

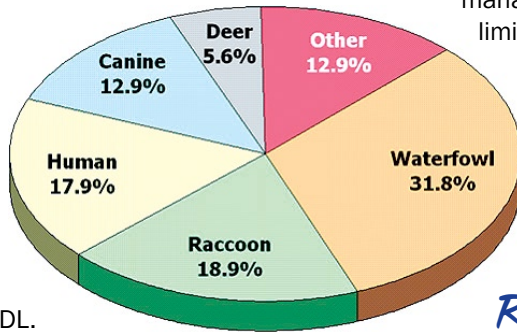


# Understanding Impaired Waters and Total Maximum Daily Load (TMDL) Requirements for Municipal Stormwater Programs

## Executive Summary

Does your municipal separate storm sewer system (MS4) contribute a pollutant of concern to an impaired waterbody, a waterbody with an approved Total Maximum Daily Load (TMDL), or to a tributary of the Chesapeake Bay? If so, you most likely need to take steps to modify your municipal stormwater management program to meet state and federal National Pollutant Discharge Elimination System (NPDES) regulations.

This document describes how municipal stormwater managers can determine if their storm drain system discharges to an impaired waterbody and how to update their stormwater management program to address the TMDL.



Sources of fecal coliform in Four Mile Run, Virginia

## Introduction

In the Mid-Atlantic Region, stormwater runoff is a leading source of stream impairments. Stormwater runoff contributes to the primary pollutants impairing the Chesapeake Bay—nitrogen, phosphorus, and sediment.

Section 303(d) of the Clean Water Act requires that states develop impaired waters lists for rivers, lakes, coastal waters, and estuaries that do not meet water quality standards. These 303(d) lists are published biannually and are available at the web link listed in the Resources section of this document. TMDLs, developed for waterbodies placed on the list, specify the maximum amount of a pollutant that a waterbody can receive in order to meet water quality standards. Regulations governing the TMDL program (40 CFR 130.2 and 130.70) define the TMDL as “the sum of the individual wasteload allocations (WLA) for point sources and load allocations (LAs) for nonpoint sources.” Mathematically the TMDL can be represented by the following equation:

$$TMDL = \sum WLA + \sum LA + MOS$$

Where MOS is the margin of safety.

WLA are generally expressed in numeric form (e.g., 500 lbs/day phosphorus). Municipal stormwater sources, which are regulated as point sources under the NPDES program, are included as part of the wasteload allocations. Non-NPDES permitted areas are included as LAs.

If your MS4 is affected by a TMDL, a numeric WLA will be assigned and your NPDES permit, when it is reissued or revised, will include effluent limits consistent with the requirements

of the WLA. These TMDL requirements convey the goal of the Clean Water Act and the implementing NPDES regulations which is to not cause or contribute to exceedance of water quality standards. However, EPA recognizes the difficulty in characterizing stormwater discharges because of the highly variable frequency and duration of storm events. Therefore, EPA issued a memorandum on November 22, 2002 that recommends initially expressing NPDES permit requirements (effluent limits) for NPDES-regulated municipal stormwater sources as best management practices (BMPs) rather than as numeric effluent limits. [www.epa.gov/npdes/pubs/final-wwtmdl.pdf](http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf)

This BMP approach provides more flexibility to MS4s, but requires that MS4s monitor and evaluate BMPs. When BMPs are not found to be effective, expanded or better-tailored BMPs may be necessary to attain water quality.

## Steps to Address TMDL Requirements in MS4 Permits

The following five steps will help you determine if TMDL requirements apply to you and, if so, how to comply with those requirements. The first two steps describe how to determine if your MS4 discharges to an impaired waterbody. If your MS4 does not discharge to an impaired waterbody, you will only need to complete steps 1 and 2.

1. Determine if the waterbody into which your MS4 discharges is impaired, has a TMDL assigned, or drains to the Chesapeake Bay
2. Determine what requirements apply to your MS4
3. Update your stormwater management program
4. Implement programs and practices to address the TMDL
5. Assess effectiveness of the stormwater program in addressing pollutant(s) of concern

### Step 1: Determine if the waterbody into which your MS4 discharges is impaired, has a TMDL assigned, or drains to the Chesapeake Bay

The first step is to identify the waterbodies into which your MS4 discharges. Most MS4s have developed maps of their outfalls and receiving waters. You should use your maps to develop a list of all the named and unnamed waterbodies into which your outfalls discharge. To facilitate the process to determine impairment status, you should include stream codes as assigned by states.

One source of information on waterbodies is EPA’s Enviromapper for Water ([www.epa.gov/waters/enviromapper/index.html](http://www.epa.gov/waters/enviromapper/index.html)). This Web-based system can map receiving waters in your jurisdiction.

Once you have the list of waterbodies into which your MS4 discharges, you will need to determine if any of these waterbodies

## Understanding Impaired Waters and Total Maximum Daily Load (TMDL) Requirements for Municipal Stormwater Programs

are impaired, have been assigned a TMDL or drain to the Chesapeake Bay and therefore are covered by a state Tributary Strategy. This determination can be made by reviewing your state 303(d) list, state TMDL list, Chesapeake Bay Program web site or contacting your state stormwater coordinator or TMDL coordinator. Links to state 303(d), TMDL lists, and Chesapeake Bay Program web site are included in the Resources section of this document.



EPA's EnviroMapper for Water

### Step 2: Determine what requirements apply to your MS4

Review your NPDES MS4 permit to identify specific TMDL allocations or requirements pertaining to MS4 stormwater discharges to impaired waterbodies. You will most likely find these requirements under the Special Conditions section of your MS4 NPDES stormwater permit. Keep in mind that NPDES permits have five year permit terms; therefore, your requirements for discharges to impaired waters might change as your state reissues your MS4 stormwater permit.

*Impaired waterbodies for which a TMDL has not yet been developed.* Contact your state TMDL coordinator to determine the schedule for TMDL development. You may be asked to participate in or supply information for the TMDL development process for impaired waterbodies that do not yet have an approved TMDL. Your participation in the TMDL process will likely mean attending public meetings as a stakeholder and providing information that will assist in characterizing your MS4 system. TMDL development is a data-intensive exercise; therefore you should provide the best available data related to your stormwater discharges, such as outfall locations, drainage areas, types and locations of structural and non-structural BMPs, as well as the expected or measured pollutant load reductions from the BMPs. This information supports calculation of an accurate and reasonable WLA for your system.

*Impaired Waterbodies with approved TMDLs.* Review TMDL reports and supporting documents to identify WLA(s) assigned to your MS4 and review the approach and assumptions used to calculate the WLA(s). Depending on the availability of information and the technical approach used to develop the TMDL, a TMDL might assign your MS4 a specific WLA or use a broader approach, such as assigning an aggregate WLA to several MS4s. In some cases, the TMDL might assign an aggregate WLA to all

permitted stormwater sources (e.g., MS4s, industrial facilities, and construction sites) because data are not available to make source-specific allocations.

Given the general WLAs assigned to MS4s, it is often beneficial to estimate more specifically the pollutant loads and reductions needed within and across the MS4. For more examples of methods to estimate MS4 contributions, please refer to “Summary of 17 TMDLs with Stormwater Sources” listed in the resources section of this document. The following are some suggestions for estimating your MS4’s specific contribution to the impaired waterbodies pollutant(s) of concern:

- General estimation:** Assess to what extent your MS4 discharge contributes to the water quality impairment listed in the 303(d) list, TMDL or Chesapeake Bay Tributary Strategy. Land use patterns, in particular, impervious cover and vegetation, influence the volume and rate of runoff and the type of pollutants found in stormwater runoff. Assessing the amount and location of industrial and commercial, light medium and dense residential areas, etc., provides a rough indication of the amount and type of pollutant loads to anticipate from these areas. The Chesapeake Bay Program web site and EPA published reports on urban stormwater contain common pollutant levels found in urban storm water runoff based on land use.
- More refined estimation:** Once you have an indication of the types of pollutant loads that may emanate from your MS4 during a storm, you may either directly monitor your discharge and/or estimate through simple calculations or models, to get a better sense of what is causing the water quality standard exceedances and where in your jurisdiction are the anticipated hotspots. This effort can include reviewing existing monitoring data (if available) or conducting new stormwater outfall monitoring, estimating pollutant loads using common computational methods such as the Simple Method ([www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm](http://www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm)), or modeling using any number of computer models. EPA’s SWMM Model is one such model that simulates stormwater runoff quantity and quality in any given area ([www.epa.gov/ednrmrl/models/swmm/index.htm](http://www.epa.gov/ednrmrl/models/swmm/index.htm)). Additional TMDL models are available from EPA’s Watershed and Water Quality Modeling Technical Support Center ([www.epa.gov/athens/wwqts/](http://www.epa.gov/athens/wwqts/)).

Getting a better sense of your MS4’s specific contribution to the pollutants of concern will enable you to design and implement the most appropriate controls in the best locations across your MS4.

For example, several TMDLs have been established for waters within for the city of Portland, Oregon and surrounding municipalities. These TMDLs include WLAs for all urban areas, within and adjacent to the MS4 boundaries (Portland’s NPDES permit is available at [www.deq.state.or.us/wq/stormwater/municipalph1.htm](http://www.deq.state.or.us/wq/stormwater/municipalph1.htm)). As a result, the aggregated WLA assigned to Portland includes contributions from areas outside their control and does not separate allocations to each MS4 jurisdiction separately. The City of Portland and its co-permittees refined the WLAs in the TMDLs by delineating the land area within each MS4

## Understanding Impaired Waters and Total Maximum Daily Load (TMDL) Requirements for Municipal Stormwater Programs

boundary, estimating the stormwater runoff for each jurisdiction, and apportioning the WLA for each MS4.

For additional examples of how TMDLs have been implemented through stormwater permits, the following reports may be useful: “Summary of 17 TMDLs with Stormwater Sources” ([www.epa.gov/owow/tmdl/17\\_TMDLs\\_Stormwater\\_Sources.pdf](http://www.epa.gov/owow/tmdl/17_TMDLs_Stormwater_Sources.pdf)) and “Total Maximum Daily Loads and National Pollutant Discharge Elimination System Storm Water Permits for Impaired Water Bodies: A Summary of State Practices” ([www.epa.gov/region5/water/wshednps/topic\\_tmdls.htm](http://www.epa.gov/region5/water/wshednps/topic_tmdls.htm)).

### Step 3: Update your stormwater management program

You should consider updating your MS4 stormwater management program and associated legal documents (e.g., stormwater ordinances) to address the allocations in the TMDL (relevant WLAs). For those waterbodies that do not yet have a TMDL issued, consult your MS4 NPDES permit and your state stormwater coordinator to determine what intermediate steps can be taken to address those impairments.

Updates to your MS4 stormwater management program will be based on estimations of pollutant loads emanating from various land uses across your MS4 as described in Step 2 and an understanding of what BMPs can be put in place to target those pollutants. There are several resources available to assist with the design of appropriate BMPs to reduce pollutant loads. For instance, the International Stormwater BMP Database ([www.bmpdatabase.org](http://www.bmpdatabase.org)) or the SWMM model mentioned above, can be used as aids in this process to help the municipality devise a suite of BMPs that will meet the requirements of the effluent limits based on the TMDL or reduce the pollutants of concern in the impaired waterbody.

In addition to revising your stormwater management program, you may be invited to participate in the development of a TMDL Implementation Plan to specifically address implementation of any TMDLs in your watershed. Maryland, Virginia and Delaware currently require development of TMDL Implementation Plans (in Delaware, these plans are called Pollution Control Strategies). An Implementation Plan describes and quantifies the types of activities to be implemented, along with a time frame to meet the WLA. Because most TMDLs cross multiple jurisdictions, these TMDL Implementation Plans are often developed by a group of stakeholders. Additional information on TMDL implementation plans can be found at:

- Virginia – [www.deq.virginia.gov/tmdl/implement.html](http://www.deq.virginia.gov/tmdl/implement.html)
- Maryland – [www.mde.state.md.us/Programs/WaterPrograms/TMDL/implementation.asp](http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/implementation.asp)
- Delaware – [www.dnrec.state.de.us/water2000/Sections/Watershed/ws/pcs.htm](http://www.dnrec.state.de.us/water2000/Sections/Watershed/ws/pcs.htm)

An example of how an MS4 updated its program to address TMDLs is once again provided by the city of Portland, Oregon. In Portland, TMDLs and wasteload allocations have been developed for two watersheds. Pollutants include among others, bacteria, phosphorus and pesticides.

To comply with the effluent limits based on the TMDL WLAs, Portland conducted a thorough review of its existing MS4 stormwater management program and identified additional activities necessary to fulfill new MS4 permit requirements for stormwater discharges to waters with assigned TMDLs. The city developed performance measures for each BMP and numeric benchmarks for each pollutant as required by the permit (e.g. reduction of 436 lbs/day of phosphorous), as well as modified the existing stormwater monitoring program to evaluate progress towards achieving the benchmarks. The city used the GRID model to model pollutant loads and develop benchmarks. BMPs included such things as instream flow control, riparian tree protection and planting, culvert replacement, streambank restoration, and water quality facilities. If any new TMDLs are developed and approved for impaired waters within the MS4 boundary, the city of Portland will have 18 months to again review and update its existing stormwater management program to ensure current BMPs adequately address new WLAs. Information on Portland’s stormwater management program is available at [www.portlandonline.com/bes/index.cfm?c=31892](http://www.portlandonline.com/bes/index.cfm?c=31892).

### Step 4: Implement programs and practices to address the TMDL

The crucial step is to implement the programs and practices described in your updated stormwater management plan to address the effluent limits based on the TMDL and to reduce the pollutant(s) of concern. These programs can range from tailoring your public education and outreach to pet owners in order to reduce fecal coliform, to installing a series of BMPs such as porous pavement, percolation trenches, and biofilters in dense residential areas to capture the first flush and reduce any number of pollutants including nutrients, BOD or sediment.

Implementation will require proper budgeting and oversight to ensure BMPs are built or enacted appropriately and effectively.

### Step 5: Assess Effectiveness of the Stormwater Program in Reducing Pollutant(s) of Concern

Because implementation of most MS4 WLAs will be BMP-based, it is critical to assess the effectiveness of those BMPs and your stormwater management program in meeting the effluent limits based on the WLA. NPDES regulations require such assessment. The EPA document *Evaluating the Effectiveness of Municipal Stormwater Programs* describes different approaches available to evaluate effectiveness of the stormwater management program.

Some steps you can take to evaluate the effectiveness of your program in reducing the pollutants of concern include:

- *Track BMPs.* Develop a process to inventory the type and quantity of existing structural and non-structural BMPs and determine the current pollutant load reductions from these practices based on estimated or modeled reduction estimates. It is also helpful to track the year of installation and applicable design standards, where available. This information will help you to document compliance with the TMDL.
- *Assess BMP monitoring data for the pollutant(s) of concern.* Review BMP performance data collected through monitoring



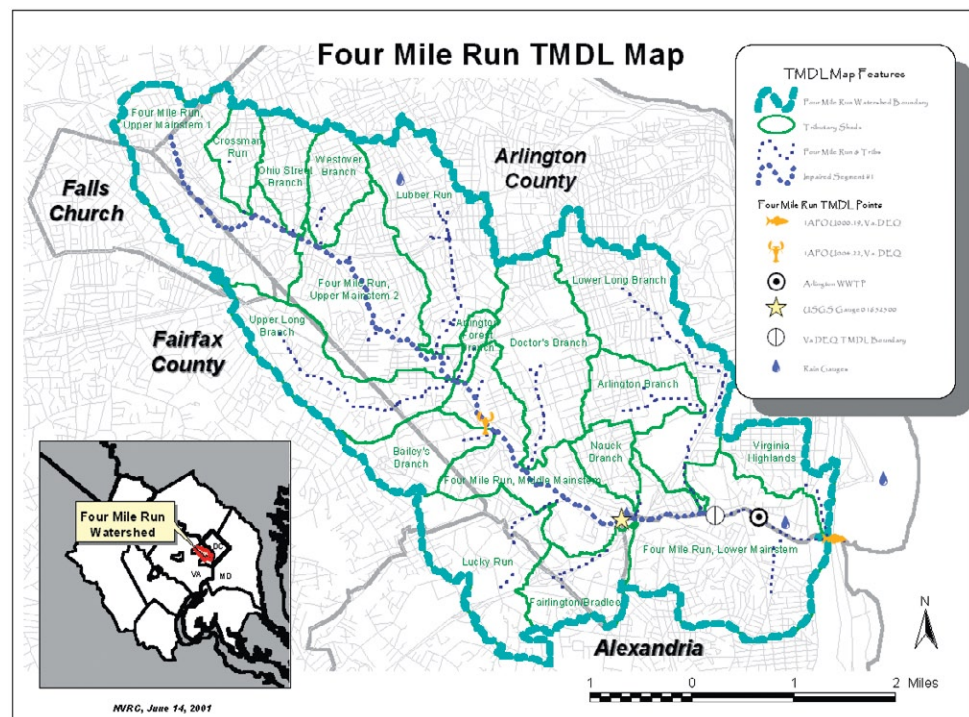
programs, including BMP performance data collected regionally. Conduct early reviews of BMP monitoring data to gauge whether BMPs are generating the expected flow volume and pollutant load reductions anticipated. Address BMP performance issues if early data indicate that BMPs are not performing as expected. Implement additional BMPs, if necessary, to provide additional pollutant load reductions.

- Assess water quality monitoring data for the pollutant(s) of concern, and/or data on TMDL surrogates such as flow or percent impervious cover. Review data from outfall monitoring and/or ambient water quality monitoring, to determine the impact of stormwater discharges on water quality. Other possible sources of local data to help characterize discharges from your MS4 include local watershed management plans, university studies and reports, or reports generated by departments with stormwater management related responsibilities (e.g., public works department catch basin cleaning or street sweeping reports).

## Case Study: Implementing the Four Mile Run Fecal Coliform TMDL through MS4 Stormwater Programs

### Watershed Overview

Four Mile Run is one of the most urbanized watersheds in Northern Virginia and has been included in Virginia's 303(d) list as being impaired by bacteria. In May 2002, EPA approved the Fecal Coliform TMDL for Four Mile Run (available at [www.novaregion.org/bacteriatmdl.htm](http://www.novaregion.org/bacteriatmdl.htm)).



Four Mile Run Watershed

### Regulated MS4s in the Four Mile Run Watershed

The Fecal Coliform TMDL for Four Mile Run documents bacteria contributions from Fairfax and Arlington Counties, which are both Phase I MS4s covered under individual permits, as well as Alexandria and Falls Church, which are both Phase II MS4s covered under general permits.

### Four Mile Run TMDL Wasteload Allocations for MS4s

The technical approach used to develop the TMDL focused on modeling runoff from impervious surfaces in the watershed to determine wasteload allocations for the MS4s. The wasteload allocation assigns all MS4s one aggregate wasteload allocation (average annual fecal coliform loadings of  $9.61E+14$  counts/year for pervious lands, and  $2.04E+13$  counts/year for impervious lands). The TMDL modeling estimated that bacteria will need to be reduced by 98% from human and canine sources to achieve water quality standards for bacteria.

### TMDL Implementation Plans

The Four Mile Run TMDL Implementation Plan (available at [www.novaregion.org/bacteriainplementation.htm](http://www.novaregion.org/bacteriainplementation.htm)), finalized in May 2004, documents the commitments of each jurisdiction to address bacteria contributions. Many of the activities documented in the implementation plan are activities that were already required under each jurisdiction's respective MS4 permit (e.g., illicit discharge detection and elimination). The implementation plan focuses on pollution prevention practices (such as illicit discharge controls and proper pet waste disposal), mitigation measures (such as stormwater treatment using sand filters), and indirect measures (such as general outreach). The implementation plan also includes a timeline for implementation and monitoring/evaluation measures.

### Connecting Chesapeake Bay Requirements to TMDL Implementation and MS4 Stormwater Management Programs

Each MS4 in the Four Mile Run watershed is subject to Virginia's 1988 Chesapeake Bay Preservation Act and, subsequently, has a local Chesapeake Bay Preservation Ordinance that requires the assessment of stormwater impacts from development and redevelopment on local tributaries to the Chesapeake Bay. These stormwater management efforts, tied to local Chesapeake Bay Preservation Ordinances are incorporated into each jurisdiction's MS4 stormwater management program and documented in the Four Mile Run TMDL Implementation Plan.

## Understanding Impaired Waters and Total Maximum Daily Load (TMDL) Requirements for Municipal Stormwater Programs

### Resources

#### State TMDL Websites

EPA Region 3 TMDL website: [www.epa.gov/reg3wapd/tmdl/index.htm](http://www.epa.gov/reg3wapd/tmdl/index.htm)

Delaware: [www.dnrec.state.de.us/water2000/Sections/Watershed/TMDL/tmdlinfo.htm](http://www.dnrec.state.de.us/water2000/Sections/Watershed/TMDL/tmdlinfo.htm)

District of Columbia: [http://app.doh.dc.gov/services/administration\\_offices/environmental/services2/water\\_division/report.shtm](http://app.doh.dc.gov/services/administration_offices/environmental/services2/water_division/report.shtm)

Maryland: [www.mde.state.md.us/Programs/WaterPrograms/TMDL/index.asp](http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index.asp)

Pennsylvania: [www.dep.state.pa.us/watermanagement\\_apps/tmdl](http://www.dep.state.pa.us/watermanagement_apps/tmdl)

Virginia: [www.deq.state.va.us/tmdl/develop.html](http://www.deq.state.va.us/tmdl/develop.html)

West Virginia: [www.wvdep.org/item.cfm?ssid=11&sslid=930](http://www.wvdep.org/item.cfm?ssid=11&sslid=930)

#### State 303(d) Lists

Reports and lists for all Region 3 states are available at: [www.epa.gov/reg3wapd/tmdl/303d.htm](http://www.epa.gov/reg3wapd/tmdl/303d.htm)

#### General TMDL Information

EPA TMDL website: [www.epa.gov/owow/tmdl](http://www.epa.gov/owow/tmdl)

EPA November 22, 2002 Memorandum *Establishing Total Maximum Daily Loads (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs.*

[www.epa.gov/npdes/pubs/final-wwtmdl.pdf](http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf)

*Total Maximum Daily Loads and National Pollutant Discharge Elimination System Storm Water Permits for Impaired Water Bodies: A Summary of State Practices*

[www.epa.gov/r5water/wshednps/pdf/state\\_practices\\_report\\_final3\\_09\\_07.pdf](http://www.epa.gov/r5water/wshednps/pdf/state_practices_report_final3_09_07.pdf)

Summary of 17 TMDLs with Stormwater Sources: [www.epa.gov/reg3wapd/tmdl/StormwaterResources](http://www.epa.gov/reg3wapd/tmdl/StormwaterResources)

Region 3 TMDL Modeling Toolbox: [www.epa.gov/athens/wwqtsc/](http://www.epa.gov/athens/wwqtsc/)

#### BMP Monitoring Guidance or Resources

Chesapeake Bay Program BMP Efficiencies and Definitions:

[www.chesapeakebay.net/pubs/subcommittee/nsc/uswg/BMP\\_Pollutant\\_Removal\\_Efficiencies.pdf](http://www.chesapeakebay.net/pubs/subcommittee/nsc/uswg/BMP_Pollutant_Removal_Efficiencies.pdf)

#### Chesapeake Bay State Tributary Strategies Websites

Chesapeake Watershed Profile website [www.chesapeakebay.net/wshed.htm](http://www.chesapeakebay.net/wshed.htm)

Delaware: [www.dnrec.state.de.us/water2000/Sections/Watershed/ws/map\\_chesapeake.htm](http://www.dnrec.state.de.us/water2000/Sections/Watershed/ws/map_chesapeake.htm)

District of Columbia: [http://doh.dc.gov/doh/cwp/view,a,1374,q,586841,dohNav\\_GID,1802,dohNav\\_|33200|33215|.asp](http://doh.dc.gov/doh/cwp/view,a,1374,q,586841,dohNav_GID,1802,dohNav_|33200|33215|.asp)

Maryland: [www.dnr.state.md.us/bay/tribstrat/index.html](http://www.dnr.state.md.us/bay/tribstrat/index.html) and [www.dnr.state.md.us/bay/tribstrat/implementation\\_plan/urban.pdf](http://www.dnr.state.md.us/bay/tribstrat/implementation_plan/urban.pdf)

Pennsylvania: [www.depweb.state.pa.us/chesapeake/cwp/view.asp?a=3&Q=442886&chesapeakeNav=|29958|](http://www.depweb.state.pa.us/chesapeake/cwp/view.asp?a=3&Q=442886&chesapeakeNav=|29958|)

Virginia: [www.deq.virginia.gov/bay](http://www.deq.virginia.gov/bay)

West Virginia: [www.wvnet.org](http://www.wvnet.org)

#### Other Resources

Ventura, California, MS4 Permit

[www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/venturaMs4.html](http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/venturaMs4.html)

Portland, Oregon, MS4 Permit

[www.deq.state.or.us/wq/stormwater/municipal1.htm](http://www.deq.state.or.us/wq/stormwater/municipal1.htm)

### Contacts

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NOTE: This document is not law or regulation; it provides recommendations and explanations that MS4s may consider in determining how to comply with requirements of the CWA and NPDES permit requirements.