsf/page/epd_epdgeneral
Missouri	http://www.dnr.mo.gov/ENV/wpp/permits/wpcpermits-stormwater.htm
Montana	http://www.deq.state.mt.us/wqinfo/MPDES/StormwaterConstruction.mcp
Nebraska	http://www.deq.state.ne.us/WaterPer.nsf/Pages/NPDES
Nevada	http://ndep.nv.gov/BWPC/storm01.htm

New Hampshire	http://des.nh.gov/organization/divisions/water/stormwater/categories/permits.htm
New Jersey	http://www.nj.gov/dep/dwq/msrp_home.htm
New Mexico	http://www.nmenv.state.nm.us/swqb/StormWater/index.html
New York	http://www.dec.ny.gov/chemical/43133.html
North Carolina	http://portal.ncdenr.org/web/wq/ws/su
North Dakota	http://www.ndhealth.gov/WQ/Storm/MS4/MS4Permit.htm
Ohio	http://www.epa.ohio.gov/dsw/permits/GP_ConstructionSiteStormWater.aspx
Oklahoma	http://www.deq.state.ok.us/WQDnew/stormwater/
Oregon	http://www.deq.state.or.us/wq/stormwater/stormwater.htm
Pennsylvania	http://www.portal.state.pa.us/portal/server.pt/community/stormwater_management/10628/npdes_ms4%C2%A0information/669119
Rhode Island	http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/index.htm
South Carolina	http://www.scdhec.gov/environment/ocrm/permit/stormwater.htm
South Dakota	http://denr.sd.gov/des/sw/stormwater.aspx
Tennessee	http://www.tennessee.gov/environment/permits/strmh2o.shtml
Texas	http://www.tceq.state.tx.us/nav/permits/sw_permits.html
Utah	http://www.waterquality.utah.gov/UPDES/stormwater.htm
Vermont	http://www.anr.state.vt.us/dec/waterq/stormwater/htm/sw_RDA.htm
Virginia	http://www.dcr.virginia.gov/soil_and_water/vsmp.shtml
Washington	http://www.ecy.wa.gov/programs/wq/stormwater/index.html
West Virginia	http://www.wvdep.org/Item.cfm?ssid=11&SS1ID=540
Wisconsin	http://dnr.wi.gov/runoff/stormwater/permits/
Wyoming	http://deq.state.wy.us/wqd/WYPDES_Permitting/WYPDES_Storm_Water/stormwater.asp

EPA DOT Stormwater Program

<http://cfpub.epa.gov/npdes/stormwater/municroads/transportprograms.cfm>

Center for Environmental Excellence by AASHTO

http://environment.transportation.org/center/products_programs/practitioners_resources.aspx?id=11

APPENDIX

New Hampshire DOT Water Quality Certification

NH Department of Transportation
Charles Hood, Administrator
Bureau of Environment
1 Hazen Drive
P.O. Box 483
Concord, NH 03302-0483

WATER QUALITY CERTIFICATION

In Fulfillment of

Section 401 of the United States Clean Water Act (33 U.S.C 1341)

WQC # 2006-013

Activity Name	Newington - Dover, 11238, NHS-027-1(37)
Activity Location	Spaulding Turnpike, Newington and Dover, New Hampshire
Affected Surface waters	Paul Brook, Pickering Brook (including 2 unnamed ponds), Flagstone Brook, Railway Brook, 2 unnamed tributaries, Bellamy River, Piscataqua River, Little Bay, and several unnamed wetlands.
Owner/Applicant	State of New Hampshire Department of Transportation 7 Hazen Drive P.O. Box 483 Concord, NH 03302-0483
Appurtenant permit(s):	U.S. Army Corps of Engineers No. NAE-2004-3545 Wetlands Bureau Permit No. 2006-02007
DATE OF APPROVAL (subject to Conditions below)	February 3, 2010

A. INTRODUCTION

The State of New Hampshire, acting by the Department of Transportation (DOT) (Applicant), proposes to reconstruct and widen a 3.5 mile section of an existing highway facility (Spaulding Turnpike) from just north of Exit 1 in Newington to just south of the Dover Toll Plaza including rehabilitation and widening of the Little Bay Bridges to eight lanes (three general purpose lanes plus an auxiliary lane in each direction), rehabilitation of the General Sullivan Bridge (GSB) to continue to function as a pedestrian/bicycle/recreational facility and to accommodate emergency response and maintenance vehicles, and improvements to the interchange areas at Exits 2, 3, 4, 5 and 6 (generally defined as the Activity – see item D-1 below for a more complete definition).

The Activity is anticipated to consist of five major construction contracts with

an overall construction period that is expected to extend over 8 years starting in 2010 and ending in 2017. The operation period is indefinite after completion of construction. The following provides a breakdown of the anticipated major construction contracts.

The first contract involves the construction of the new Little Bay Bridge and the associated roadway approach work. This contract is anticipated to start in 2010 and conclude in 2013.

The second contract is expected to involve construction of the major roadway improvements in Newington. This contract is anticipated to start in 2012 and conclude in 2014.

The third contract is expected to involve the rehabilitation of the existing Little Bay Bridge and the associated roadwork. This contract is anticipated to start in 2014 and conclude in 2015.

The fourth contract is expected to involve the majority of the roadway improvements in Dover and the remaining minor work to be completed in Newington. This contract is anticipated to start in 2013 and conclude in 2015.

The fifth contract will involve rehabilitation of the General Sullivan Bridge. This contract is anticipated to commence in 2015 and conclude in 2017.

This 401 Water Quality Certification (401 WQC) documents laws, regulations, determinations and conditions related to the Activity for the attainment and maintenance of NH surface water quality standards, including the provisions of NH RSA 485-A:8 and NH Code of Administrative Rules Env-Wq 1700, for the support of designated uses identified in the standards.

B. 401 CERTIFICATION APPROVAL

Based on the findings and conditions noted below, the New Hampshire Department of Environmental Services (DES) has determined that any discharge associated with the Activity will not violate surface water quality standards, or cause additional degradation in surface waters not presently meeting water quality standards. DES hereby issues this 401 WQC subject to the conditions defined in Section E of this 401 Certification, in accordance with Section 401 of the United States Clean Water Act (33 U.S.C. 1341).

C. STATEMENT OF FACTS AND LAW

C-1. Section 401 of the United States Clean Water Act (33 U.S.C. 1341) states, in part: "Any applicant for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates or will originate...that any such discharge will comply with the applicable provisions of sections 301, 302, 303, 306, and 307 of this

title.....No license or permit shall be granted until the certification required by this section has been obtained or has been waived...No license or permit shall be granted if certification has been denied by the State..."

- C-2. Section 401 further states, in part "Any certification provided under this section shall set forth any effluent limitations and other limitations, and monitoring requirements necessary to assure that any applicant for a Federal license or permit will comply with any applicable effluent limitations and other limitations...and shall become a condition on any Federal license or permit subject to the provisions of this section."
- C-3. NH RSA 485-A:12, III, states: "No activity, including construction and operation of facilities, that requires certification under section 401 of the Clean Water Act and that may result in a discharge, as that term is applied under section 401 of the Clean Water Act, to surface waters of the state may commence unless the department certifies that any such discharge complies with the state surface water quality standards applicable to the classification for the receiving surface water body. The department shall provide its response to a request for certification to the federal agency or authority responsible for issuing the license, permit, or registration that requires the certification under section 401 of the Clean Water Act. Certification shall include any conditions on, modifications to, or monitoring of the proposed activity necessary to provide assurance that the proposed discharge complies with applicable surface water quality standards. The department may enforce compliance with any such conditions, modifications, or monitoring requirements as provided in RSA 485-A:22."
- C-4. NH RSA 485-A:8 and Env-Wq 1700 (Surface Water Quality Regulations, effective May 21, 2008) together fulfill the requirements of Section 303 of the Clean Water Act that the State of New Hampshire adopt water quality standards consistent with the provisions of the Act.
- C-5. Env-Wq 1701.02, entitled "Applicability", states that:
- "(a) These rules shall apply to all surface waters.
- (b) These rules shall apply to any person who causes point or nonpoint source discharge(s) of pollutants to surface waters, or who undertakes hydrologic modifications, such as dam construction or water withdrawals, or who undertakes any other activity that affects the beneficial uses or the level of water quality of surface waters."
- C-6. Env-Wq 1702.18 defines a discharge as:
- "a. The addition, introduction, leaking, spilling, or emitting of a pollutant to surface waters, either directly or indirectly through the groundwater, whether done intentionally, unintentionally, negligently, or otherwise; or

- b. The placing of a pollutant in a location where the pollutant is likely to enter surface waters."
- C-7. Env-Wq 1702.39 defines a pollutant as: "pollutant" as defined in 40 CFR 122.2. This means "dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water."
- C-8. Env-Wq 1702.46 defines surface waters as "perennial and seasonal streams, lakes, ponds and tidal waters within the jurisdiction of the state, including all streams, lakes, or ponds bordering on the state, marshes, water courses and other bodies of water, natural or artificial," and waters of the United States as defined in 40 CFR 122.2."
- C-9. Surface waters are navigable waters for the purposes of certification under Section 401 of the Clean Water Act. Surface waters are jurisdictional wetlands for the purposes of wetlands permitting under RSA 482-A.
- C-10. Env-Wq 1703.01 (c) states that "All surface waters shall provide, wherever attainable, for the protection and propagation of fish, shellfish and wildlife, and for recreation in and on the surface waters."
- C-11. Env-Wq 1703.14, entitled "Nutrients", states that
 - "a. Class A waters shall contain no phosphorous or nitrogen unless naturally occurring.
 - b. Class B waters shall contain no phosphorous or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring.
 - c. Existing discharges containing either phosphorous or nitrogen which encourage cultural eutrophication shall be treated to remove phosphorus or nitrogen to ensure attainment and maintenance of water quality standards.
 - d. There shall be no new or increased discharge of phosphorous into lakes or ponds.
 - e. There shall be no new or increased discharge(s) containing phosphorous or nitrogen to tributaries of lakes or ponds that would contribute to cultural eutrophication or growth of weeds or algae in such lakes and ponds."
- C-12. Env-Wq 1703.19, entitled "Biological and Aquatic Community Integrity", states that

"a. The surface waters shall support and maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region; and

b. Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function."

- C-13. Env-Wq 1703.21 (a)(1) states that "Unless naturally occurring or allowed under part Env-Ws 1707, all surface waters shall be free from toxic substances or chemical constituents in concentrations or combinations that injure or are inimical to plants, animals, humans or aquatic life."
- C-14. Env-Wq 1703.07 through 1703.11 contain standards relative to dissolved oxygen, bacteria, benthic deposits, oil and grease, and turbidity.
- C-15. Env-Wq 1702.06 states ""Best management practices" means those practices which are determined, after problem assessment and examination of all alternative practices and technological, economic and institutional considerations, to be the most effective practicable means of preventing or reducing the amount of pollution generated by point or nonpoint sources to a level compatible with water quality goals."
- C-16. Section 303(d) of the Clean Water Act (33 U.S.C. 1313(d)) and the regulations promulgated thereunder (40 C.F.R. 130.0 – 40 C.F.R. 130.11) require states to identify and list surface waters that are violating state water quality standards (i.e., Section 303(d) List) that do not have an approved TMDL. For these water quality-impaired waters, states must establish Total Maximum Daily Loads (TMDLs) for the pollutants causing the impairments and submit the list of impaired surface waters and TMDLs to EPA for approval. TMDLs include source identification, determination of the allowable load and pollutant reductions (by source) necessary to meet the allowable load. Once a TMDL is conducted, the pollutant/surface water is transferred to the list of impaired waters with approved TMDLs (known as Category 4A waters). The Section 303(d) List is, therefore, a subset of all impaired waters. The most recent Section 303(d) list of impaired waters is the 2008 Section 303(d) List. On August 14, 2009, DES submitted a letter to EPA requesting that the 2008 303(d) List be amended to include the following additional impairments in 36 of the Great Bay estuarine assessment units: nitrogen, chlorophyll a, clarity (light attenuation), estuarine bioassessment, and/or dissolved oxygen. On September 30, 2009, EPA approved New Hampshire's 2008 303(d) List with amendments. A list of all impaired waters (including the August 14, 2009 amendments) is available at <http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/index.htm>.

- C-17. On December 20, 2007, EPA approved the Northeast Regional Mercury TMDL¹ which addressed mercury impairments in all New Hampshire fresh surface waters.
- C-18. When a surface water does not meet water quality standards (i.e., when it is impaired), the addition of pollutants causing or contributing to impairment is prohibited in accordance with the following:
- a. Env-Wq 1703.03 (a) states that "The presence of pollutants in the surface waters shall not justify further introduction of pollutants from point or nonpoint sources, alone or in any combination".
 - b. NH RSA 485-A:12 (I) (Enforcement of Classification) states that "After adoption of a given classification for a stream, lake, pond, tidal water, or section of such water, the department shall enforce such classification by appropriate action in the courts of the state, and it shall be unlawful for any person or persons to dispose of any sewage, industrial, or other wastes, either alone or in conjunction with any other person or persons, in such a manner as will lower the quality of the waters of the stream, lake, pond, tidal water, or section of such water below the minimum requirements of the adopted classification".
- C-19. Antidegradation provisions are included in Env-Wq 1702 and Env-Wq 1708.
- a. Env-Wq 1702.02 states that "Antidegradation" means a provision of the water quality standards that maintains and protects existing water quality and uses.
 - b. Env-Wq 1708.02 states that "Antidegradation shall apply to: (a) Any proposed new or increased activity, including point source and nonpoint source discharges of pollutants, that would lower water quality or affect the existing or designated uses; (b) Any proposed increase in loadings to a waterbody when the proposal is associated with existing activities; (c) Any increase in flow alteration over an existing alteration; and (d) Any hydrologic modifications, such as dam construction and water withdrawals."
 - c. Antidegradation applies to all parameters as evidenced by Env-Wq 1708.08 (a) (Assessing Waterbodies) which states " The applicant shall characterize the existing water quality and determine if there is remaining assimilative capacity for each parameter in question."
 - d. According to Env-Wq 1708.04 (b), "A proposed discharge or activity shall not eliminate any existing uses or the water quality needed to maintain and protect those uses".

1. Northeast Regional Mercury Total Maximum Daily Load. Connecticut Department of Environmental Protection, Maine Department of Environmental Protection, Massachusetts Department of Environmental Protection, New Hampshire Department of Environmental Services, New York State Department of Environmental Conservation, Rhode Island Department of Environmental Management, Vermont Department of Environmental Conservation, New England Interstate Water Pollution Control Commission. October 24, 2007.

- e. Env-Wq 1702.03 states that "Assimilative capacity" means the amount of a pollutant or pollutants that can safely be released to a waterbody without causing violations of applicable water quality criteria or negatively impacting uses.
- f. Env-Wq 1708.08 describes the process for assessing waterbodies to determine if there is remaining assimilative capacity for each parameter in question.
- g. Determination of significant and insignificant discharges is described in Env-Wq 1708.09 which are, in part, based on the remaining assimilative capacity of pollutant.
- h. Env-Wq 1708.01 (b) states: "For significant changes in water quality, where the quality of the surface waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water, that quality shall be maintained and protected unless the department finds, after full satisfaction of the intergovernmental coordination and public participation provisions that, in accordance with Env-Wq 1708.10, allowing lower water quality is necessary to accommodate important economic or social development in the area in which the surface waters are located. In allowing such degradation or lower water quality, the department shall assure water quality adequate to fully protect existing uses. Further, the department shall assure that the highest statutory and regulatory requirements shall be achieved for all new and existing point sources and that all cost effective and reasonable best management practices for nonpoint source control shall be implemented".
- i. Env-Wq 1708.01 (c) states: "For insignificant changes in water quality, where the quality of the surface waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water, that quality shall be maintained and protected. In allowing such degradation or lower water quality, the department shall assure water quality adequate to protect existing uses fully. Further, the department shall assure that the highest statutory and regulatory requirements shall be achieved for all new and existing point sources and that all cost effective and reasonable best management practices for nonpoint source control shall be implemented".
- j. Significant discharges require 1) a demonstration that the Activity will provide an important economic or social development (Env-Wq 1708.10), 2) an alternative analysis to determine if it is possible to achieve the important economic or social development without lowering water quality or with a reduced degree of degradation (Env-Wq 1708.10 (b)), and 3) opportunity for public comment and intergovernmental coordination (Env-Wq 1708.11).

C-20. The Activity reviewed for this 401 Certification requires a federal wetlands permit under the federal Clean Water Act Section 404. The U.S. Army Corps of Engineers provided public notice for the Activity on August 21, 2006. On June 19, 2009, the U.S. Army Corps of Engineers issued a provisional permit for the Activity.

- C-21. The Applicant is responsible for the Activity, including construction and operation.
- C-22. The Applicant submitted documentation for 401 Certification to DES in February 2008, as follows:
- a. An application for 401 Certification was submitted on February 7, 2008, which included a USGS topographic locus map of the project area and a copy of the August 2006 *Application for Department of the Army Permit/NH Wetlands Bureau Permit*.
 - b. A copy of the Final Environmental Impact Statement (FEIS) entitled "Spaulding Turnpike Improvements NHS-027-1(37)-11238", dated December 2007 and consisting of an Executive Summary and Volumes 1-4 was submitted on February 11, 2008. The environmental study was included in the application for 401 Certification and discussed surface water impacts and mitigation measures for water quality protection during construction. The FEIS includes comments raised by the public and the Applicant's response to comments.
- C-23. A draft Environmental Impact Statement (EIS) was issued for public comment in 2006 by the Applicant and the Federal Highway Administration (FHA). A final EIS² was issued in December 2007. The final EIS included a summary of public comments received on the draft and responses by the Applicant and FHA.
- C-24. On October 24, 2008, the Federal Highway Administration issued a Record of Decision (ROD) for the Activity (FHWA-NH-EIS-06-01-F).
- C-25. On April 16, 2009, the DES Waste Management Division received a copy of a letter report dated December 30, 2008 from ATC Associates Inc. to the Applicant regarding marine sediment testing. The purpose of the soil/sediment sampling program was to determine the thickness of sediment / soil overlying the bedrock and the presence of oil and/or hazardous material (OHM) that might be encountered during the construction of piers in the Piscataqua River. Sediment samples were taken in September and October of 2008 in the river channel between the existing General Sullivan and Little Bay bridges.
- C-26. On June 17, 2009 the DES Wetlands Bureau issued Wetlands Permit #2006-02007 for alterations or impacts to jurisdictional wetlands associated with the Activity. A Joint Public Hearing with the US Army Corp of Engineers, the Federal Highway Administration, and the NH Department of Environmental Services Wetlands Bureau was held on September 21, 2006.

2. Final Environmental Impact Statement, Spaulding Turnpike Improvements NHS-027-1(37), 11238, Newington to Dover New Hampshire. December 2007. Prepared for the NH Department of Transportation and the Federal Highway Administration by VHB/Vanesse Hangen Brustlin, Inc.

- C-27. DES Alteration of Terrain regulations (Env-Wq 1500), effective January 1, 2009) include design criteria for stormwater best management practices (BMPs) as well as criteria for minimizing the hydrologic impacts of stormwater runoff both during and after construction. Further, BMP design details as well as guidance for preparing pollutant loading analyses using the "Simple Method" are provided in *The New Hampshire Stormwater Manual* (<http://des.nh.gov/organization/divisions/water/stormwater/manual.htm>). The pollutant loading guidance assumes all permanent stormwater practices (i.e., best management practices or BMPs) referenced in the loading analysis are designed in accordance with current Alteration of Terrain regulations (Env-Wq 1500).
- C-28. DES maintains an Environmental Monitoring Database (EMD) for all environmental data collected and received by DES. The EMD is accessible to the public on the World Wide Web and is designed to accept data from sources outside of DES.

D. FINDINGS

- D-1. The Activity reviewed for this 401 Certification is the "Selected Alternative" as described in the 2007 FEIS (see section C-22 of this Certification) and the FHWA ROD (see section C-23 of this Certification) and in general includes construction and operation of the following: Reconstruction and widening of a 3.5 mile section of an existing highway facility (Spaulding Turnpike) from just north of Exit 1 in Newington to just south of the Dover Toll Plaza, including: improvements to five interchange areas (Exits 2, 3, 4, 5 and 6), rehabilitation and widening of the Little Bay Bridges to eight lanes (three general purpose lanes plus an auxiliary lane in each direction), and rehabilitation of the General Sullivan Bridge (GSB) to continue to function as a pedestrian/bicycle/recreational facility and to accommodate emergency response and maintenance vehicles.
- D-2. The Activity requires water quality certification under Section 401 of the federal Clean Water Act.
- D-3. The Activity will result in a discharge and may cause the permanent alteration of, or temporary impacts to surface waters.
- D-4. Storm water runoff, including snowmelt, and groundwater flow to surface waters from within the area affected by the Activity during warm and cold-weather conditions are discharges under the definitions of Env-Wq 1702.18.
- D-5. The Activity includes dredge and fill of wetlands. The 401 Certification decision relies, in part, on an approved permit from the DES Wetlands Bureau for the potential construction-related impacts to jurisdictional wetlands. Through its processing and issuance, the DES wetlands permit will address the dredge and fill impacts to jurisdictional wetlands.

- D-6. The named and unnamed fresh water and tidal rivers and streams, lakes and ponds, and wetlands, affected by the Activity, are surface waters under Env-Wq 1702.46. DES has assigned Assessment Unit (AU) identification numbers to surface waters that appear on 1:100,000 scale hydrography. Consequently, not all surface waters currently have an AU number. Surface waters that do not have an AU number are still considered surface waters of the State in accordance with Env-Wq 1702.46 (see section C-8 of this Certification). Surface waters that could be potentially affected by the Activity and their associated AU numbers (where available) include the following: Paul Brook (NHRIV600031001-07), Pickering Brook (including 2 unnamed ponds) and Flagstone Brook (NHRIV600031001-01), Railway Brook (NHRIV600031001-08), 2 unnamed tributaries to the Piscataqua River, the tidal portion of the Bellamy River (NHEST600030903-01-02), Little Bay (NHEST600030904-06-13, NHEST600030904-06-14 and NHEST600030904-06-15), the Piscataqua River (NHEST600031001-02-01, NHEST600031001-01-02 and NHEST600031001-01-03), and several unnamed wetlands.
- D-7. The potentially affected surface waters are Class B waterbodies; therefore Class B New Hampshire surface water quality standards apply to the Activity. Class B waterways are considered suitable for aquatic life, primary and secondary contact recreation, fish consumption, wildlife, and, after adequate treatment, as a water supply ³.
- D-8. The Activity includes the addition of approximately 23.3 acres of impervious roadway, shoulders, and sidewalks to accommodate vehicular and bicycle traffic and pedestrians. The increase in impervious area and use of the roadway and associated facilities can result in increased deposition of pollutants such as chlorides, sediments, nutrients (phosphorus and nitrogen), various metals (i.e, lead, zinc, etc), bacteria and petroleum aromatic hydrocarbons (PAHs). These pollutants can then be mobilized and transported from impervious surfaces to surface waters and can potentially cause or contribute to violations of surface water quality standards.
- D-9. The Activity may temporarily or permanently result in increased flow and volume of stormwater runoff and reductions in groundwater recharge due to increases in impervious surfaces. Such hydrologic alterations could violate the antidegradation provisions of the state surface water quality regulations (see section D-10 of this Certification). The current Alteration of Terrain regulations (Env-Wq 1500) include provisions to prevent degradation associated with hydrologic alterations. In specific, Env-Wq 1507.05 and Env-Wq 1507.06 address stormwater flow and Env-Wq 1507.04 addresses groundwater recharge. Requiring the Applicant to comply with these regulations is expected to prevent hydrologic related violations of the antidegradation provisions of the state surface water quality regulations.

3. 2008 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology. March 2008. NH Department of Environmental Services. NHDES-R-WD-05-29.

D-10. Since the Activity could include new discharges of pollutants and increases in flow alteration (i.e., due to increased impervious cover), the antidegradation provisions of Env-Wq 1708 apply (see section C-19 of this 401 Certification).

D-11. According to the 2008 list of impaired waters (see section C-16 of this Certification), the following surface waters in the vicinity of the proposed Activity are listed as impaired. All impairments, with the exception of those highlighted in bold (which have approved TMDLs), are on the Section 303(d) List:

Assessment Unit (AU)	Waterbody Name	Cause of Impairment (Designated Use Impaired)
NHEST600030903-01-02	Estuary - Bellamy River South	Estuarine Bioassessment, Total Nitrogen (AL) Mercury, PCB (FC) Enterococcus (PCR) Dioxin, Fecal Coliform, Mercury, PCB (SFC)
NHEST600030904-06-13	Estuary- Lower Little Bay	Clarity, Total Nitrogen, Estuarine Bioassessment (AL) Mercury, PCB (FC) Dioxin, Fecal Coliform, Mercury, PCB (SFC)
NHEST600030904-06-14	Estuary - Lower Little Bay Marina SZ	Clarity, Total Nitrogen, Estuarine Bioassessment (AL) Mercury, PCB (FC) Dioxin, Mercury, PCB (SFC)
NHEST600030904-06-15	Estuary - Lower Little Bay General Sullivan Bridge	Clarity, Total Nitrogen, Estuarine Bioassessment (AL) Mercury, PCB (FC) Dioxin, Mercury, PCB (SFC)
NHEST600031001-01-02	Estuary - Upper Piscataqua River - Dover WWTF SZ	Clarity, Total Nitrogen, Estuarine Bioassessment (AL) Mercury, PCB (FC) Enterococcus (PCR) Dioxin, Mercury, PCB (SFC)
NHEST600031001-01-03	Estuary - Upper Piscataqua River	Clarity, Total Nitrogen, Estuarine Bioassessment (AL) Mercury, PCB (FC) Dioxin, Mercury, PCB (SFC)
NHEST600031001-02-01	Estuary - Lower Piscataqua River North	Estuarine Bioassessment (AL) Mercury, PCB (FC) Enterococcus (PCR and SCR) Dioxin, Mercury, PCB (SFC)
NHRIV600031001-01	Pickering Brook (including 2 unnamed ponds) and Flagstone Brook	Aluminum, Iron (AL) Mercury (FC)
NHRIV600031001-07	Paul Brook	Benthic Macroinvertebrate Bioassessment, Chloride, Dissolved Oxygen (AL) Mercury (FC) Escherichia Coli (PCR)
HRIV600031001-08	Railway Brook	Iron (AL) Mercury (FC)

Assessment Unit (AU)	Waterbody Name	Cause of Impairment (Designated Use Impaired)
Notes: AL = Aquatic Life, PCR = Primary Recreation, SCR = Secondary Recreation, FC = Fish Consumption, SFC = Shellfish Consumption		
Impairments highlighted in bold have approved TMDLs. All other impairments are on the Section 303(d) List.		

D-12. As stated in section C-18 of this Certification, when a surface water does not meet water quality standards (i.e., when it is impaired), the addition of pollutants causing or contributing to impairment is prohibited. That is, existing loadings must be held. Further, as stated in C-16 of this Certification, TMDLs must be conducted for any surface water listed on the Section 303(d) List. The TMDL includes source identification, determination of the allowable load and reductions (by source) necessary to meet the allowable load. For waters with an approved TMDL, pollutant reductions per the TMDL are required. For pollutants causing an impairment without a TMDL, loadings of the pollutant causing impairment must be held such that there are no increased loadings until such time as a TMDL is prepared.

For all other pollutants (i.e., those not known to be causing impairment) which are likely to be discharged from the Activity, Applicants can either hold existing loadings (i.e., no degradation), or request to degrade the water in accordance with the antidegradation provisions of Env-Wq 1700. As stated in section C-19 of this Certification, to satisfy antidegradation, Applicants must 1) determine the remaining assimilative capacity of the pollutant(s) of concern (which may require monitoring), 2) determine if the discharge is "significant " or insignificant (which will likely require modeling to predict the percent of the remaining assimilative capacity used by the Activity) 3), if "significant", provide justification that the Activity provides an important economic or social benefit including an alternative analysis to minimize the degradation, and 4) provide opportunity for public comment and intergovernmental agency coordination. This information is then submitted to DES for approval or denial of the requested degradation.

To demonstrate no additional loading for pollutants which can be removed by structural BMPs, DES allows Applicant's to submit loading analyses in accordance with guidance included in the DES Stormwater Manual (see section C-27 of this Certification). The guidance allows use of the "Simple Method" for calculating loads before and after construction. At this time, DES uses total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP) as surrogates for all other parameters. That is, if the loadings for TSS, TN and TP are held to pre-construction levels, it is assumed that loadings of all other parameters which can be removed by structural BMPs, are held as well. The pollutant loading guidance also assumes that all permanent stormwater practices (i.e., best management practices or BMPs) referenced in the loading analysis are designed and maintained in accordance with current Alteration of Terrain regulations (Env-Wq 1500).

Chlorides cannot be treated by structural BMPs because they are conservative and relatively untreatable substances that persist in the environment. De-icing chemicals containing chloride (i.e., road salt) are a primary source of chlorides in fresh surface waters. Because they cannot be treated by structural BMPs, chlorides cannot be addressed by typical loading analyses. In the FHWA ROD (see item C-23), it is stated that "NHDOT will continue to investigate various measures and technologies as a means of reducing overall salt use in the project corridor". Submittal of a road salt minimization plan to reduce chloride to the maximum extent practicable, can be required to address concerns associated with chloride.

- D-13. As stated in section C-17 of this Certification, a TMDL was approved by EPA in 2007 for mercury impairments in New Hampshire fresh surface waters. All surface waters in New Hampshire are impaired because of a statewide fish consumption advisory due to levels of mercury in fish tissue. The vast majority of the mercury is believed to be due to atmospheric deposition. The TMDL calls for an 87% to 98% reduction in anthropogenic atmospheric deposition of mercury. The TMDL does not call for a specific reduction in stormwater loads due to activities such as those proposed in this Certification. Rather, reductions in stormwater mercury load are expected to be achieved through reductions in atmospheric deposition, which is believed to be the primary source of mercury in stormwater (page 36 of TMDL). Increased impervious area flowing directly to surface waters can increase the volume of stormwater runoff. Consequently, until atmospheric loadings are reduced, an increase in stormwater runoff can result in an increase in mercury loading reaching surface waters via stormwater runoff. It is expected, however, that the requirement to hold loadings for the surrogate pollutants discussed in section D-12 of this Certification, coupled with the requirements to satisfy peak flow and groundwater recharge requirements in the Alteration of Terrain regulations (see section D-9 of this Certification), will be adequate to prevent any increase in mercury loadings (as well as other pollutants which can be removed by structural BMPs) to surface waters due to stormwater associated with the Activity.
- D-14. Section C-19 h and C-19 i of this Certification includes excerpts from Env-Wq 1708.01 regarding antidegradation which state that "the department shall assure that the highest statutory and regulatory requirements shall be achieved for all new and existing point sources and that all cost effective and reasonable best management practices for nonpoint source control shall be implemented". In addition to being cost effective and reasonable, best management practices must be selected to ensure attainment of water quality standards in receiving waters as evidenced by the following:
- a. As stated in section C-15 of this Certification, "Best Management Practices" (BMPs) are defined in Env-Wq 1702.06 as "those practices which are determined, after problem assessment and examination of all alternative practices and technological, economic and institutional considerations, to be the most effective practicable means of preventing

- or reducing the amount of pollution generated by point or nonpoint sources to a level *compatible with water quality goals*" (italics added).
- b. Env-Wq 1708 (b) and (c) (see section C-19 h and C-19 i of this Certification) which states "In allowing such degradation or lower water quality, the department shall assure water quality adequate to fully protect existing uses".
- D-15. During construction, the disturbance of earth, such as the placement of fill on the Activity site, may temporarily increase turbidity levels in surface waters adjacent to and downstream from the area affected by the Activity, particularly during wet weather events, and may contribute to long-term sediment retention in and/or transport through the surface water adjacent to and downstream from the Activity site. During construction, erosion control inspections and turbidity monitoring can be imposed to manage turbidity. DES, in consultation with NHDOT, has developed the following guidance for this purpose: Inter-Department Communication dated February 2, 2009 from Paul Currier, (DES) to Charles Hood (NHDOT) regarding Amendment of the November 16, 2006 Guidance for BMP Inspection and Maintenance, and Turbidity Sampling and Analysis Plans for I-93 Expansion Project Water Quality Certification.
- D-16. Excavation associated with the construction and/or expansion of bridge piers on the Activity site, may temporarily suspend bottom sediments within the project area that may adversely impact water quality in the adjacent surface waters. During construction, sediment control inspections and sediment characterization monitoring can be imposed to manage sedimentation and any impacts from the suspension of contaminated sediments. In the December 2007 FEIS (see C-22 of this Certification and Volume 4, page S-7 of the FEIS), the following is stated: " The NHDOT and FHWA recognize the risk posed by the suspension of potentially contaminated marine sediments and the NHDOT will develop a sediment sampling and characterization program in consultation with the NHDES, the USACOE and other agencies. This sampling would typically occur in conjunction with the geotechnical investigations conducted during the final design phase. Even if the sediments are determined to not pose a contamination risk, stringent requirements will be incorporated into the final design plans to require the selected contractor to minimize any movement of sediment beyond the work area. It is anticipated that all work on the bridge piers will be conducted behind sealed cofferdams, which will substantially limit the movement of suspended sediments. The NHDOT will conduct regular inspections of the measures designed to minimize this risk. Additional measures will be developed if contaminants in the marine sediments exceed NOAA thresholds for ecological or human health. These requirements are typically a condition in the USACOE and NHDES Wetland Bureau permits, as well as a USEPA Remedial General Permit (RGP) which may be required for the project."

As stated in section C-25 of this Certification, ATC Associates Inc (ATC), conducted marine sediment analyses in the Piscataqua River between the General Sullivan and Little Bay bridges in September and October of 2008. A

total of 21 samples from 13 sites were sampled at various depths for oil and/or hazardous material (OHM). Samples were analyzed for volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH) diesel range organics (DRO), total cyanide, arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, copper, nickel and zinc. Results were compared to soil reuse thresholds in Env-Sw 900. According to ATC, "the sediment in the proposed work area is not significantly contaminated with OHM", and "the detected contaminant concentrations should not require special disposal options (i.e., the sediment may be disposed of at an approved landfill and/or recycling facility)".

To determine if sediments pose a risk to aquatic life, DES developed guidance⁴ in 2005 for application of State surface water quality standards to freshwater, estuarine and marine sediments. According to the guidance, risk posed to sediment-dwelling organisms should be assessed according to the Sediment Quality Triad approach which consists of 1) sediment chemical analyses, 2) sediment toxicity bioassays (laboratory) and 3) community assessment (field). With regards to the sediment chemical analyses, sediment contaminant levels are compared to threshold effect concentrations (TEC) and probable effect concentrations (PEC), which are based on peer reviewed screening level contaminant lists from NOAA, EPA and others. TEC values are screening thresholds below which adverse effects are unlikely. PEC values are screening thresholds above which adverse effects are likely. Hazard Quotients (HQ) are equal to the contaminant detected in the sample divided by the threshold value. An HQ calculated with a TEC (HQ-TEC) of one or greater indicates the possibility the contaminant may adversely affect sediment organisms and is considered a moderate risk contaminant of concern (COC). An HQ calculated with a PEC (HQ-PEC) of one or greater indicates the likelihood that the contaminant will adversely affect sediment organisms and is considered a high risk COC. According to the 2008 CALM⁵, assessment units with at least two samples that have an HQ-TEC greater than one, can be listed as impaired for the aquatic life designated use, provided there isn't any biological information (i.e., laboratory or field bioassays) that suggests otherwise (in such cases a weight of evidence approach is used to make an assessment).

In September 2009, DES compared the sediment data to HQ-TEC and HQ-PEC thresholds. As shown in the table, eight contaminants exceed the HQ-TEC and/or HQ-PEC thresholds. Of these, eight are considered moderate risk COCs and four (2-methylnaphthalene, naphthalene, mercury and nickel) are considered to be high risk COCs.

4. Draft Evaluation of Sediment Quality Guidance Document. NH Department of Environmental Services. April 2005. NHDES-WD-04-9.

5. 2008 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology. March 2008. NH Department of Environmental Services. NHDES-R-WD-05-29.

Naphthalene, 2-methylnaphthalene, fluoranthene and pyrene are polyaromatic hydrocarbons (PAHs) which are components of petroleum products. PAHs may be introduced to the environment through fuel spills and combustion of fuels (including automobiles). According to the 2009 Estuaries Indicator Report⁶, total PAH concentrations in mussel tissue at station NHDP at Dover Point (which is located by Pier 8 under the Little Bay Bridge) have shown an increasing trend since 1993 whereas lead has exhibited a decreasing trend.

Table 1

Chemical	TEC (ppm)	PEC (ppm)	Highest Sediment Result (ppm)	HQ-TEC	Possibility of adverse effects based on TEC	No. of Stations over TEC Threshold	HQ-PEC	Likelihood of adverse effects based on PEC
2-methylnaphthalene	0.0202	0.201	0.3	14.9	Moderate	1	1.5	High
Fluoranthene	0.113	1.494	0.3	2.7	Moderate	1	0.2	Low
Naphthalene	0.0346	0.391	0.5	14.5	Moderate	1	1.3	High
Pyrene	0.153	1.398	0.3	2.0	Moderate	1	0.2	Low
Copper	18.7	108	59	3.2	Moderate	5	0.5	Low
Lead	30.2	112	67	2.2	Moderate	4	0.6	Low
Mercury	0.13	0.696	1.3	10.0	Moderate	1	1.9	High
Nickel	15.9	42.8	90	5.7	Moderate	10	2.1	High

Nickel exceeded the TEC threshold at 10 of the 13 stations, copper exceeded the threshold at 5 stations, and lead exceeded the threshold at 4 stations. The five remaining contaminants (which include the four PAHs mentioned above and mercury) exceeded TEC thresholds at only 1 station.

With the information provided it is difficult to determine if all 13 sampling stations are in the same assessment unit or if they are split into two assessment units. According to the 2008 CALM⁷, assessment units with at least two samples that have an HQ-TEC greater than one, can be listed as impaired for the aquatic life designated use, provided there isn't any biological information (i.e., laboratory or field bioassays) that suggests otherwise (in such cases a weight of evidence approach is used to make an assessment). As shown in Table 1, there are eight contaminants that exceed the TEC threshold. Nine of the stations had two or more exceedances. Consequently, one or possibly two estuarine assessment units may be listed as impaired for aquatic life in the 2010 assessment unless there is biological evidence (i.e., laboratory bioassays or field community studies) that indicate the sediments are not toxic to aquatic organisms.

Requiring the Applicant to design, construct and maintain the Activity in a manner that will not result in an increase in pollutant loads to surface waters (see section D-12 of this Certification) is expected to prevent further degradation of the sediments associated with operation of the Activity.

6. 2009 Piscataqua Region Estuaries Partnership Environmental Indicators Report. Prepared by Phil Trowbridge of the Piscataqua Region Estuaries Partnership. June 2009.
7. 2008 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology. March 2008. NH Department of Environmental Services. NHDES-R-WD-05-29.

Development and implementation of a plan that includes 1) stringent measures to minimize the area of disturbed sediments and settling of contaminated sediments beyond the immediate work zone 2) monitoring to confirm that water quality standards are being met and that the method of sediment confinement is operating as intended, and 3) methods for disposal of dredged sediments and drain water in a manner that will not adversely impact surface waters, is expected to prevent water quality standard violations due to dredging and disposal of sediments associated with construction of the Activity.

- D-17. To help ensure that best management practices (BMPs) will always function as intended, development and implementation of a BMP inspection and maintenance plan, in accordance with current Alteration of Terrain regulations (Env-Wq 1500), can be required.
- D-18. The December 2007 FEIS includes concerns raised by the NH Fish and Game Department (see C-22, Volume 4, page S-5) with regards to bridge construction and impact on aquatic habitat and anadromous fish. In response NHDOT stated that "NHDOT and FHWA will coordinate design methods and anticipated schedule of the pier construction during the project's final design with NHF&GD's Durham office".
- D-19. The December 2007 FEIS includes concerns raised by the NH Estuaries Project (now the Piscataqua Region Estuaries Partnership or PREP) (see C-22 of this Certification and Volume 4, section S-4 of the FEIS) with regards to the potential impact of the Activity on tidal water quality and on existing long term tidal sampling stations. PREP recommends that because the Activity may increase loadings to the estuary (especially if BMPs do not function as planned), the Applicant should contribute to the annual cost of sampling at the Little Bay, Bellamy River and Upper Piscataqua trend monitoring stations as well as at the mussel tissue monitoring station located by Pier 8. This is especially important in the tidal waters, many of which are currently listed as impaired for numerous pollutants including nitrogen (see item D-11). In their response to comments, the Applicant responded that "Since NHDES is responsible for monitoring pollutants in the Great Bay, the NHDOT and FHWA will coordinate with NHDES and as practicable will assist and facilitate with the monitoring effort." With regards to the mussel sampling station NHDOT responded with the following: "The NHDOT and FHWA will coordinate with the NH Estuaries Program to avoid any impacts to the sampling station located between Pier 8 and the Dover shoreline during construction. There will be no direct impacts to the station associated with the project and therefore mitigation is not warranted. The NHDOT and FHWA will work with NHDES to facilitate their monitoring efforts at the sampling station."

To ensure that construction and operation of the Activity will not impact the PREP long term sampling station located near Pier 8, and in accordance with representations made in the FEIS, it is appropriate to require development and implementation of a plan to prevent any impacts to the long term sampling station due to construction and operation of the Activity.

E. WATER QUALITY CERTIFICATION CONDITIONS

- E-1. The Activity shall not cause or contribute to a violation of surface water quality standards. DES may modify this 401 Certification to include additional conditions to ensure the Activity complies with surface water quality standards, when authorized by law, and after notice and opportunity for hearing, should DES determine that surface water quality standards are being violated as a result of the Activity.
- E-2. The Applicant shall allow DES to inspect the Activity and its effects on affected surface waters at any time to monitor compliance with the conditions of this 401 Certification.
- E-3. The Applicant shall consult with DES regarding any proposed modifications to the Activity, including construction or operation, to determine whether this 401 Certification requires modification in the future.
- E-4. The Applicant shall not use any surface waters (as defined in section C-8 of this Certification) for treatment of stormwater runoff unless otherwise permitted by the DES Wetlands Bureau and the DES Watershed Bureau.
- E-5. Prior to advertising each contract for the Activity, the Applicant shall receive written approval from DES of documentation demonstrating that the Activity is in compliance with current DES Alteration of Terrain Regulations (Env-Wq 1500) regarding stormwater flow (Env-Wq 1507.05 and Env-Wq 1507.06) and groundwater recharge (Env-Wq 1507.04).
- E-6. Prior to advertising each contract for the Activity, the Applicant shall obtain DES written approval of a pollutant loading analysis that demonstrates, with reasonable assurance, no increase in loading of pollutants that can be removed by structural best management practices, and which are likely to be discharged to surface waters as a result of operation of the Activity. This condition does not apply to chlorides as they cannot be removed by structural BMPs. Unless otherwise authorized by DES, the Applicant shall use the Simple Method described in section D-12 of this Certification for conducting the pollutant loading analysis and shall use the surrogate pollutants TSS, TN and TP to represent the pollutants of concern that can be removed by structural best management practices. Prior to conducting the loading analyses, the Applicant shall obtain DES written approval of the surface water locations (i.e., analysis points) where pollutant loading analyses will be conducted. Unless otherwise authorized by DES, all BMPs included in the loading analysis shall be designed and constructed in accordance with the current DES Alteration of Terrain regulations (Env-Wq 1500). Prior to advertising each contract for the Activity, the Applicant shall obtain DES written approval of the design of the BMPs used in the loading analysis.
- E-7. The Applicant shall not increase chloride loading to Paul Brook, which is impaired for chlorides (see section D-11 of this Certification). Prior to

advertising contracts for the Activity, the Applicant shall obtain DES written approval of a plan to prevent any increase in loading of chloride from the Activity (i.e., no additional loading) to Paul Brook, The Applicant shall then implement the approved plan.

E-8. Within 180 days of the date of approval of this Certification, the Applicant shall prepare and submit a Road Salt Minimization Plan to DES for approval to minimize, to the maximum extent practicable, discharges of de-icing chemicals containing chloride (road salt) within the project corridor. As a minimum, the Road Salt Minimization Plan shall include the following:

- 1) A description of current DOT de-icing application practices and rates in the project corridor
- 2) An evaluation of alternative measures and technologies including use of brine for pre-wetting salt and for anti-icing, and pervious pavement;
- 3) A schedule for implementation of salt reduction measures; and
- 4) A method for tracking and reporting progress in reducing salt usage.

The Applicant shall then implement the approved plan.

E-9. To ensure the long-term effectiveness of approved permanent stormwater practices, the Applicant shall prepare an Inspection and Maintenance (I & M) manual. The manual shall include:

- 1) The names of the responsible party or parties who will implement the required reporting, inspection and maintenance activities;
- 2) The frequency of inspections;
- 3) An inspection checklist to be used during each inspection;
- 4) An I & M log to document each I & M activity;
- 5) A log to document road salt use and application rates and documentation showing the relationship between salt usage and the winter severity index
- 6) A plan showing the locations of stormwater practices described in the I & M manual; and
- 7) Actions to be taken if any invasive species begin to grow in the stormwater management practices.

All record keeping required by the I & M manual shall be maintained by the Applicant and made available to DES upon request.

The Applicant shall obtain DES's written approval of the I & M manual prior to operation of permanent stormwater practices. The Applicant shall then implement the activities described in the approved I & M manual.

- E-10. The Applicant shall prepare and submit an erosion control inspection and maintenance plan and a turbidity sampling and analysis plan for soil erosion control during construction. The plans shall be in accordance with the following guidance developed by DES, in consultation with NHDOT: Inter-Department Communication dated February 2, 2009 from Paul Currier, (DES) to Charles Hood (NHDOT) regarding Amendment of the November 16, 2006 Guidance for BMP Inspection and Maintenance, and Turbidity Sampling and Analysis Plans for I-93 Expansion Project Water Quality Certification. The Applicant shall obtain DES's written approval of the turbidity sampling locations prior to advertising each contract for the Activity, include the above mentioned memorandum in the Storm Water Pollution Prevention Plan (SWPPP) and file a Notice of Intent for coverage under the EPA National Pollutant Discharge Elimination System (NPDES) Construction General Permit. The Applicant shall then implement the approved plan.
- E-11. The Applicant shall prepare and submit a plan to minimize movement of marine sediment during construction and to prevent water quality violations beyond the work area. The plan shall:

- 1) Detail how marine sediment disturbance will be minimized;
- 2) Have provisions for regular inspection and maintenance of protective measures;
- 3) Require sampling to determine compliance with water quality standards and to confirm that disturbed marine sediments are confined within the work area;
- 4) Describe additional protective measures that will be taken for sediments that exceed NOAA thresholds for ecological risk (as stated in the 2007 FEIS, see section D-16 of this Certification);
- 5) Specify methods for disposal of dredged sediments and drain water in a manner that will not cause surface water quality violations; and
- 6) Be compliant with the NPDES Remedial General Permit if discharges to surface waters occur.

The Applicant shall obtain DES's written approval of the plan prior to commencing any construction in tidal waters associated with the Activity. The Applicant shall then implement the approved plan.

- E-12. The Applicant shall coordinate with the NH Fish and Game Department regarding final design, methods and anticipated schedule of the pier construction to minimize impact on valuable aquatic habitat and to lessen, to

the extent practicable the potential temporary effects that construction activities may have on anadromous fish. Prior to advertising contracts for bridge construction associated with the Activity, the Applicant shall provide evidence of such coordination to DES.

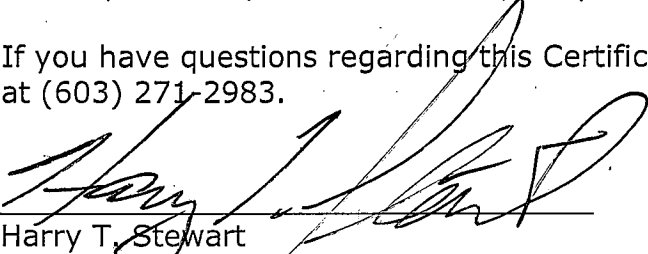
E-13. Prior to advertising contracts for bridge construction associated with the Activity, the Applicant shall obtain DES's written approval of a plan to minimize impacts to the Piscataqua Region Estuaries Partnership long term sampling station located in the vicinity of Pier 8 during construction. The Applicant shall then implement the approved plan.

E-14. The Applicant shall comply with the conditions of DES Wetlands Bureau Permit No. 2006-02007, including any amendments and shall comply with DES wetlands rules and regulations. The conditions shall become conditions of this 401 Certification upon issuance of this 401 Certification.

F. APPEAL

If you are aggrieved by this decision, you may appeal the decision to the Water Council. Any appeal must be filed within 30 days of the date of this decision, and must conform to the requirements of Env-Wq 200. Inquiries regarding appeal procedures should be directed to NHDES Council Appeals Clerk, 29 Hazen Drive, PO Box 95, Concord, NH 03302-0095; telephone (603) 271-6072.

If you have questions regarding this Certification, please contact Gregg Comstock at (603) 271-2983.



Harry T. Stewart
Director, DES Water Division

cc: Richard Roach, ACOE
Newington Board of Selectmen
J. Michael Joyal, Jr., Dover City Manager
John Warner, US Fish and Wildlife Service
Mark Kern, US Environmental Protection Agency
Gino Infascelli, DES Wetlands Bureau
Chris Williams, DES Watershed Management Bureau (Coastal Program)
Ridge Mauck, DES Alteration of Terrain Bureau
Carol Henderson, NH Fish and Game

