

## **Virginia Stormwater BMP Clearinghouse Committee Meeting**

Virginia Department of Forestry (DOF) Building, Training Room  
Charlottesville, VA  
October 24, 2011

Meeting minutes by Jane Walker

### **Committee Members Present**

Joe Battiata, Center for Watershed Protection  
Dean Bork, Department of Landscape Architecture, Virginia Tech  
Joanna Curran, Department of Civil & Environmental Engineering, University of Virginia  
John McCutcheon, Virginia Department of Conservation and Recreation (DCR)  
Greg Johnson, Patton Harris Rust and Associates (PHR&A)  
Roy Mills, Virginia Department of Transportation (VDOT)  
Madan Mohan, Prince William County Department of Public Works  
Craig Moore, Site and Infrastructure Development (SID), Virginia Tech  
Scott Perry, Imbrium Systems  
David Powers, Department of Civil and Environmental Engineering, Virginia Tech  
David Sample, Biological Systems Engineering and Occoquan Watershed Monitoring Laboratory, Virginia Tech  
Joe Wilder, Frederick County Department of Public Works  
Kevin Young, Department of Civil and Environmental Engineering (CEE), Virginia Tech

### **Department of Conservation and Recreation (DCR) Staff Present**

David Johnson  
Ved Malhotra  
Reese Peck  
Ginny Snead

### **Virginia Water Resources Research Center (VWRRC) Staff Present**

Jane Walker

### **Others Present**

Derek Berg, Contech  
Whitney Blankenship, SID, Virginia Tech  
Nick Burns, Hydro International  
Jacob Dorman, City of Lynchburg, alternate for Jim Talian  
Tom Fitzpatrick, Filterra  
Tom Grizzard, CEE and Occoquan Watershed Monitoring Laboratory, Virginia Tech  
Lee Hill, Joyce Engineering  
John Olenik, VDOT, alternate for Roy Mills  
Glen Payton, Filterra  
Steve Rossi, Concrete Specialties  
Adam Sapp, Contech  
Terry Siviter, Contech

Dan Wilson, Imbrium Systems, alternate for Scott Perry

### **Call to Order and Introductions**

John McCutcheon of the DCR called the meeting to order and thanked everyone for coming. Each person introduced herself or himself. John announced that Gary Boring retired from the Natural Resources Conservation Service (NRCS) on September 2, 2011 and requested to resign from the committee upon his retirement. John offered his appreciation for Gary's work as a valuable member of the committee and expressed that he was sorry to see him leave.

### **Virginia Technology Assessment Protocol (VTAP)**

DCR's director, David Johnson, provided background information concerning his personal interest in the use of technologies to help address environmental issues. He served on the Environmental Stewardship Commission under Governor Allen's administration and was a member of the Environmental Technology Committee. At DEQ, he helped foster the role of environmental technologies and learned of the Technology Acceptance and Reciprocity Partnership (TARP). He became interested in the reciprocity concept and is glad that Virginia supports TARP in its stormwater program.

David Johnson asked the committee why it sees value in advancing environmental technologies. Several members listed protecting the natural environment, meeting Clean Water Act and TMDL (total maximum daily load) implementation requirements, and generating profits. Director Johnson agreed with these reasons and added that new technologies can be used to provide more effective and efficient methods for removing pollutants.

David Johnson cited improved results observed in the wastewater treatment field in the past decade. He added that control of non-point pollution is where the action is because the science and technology are not there to control pollutants from non-point sources. He stated his belief that the Clearinghouse Committee's efforts are critical for controlling costs. He commented that the government does not have the funding needed to adequately test best management practices (BMPs) and is not good as a research and development group. He wants to encourage new ideas that will help drive down costs. He sees the Clearinghouse Committee as encouraging innovation. He supports having valid data that is generated more cheaply. He supports "cheaper, better, faster" innovations while at the same time generating valid data.

David Johnson added that while stormwater technologies may remove relatively small loads compared to wastewater treatment plants, these loads add up. He offered that from a risk-benefit approach, Virginia needs a protocol and thus needs the VTAP. If during testing, mistakes are made, it won't be "the end of the world." Corrections can be made. He added that we need to demonstrate that we are serious about reducing costs.

One Clearinghouse Committee member commented that the Stormwater Committee of the Virginia Section of the American Society of Civil Engineers (ASCE) is considering how to get funding into the hands of people who are testing BMPs. He asked about DCR's position on getting money to the academics for testing BMPs. Director Johnson replied that the Agency is in the beginning stages of addressing this issue and added that the Agency is interested in moving this along.

Another committee member who represents a local government added that in considering costs, maintenance costs must be included. David Johnson agreed and added that costs should always include life-cycle costs.

A different committee member commented that up to this time, dozens of different types of products have been installed without having to undergo any type of testing. Thus, whatever the VTAP requires in the way of testing will drive up costs for the manufacturers, even though the committee has worked to keep the testing costs low. He suggested trying not to get caught up in minimizing the costs too much. He noted that the committee has worked to keep costs down in the VTAP and still have a reliable process that is accepted in Virginia and elsewhere throughout the country.

David Johnson responded that it has come to his attention that DCR is not permitting technologies because the Agency does not know how well the products perform. When approving a technology for use across the state, DCR needs to know what it is doing and if it can be done better. He stressed that doing things better is important. Driving down costs to reduce pollution is absolutely a priority (e.g., reduce space or improve process time, etc.). He added, “We can never be satisfied with the technologies that we currently have.”

Another member offered that at a meeting of the Stormwater Committee of the Virginia Section of ASCE, he learned that the group will be pressing for money for testing of the non-proprietary BMPs to increase the knowledge of performance of standardized BMPs. David Johnson proposed that this would be a perfect role for the U.S. Environmental Protection Agency (EPA). EPA could put out a set of agreed upon reduction technologies based upon their research. Then it would be up to the states and manufacturers to show they can do better based on their research. DCR will do what it can and will advocate for this with EPA. David Johnson suggested it would be better to have a comprehensive, nationwide effort for testing the historic BMPs.

A committee member suggested that part of the funds through the Virginia Aquatic Resources Trust Fund could be diverted towards research to test stormwater BMPs. This funding is currently being used for stream restoration and while she sees value in this endeavor, she would like a small portion of the funds for use in preventing damage in the first place. Other states use these monies for research. David Johnson offered to look into her suggestion in more detail.

A vendor asked how DCR views the current draft of the VTAP. John McCutcheon replied that the next step is to take the document before the Virginia Soil and Water Conservation Board for consideration. Another vendor asked if DCR was committed to administering the process, such as managing the submitted information. Director Johnson replied that DCR staff will figure out how to administer the process.

A committee member voiced that municipalities feel paralyzed about using new technologies; they will not use new technologies until more confident in their performance. This member suggests that DCR consider being flexible with communities that allow the installation of new technologies for testing purposes. David Johnson suggested that devices that are already installed, studied, and verified should be fast-tracked. The Clearinghouse Committee member stressed that localities with Municipal Separate Storm Sewer Systems (MS4s) will not want to

accept technologies unless they are accepted by EPA. Director Johnson offered that Virginia DCR could help convince EPA that the testing is valid. David Johnson's hope is that Virginia's approach will be used as a model for the rest of the country. He added that if either DCR or EPA is seen as an impediment to using new technologies, tell him. The member added that he wants localities to be assured that if they try new technologies, they will not need to fear getting knocked down by DCR.

Another member commented that Tom Schueler is forming advisory committees to look at communities that use gross solids removal technologies, street sweeping, etc. He asked if this committee will also be looking at these types of removals. Another member asked if the Clearinghouse Committee is limited to just testing manufactured treatment devices (MTDs). This member would like for DCR to come to the committee when it has questions about innovative practices that communities are proposing. With the diversity of backgrounds of the committee members, the committee may be able to provide a quick assessment. Director Johnson suggested that the committee not lose focus on MTDs. He suggested that it could be important to look at improvements to the historic BMPs. For example, the committee could look at the maintenance "rules," e.g., frequency of cutting the grass so that the assumptions are offset by the way it is maintained.

#### **Minutes from Meeting on July 25, 2011**

Jane Walker summarized the discussion from the July 25, 2011 meeting. No changes were suggested regarding the minutes. One member of the committee requested that if minutes approved by DCR were provided after the committee had received draft minutes that a "track changes" document also be provided. The official minutes are posted on the Virginia Regulatory Town Hall Website: <http://townhall.virginia.gov/>.

#### **DCR Updates**

John McCutcheon announced that DCR's Division of Stormwater has a new regulatory programs manager, Ginny Snead. Ginny comes to DCR from the private sector. Ginny has been with the Agency for approximately two months. In addition, DCR has hired Darryl Glover as its environmental manager of the regional operations. Darryl will work with all of the regional managers. Furthermore, DCR is in the process of interviewing for a conservation manager.

#### **Stormwater Regulations Updates**

Ginny Snead of DCR announced that final adoption of the stormwater regulations occurred in mid-September 2011. The new regulations will not be implemented until July 1, 2014. All localities within the Chesapeake Bay watershed as well as localities operating a MS4 must administer a program under the new regulations. The non-Bay localities in Virginia may implement the new regulations, but they are not required to do so. However, if they choose not to, the Department will operate a program in that jurisdiction. Ginny stated that DCR is planning to start talking to localities in November and stressed that the Agency would be communicating with all localities.

The second edition of the *Virginia Stormwater Management Handbook*, the "Blue Book," is almost ready. Ginny Snead stressed if anyone has suggestions for changes, these should be submitted as soon as possible.

An observer asked if the VTAP was mentioned in the regulations and wondered if implementation of the VTAP would not begin until July 1, 2014. DCR staff replied that the new regulations include the Virginia Stormwater BMP Clearinghouse website (<http://www.vwrrc.vt.edu/swc>) and stated that certified BMPs listed on the Clearinghouse website are approved by DCR for use. Although the VTAP, specifically, is not mentioned in the new regulations, it is the means by which BMPs will be approved. The observer stressed that the company he represents is concerned that they cannot begin testing today. They do not want to wait longer. DCR staff stated that until approval of the VTAP is granted by the Virginia Soil and Water Conservation Board, the protocol has not been approved.

A committee member who represents a local government asked if localities could adopt some components of the new regulations today. He added that he realized that localities do not have authority to implement them until July 2014. DCR staff supported his interpretation of the regulation. Another member asked if localities can be more stringent under the new regulations. Ginny Snead responded that developers must meet the state's rules, but many localities have more stringent ordinances that will also need to be met. John McCutcheon added that DCR is working on an aggressive schedule for training DCR regional staff, localities, practitioners, engineers, and site designers.

Another member wondered if formal certification could be given for trained stormwater engineers and plan reviewers as is done in the erosion and sediment (E&S) control program. He suggested perhaps combining the two programs. The member stressed that in his view, training is more important on the stormwater side. Another member of the committee stated that North Carolina offers lots of training through North Carolina State University. He wondered why Virginia is not more like North Carolina and commented that we appear to be playing catch up with our neighboring state.

John McCutcheon added that DCR is working with the Center for Watershed Protection to develop model ordinances because before July 1, 2014, local governments are to establish their programs and ordinances for approval by the Virginia Soil and Water Conservation Board. A committee member stressed that he hoped the model ordinances would be drafted for all localities, not just for MS4 communities. He further suggested that DCR allow localities to review and provide input on the model ordinances as they are being developed.

The committee member further complained that money is being spent on BMPs but then the BMP does not work because it was not installed correctly. He added that localities do not have ordinances and thus no authority to inspect them. There is no one to check if the installation is correct. Another member offered that North Carolina offers a two-day BMP inspection training course with certification. The first individual stressed that Virginia does not have the authority to look at the stormwater plan and certify the BMP installation. A third committee member added that North Carolina does not have authority for certification either. Ginny Snead asked if the new regulations would take care of the concern. The committee member thought it would.

### **Registry of BMPs in Virginia**

Jane Walker of the VWRRC distributed a draft questionnaire for use in discussing the registry of stormwater MTDs to be posted on the Clearinghouse website (Appendix A). In reference to question 3 (BMP history), Ginny Snead asked if we would know the location of all the BMPs in Virginia once the device has been approved through the VTAP process. She suggested that perhaps the installation locations listed in the registry could be linked to the page with information about the certified BMPs. A representative of a BMP manufacturer explained that some companies already have 100's of installations in Virginia and it would be very time consuming to list the locations of all of them. Going forward, he thought his company could report where all installations were located.

Jane Walker summarized the changes to the questionnaire since the last meeting. She added that someone had requested that the wording of the disclaimer be stronger, but no suggestions for stronger language were provided so it remains the same as in the earlier version. As currently stated, the registry will allow posting for two years. At the end of the two-year period, the registry responses will be removed unless 1) permission for an extension is requested by the manufacturer and 2) permission for an extension is granted by the Clearinghouse Committee. Jane added that she had worked with a Clearinghouse Committee member to revise question 4 after the last meeting so suggested that all review this question carefully. Under question 7, it was suggested to clarify that certification is provided by the vendor; there is no state certification program. The certification statement at the end is from DCR's permit document as suggested at the previous meeting. Jane noted that the questionnaire currently states that penalties for submitting false information include "fines and imprisonment." Since no one has authority to impose such penalties, it was strongly suggested and agreed to remove this statement. David Johnson suggested that the document be submitted to the attorney general's office for review and update of the certification statement. John McCutcheon offered to do this. One committee member stated that there needs to be some penalty for knowingly submitting false information; otherwise the value of the results will be questioned. The committee voted to approve the questionnaire in its current form once question 9 is updated.

One committee member asked when the registry would be available on the Clearinghouse website. Jane Walker stated that the VWRRC would need to hire someone to develop an online survey that allowed the public to easily search the results. She was unsure how long this process would take. The committee set a goal for having the registry online and open to the public before the next meeting.

### **"References and Tools" Webpage**

Jane Walker distributed a draft outline of the content thus far submitted and compiled for posting on the references and tools webpage of the Stormwater BMP Clearinghouse website (Appendix B). One member asked if the page would be updated from time to time. Jane indicated that new information would be added and broken links would be replaced or removed. The committee suggested that two of the categories – "Online Sources in VTAP" and "BMP Evaluation Programs in Other States" – should be listed on the BMP evaluation page in addition to the references and tools webpage.

Someone asked if the intention of the webpage is to include information about management of construction and non-construction stormwater runoff. Ginny Snead suggested that there is confusion between rules applicable to the E&S program and stormwater program, and thus she would suggest not including E&S links on this webpage. Others thought references to the E&S program would be helpful.

One member suggested including links to the websites for the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) (<http://www.cuahsi.org>) and HydroDesktop (<http://hydrodesktop.codeplex.com/>). Jane Walker requested the best link to include for TR-55. Several individuals offered to provide this information. It was suggested to remove personal websites, e.g. Bill Hunt's and Bob Pitt's websites. An observer noted that some university faculties have ties to proprietary BMP manufacturers so he supported removing individual sites.

Jane Walker requested links to additional case study sites. One member suggested that the James River Association may have a link to its green alley work, and a member suggested that the American Society of Landscape Architects (ASLA) has recently developed a webpage of case studies (<http://www.asla.org/stormwatercasestudies.aspx>).

The committee voted to accept the content for posting on the Clearinghouse website once the following changes have been made:

- Add a link to the CUAHSI site;
- Add a link to the HydroDesktop site;
- Add links to the Virginia S&E control laws and regulations; and
- Remove links to personal websites.

### **General Comments**

A committee member stated that he would like to see more websites that are from Virginia. He thinks the webpage should highlight the research being conducted in Virginia. Another committee member from a state university added that her students conduct stormwater research, but she does not have the studies posted on a website so there is nothing to link to. The first committee member stated that if researchers do not feel their work is valued by the state, they will seek funding elsewhere and work on issues for which they receive funding.

David Johnson asked what research is being done in Virginia and who pays for it. The committee member replied that examples of university researchers in Virginia working on stormwater issues come from the Department of Biological Systems Engineering at Virginia Tech, Old Dominion University, the University of Virginia, etc. Several academics at the meeting replied that DCR provides some funding, but DCR requires a one-to-one match; VDOT also provides support. Other funding sources listed include the National Fish and Wildlife Federation. Someone added that in North Carolina, Bill Hunt is able to use 319 funding, but that is not possible in Virginia.

Another committee member added that in North Carolina, Bill Hunt's graduate students are also working full-time as Cooperative Extension Agents and thus are able to provide more research and training. Whereas in Virginia, we only have one Extension Specialist with responsibilities

related to stormwater management (David Sample). Others supported the request for more training.

One member voiced his frustration with support being provided to fund the installation of projects but a lack of support being given to monitor the project to see if it is effective.

The academics on the committee stated that they were considering having a consortium of universities in Virginia to study issues related to stormwater management. All academic researchers in the stormwater field would be invited, e.g., those from George Mason University, Old Dominion University, University of Virginia, Virginia Tech, etc. The Virginia Section of ASCE plans to request that a portion of the permit fees be used to fund research. A member stated that good research can be good for the economy. Another member from academia stated that such support could provide a win-win situation for Virginia. From such work, students could gain valuable training and would be more prepared once they graduate and enter the working environment. Another member of the committee and a representative of a local government added that he wished Virginia had more leadership and academics interested in stormwater management.

David Johnson suggested that the academics see if other states, such as California, have implemented stormwater centers, and if so, use these as benchmarks. He suggested examining their budgets, what they do, etc. He added that starting a consortium from scratch is difficult and would be easier if it built upon the work of others. They would need to sell agency leadership and others that the work being done is science-based and has an important value to the Commonwealth.

One committee member asked how best to link innovation at the local level. He noted an example from Philadelphia, Pennsylvania where “green technologies” were being used at a fraction of the costs of traditional stormwater control, but no one at this time, knows if the green technologies will work. He summarized that for change to occur, innovation is needed.

John McCutcheon asked if there was interest in forming a subcommittee to look into how best to expand stormwater research and innovation in Virginia and to develop a report of their findings for the director of DCR. Others suggested that such a subcommittee would be tangent to the purpose of the Clearinghouse Committee but supported the idea of the academics on the committee working with others to form a stormwater management consortium in Virginia. David Johnson suggested that they do this work in parallel with the work of the Clearinghouse Committee so that it is brought to his attention.

As another general comment, one committee member added that getting the VTAP off the ground depends on DCR having technical evaluators and asked what progress has been made. John McCutcheon responded that DCR is working on developing a request for proposals for evaluators. An observer suggested that a subcommittee could be formed to look into the administrative components of the VTAP such as the fee structure.

The same observer asked DCR if his company can start monitoring their products since it is likely to take 18 months for testing. Several committee members noted that an approved quality



assurance project plan (QAPP) is needed before testing is to begin. This individual added that he is ready to write a QAPP but needs to know if there will be changes to the VTAP. A member of the committee commented that much time has elapsed while developing the VTAP. He added that issues would inevitably come up and need to be handled on a case-by-case basis. The companies should just be told to go get started, and everyone needs to realize that changes in the process will be needed.

Ginny Snead offered that the Virginia Soil and Water Conservation Board needs to approve the VTAP first and said she expected they would consider it at their December meeting. A committee member asked if it would be helpful for committee members to attend the Board meeting and voice support for the VTAP. David Johnson stated that it is always good to hear from the public at the Board meetings. He doubts that passage of the VTAP will be contentious and would not want someone to drive two hours and then be disappointed if the discussion and approval of the VTAP only took five minutes. In summary, anyone is welcome to attend and can request to be put on the agenda. John McCutcheon added that it might be valuable to come to the Board meeting to speak as a practitioner.

A committee member and representative of a local government added that the efficiencies would need to be approved by EPA; otherwise EPA will not give credits and without credits, localities will be unlikely to allow the installations. David Johnson stressed that this is why the testing needs to be based on science-based studies. If Virginia has science-based information that a product works, Virginia DCR can state that it accepts the work. It will be up to EPA to show that it does not work if EPA does not want to accept it. John McCutcheon added that he is hopeful that EPA will look at the VTAP process and showcase it to others.

Another member offered that at some of the technical advisory committee meetings, they discussed aligning the E&S and stormwater regulations. He requested what progress has thus far been made in this area. He also requested the timeline for upgrading the E&S handbook. John McCutcheon replied that DCR is working on legislation to integrate the Chesapeake Bay, E&S, and stormwater laws. DCR wants one stormwater management program and one stormwater permit. He added that DCR is holding off on updating the E&S handbook at this time.

#### **Next Meeting Dates**

The next scheduled meeting of the Clearinghouse Committee is January 23, 2012. The meeting will begin at 10:00 a.m. and may continue until 3:00 p.m. The meeting location will be determined closer to the time of the meeting.

With no further business, the meeting was adjourned.

## Appendix A

# Virginia Stormwater Manufactured Treatment Device Registry

**Disclaimer:** The individual who certifies this document (Question 9) bears the sole responsibility for the presented information. The inclusion of trade names, commercial products, or services does not constitute an endorsement or recommendation by the Virginia Department of Conservation and Recreation, Virginia Water Resources Research Center, or the Virginia Stormwater BMP Clearinghouse Committee.

The purpose of this registry is to provide information about stormwater manufactured treatment devices (MTDs) installed in Virginia. The registry will exist on the Virginia Stormwater Best Management Practice (BMP) Clearinghouse website ([www.vwrrc.vt.edu/swc](http://www.vwrrc.vt.edu/swc)) and contains information about MTDs that have not been certified through the Virginia Technology Assessment Protocol (VTAP) process. The information about individual MTDs may remain on the registry for a period of two years, longer if approval is granted by the Clearinghouse Committee. Once there has been an opportunity to evaluate the MTD through the VTAP process, information about the MTD will be listed on the Virginia Stormwater BMP Clearinghouse website only if certified.

### 1 Basic Technology Information

#### BMP Manufacturer

Company name:

Address – Street:            City:            State:            Zip:

#### Contact Information

Name (to whom questions should be addressed):

Address – Street:            City:            State:            Zip:

Phone number:

Fax number:

E-mail address:

#### BMP Technology

BMP common (marketing) name:

Specific size/capacity of BMP (include units):

Drainage area ranges served by BMP:

Media used (if applicable):

### 2 Treatment for which the Technology is Designed (Check all that apply.)

- Stormwater Runoff Volume Reduction
- Stormwater Runoff Peak Rate Control
- Water Quality Treatment
- Other:

### 3 BMP History

How long has this specific model/design been on the market?

List all localities where one or more of the device is installed in Virginia.

Towns:

Cities:

Counties:

#### 4 Basis for Treatment (Check all that apply and fill in blanks.)

- Volume based** (captures & treats part or all of the runoff volume) –  
Specify the range of size limitations among the different units available (smallest and largest, e.g., pipe diameter):

Discharge flow rate and basis of design  
Infiltration, and if so percentage

- Flow rate based** (provides treatment up to a set rate of flow)

**Settling Device**

Surface loading rate (flow rate per the primary settling area), units are reported as gpm/ft<sup>2</sup>

Flow rate testing basis used which particle size gradation (e.g., NJDEP, OK 110, F-95)?

Provide documentation for the treated flow

Specify design features to prevent resuspension of captured particles/pollutants

When testing for prevention of resuspension, what flow rate and particle size gradation was tested (e.g., NJDEP, OK 110, F-95)?

Any validation or verification of testing for prevention of resuspension?

**Filtering Device**

Filtering flux rate (flow rate per the primary filtration area), units are reported as gpm/ft<sup>2</sup>

Flow rate testing basis used which particle size gradation (e.g., NJDEP, Sil-co-sil 106)?

Provide documentation for the treated flow

Specify design features to prevent resuspension of captured particles/pollutants

When testing for prevention of resuspension, what flow rate and particle size gradation was tested (e.g., NJDEP, OK 110, F-95)?

Any validation or verification of testing for prevention of resuspension?

- Other** (describe):

#### 5 Water Quality Treatment Mechanisms (Check all that apply and provide brief description. Include pollutant of interest.)

- Sedimentation/settling:  
 Infiltration:  
 Filtration (specify filter media):  
 Adsorption/cation exchange:  
 Chelation/precipitation:  
 Chemical treatment:  
 Biological transformation:  
 Other (describe):

#### 6 Design Features of Interest (Answer each of the following questions.)

Pre-treatment/removal of particles larger than 63 microns achieved via which of the following?

- No pre-treatment  
 Internal settling/sedimentation chamber  
 Upgradient (separate) settling/sedimentation device  
 Other (describe):

By-pass/diversion of larger flows (not designed for treatment) via which of the following?

- No by-pass/diversion  
 Internal by-pass verified to prevent re-suspension captured particles/pollutants during larger flows  
 Upgradient flow splitter used to divert water quality storm to device  
 Other (describe):

## 7 Maintenance Considerations (Check all that apply and briefly explain maintenance procedures/standards.)

What is the generic inspection and maintenance plan/procedure? (attach necessary documents):

What is the expected maintenance frequency, per year?

- i. Total life expectancy of BMP:
- ii. For media or amendments functioning based on cation exchange or adsorption, how long will the media last before breakthrough (indicator capacity is nearly reached) occurs?
- iii. For media or amendments functioning based on cation exchange or adsorption, how has the longevity of the media or amendments been quantified prior to breakthrough (attach necessary performance data or documents)?

Is there a maintenance track record/history that can be documented?

- No, no track record.  
 Yes, track record exists; (provide maintenance track record info):

Maintenance contract and associated costs offered by:

- Vendor – Provide current costs:  
 Other commercial entities – Provide range of current costs:

Is the maintenance procedure and/or are materials/components proprietary?

- Yes, proprietary;
- BMP lends itself to competitive bidding for maintenance
  - Recourse / options exist if the vendor goes out of business
- No, not proprietary;
- Are local certified contractors available?
- Yes; provide a list of companies and cities where located.
  - No; local contactors are not available
- Does the BMP lend itself to competitive bidding for maintenance?
- Yes; provide a list of local, certified, maintenance companies and cities where located.
  - No; local competitive bidding not possible because only one maintenance company certified locally.

Maintenance complexity (Check all that apply):

- Confined space training required for maintenance
- Liquid pumping and transportation
- Specify method:
- Specify certified disposal locations:
- Solids removal and disposal
- Specify method:
- Specify certified disposal locations:

Other noteworthy maintenance parameter (describe):

## 8 Independent Performance Certification or Verification (Check all that apply.)

Has the BMP been "certified or performance verified" by any of the organizations below?

- No** (skip to next question)
- Yes**; Continue below and include date of certification or verification.
- State Agency** (list):
    - Approved (date awarded:            )
    - Performance certified (date certified:            )
    - Status pending
    - Other (explain):
  - TARP** (list state[s]):
    - Lab tested (date approval awarded:            )
    - Particle size tested:
      - OK-110 PSD (50 to 250 microns) sands only
      - NJDEP PSD, (1 to 1,000 microns) silts and sands
      - Other PSD or test methodology (explain and provide details)
      - Approved for in-line use (scour prevention)

- Approved for off-line use only
- Field tested (date approval awarded: \_\_\_\_\_ )
- Performance verified via NJCAT (date verified: \_\_\_\_\_ )
- Other (explain): \_\_\_\_\_
- TAPE** (WA State only)
  - PLD - Pilot Level Designation (date awarded: \_\_\_\_\_ )
  - CUD - Conditional Use Designation (date awarded: \_\_\_\_\_ )
  - GULD - General Use Level Designation (date awarded: \_\_\_\_\_ )
  - Status pending
  - Other (explain): \_\_\_\_\_
- Other** (provide documentation of testing protocol and status of BMP): \_\_\_\_\_

Provide link to the web page where the approval is provided or attach approval letter.

9 Certification – To be completed by the company president or responsible officer of the organization.

By selecting this box, "I certify under penalty of law that I have read and understand this Registration Statement and that this document and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations."

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

E-mail address: \_\_\_\_\_

## Appendix B

### TOOLS AND REFERENCES

#### Categories

- A. Regulatory Information
- B. Maps and Data
- C. Tools
- D. References
- E. Demonstration/Example Sites
- F. Journals and Other Periodicals
- G. Online Sources in *Virginia Technology Assessment Protocol* (VTAP)
- H. BMP Evaluation Programs in Other States

#### Web Site Disclaimer

Neither the Virginia Department of Conservation and Recreation, the Virginia Water Resources Research Center, or the Virginia Stormwater Best Management Practices Clearinghouse Committee are responsible for the accuracy or content of external Web sites.

\* These links will take you to Web sites that may have different privacy, security, and accessibility policies than the Virginia Stormwater BMP Clearinghouse Web site.

\* Inclusion of these links does not imply endorsement or support of any programs, products, or services.

#### A. Regulatory Information

1. U.S. Environmental Protection Agency (EPA) -- <http://www.epa.gov/>
  - a. Stormwater Program -- [http://cfpub.epa.gov/npdes/home.cfm?program\\_id=6](http://cfpub.epa.gov/npdes/home.cfm?program_id=6)
  - b. National Menu of Stormwater Best Management Practices (BMPs) -- <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm>
  - c. Stormwater Pollution Prevention Plans (SWPPP) for Construction Activities -- <http://cfpub.epa.gov/npdes/stormwater/swppp.cfm>
2. Virginia Department of Conservation and Recreation (DCR) -- <http://www.dcr.virginia.gov/>
  - a. Stormwater Management -- [http://www.dcr.virginia.gov/stormwater\\_management/index.shtml](http://www.dcr.virginia.gov/stormwater_management/index.shtml)
    - i. Draft *Virginia Stormwater Management Handbook* -- <http://www.dcr.virginia.gov/lr2i.shtml>
    - ii. Virginia Stormwater Management Program (VSMP) Permit Regulations -- [http://www.dcr.virginia.gov/stormwater\\_management/documents/vaswmregs.pdf](http://www.dcr.virginia.gov/stormwater_management/documents/vaswmregs.pdf)
    - iii. The Virginia Stormwater Act -- [http://www.dcr.virginia.gov/stormwater\\_management/documents/vaswmlaw.pdf](http://www.dcr.virginia.gov/stormwater_management/documents/vaswmlaw.pdf)
3. Virginia Department of Environmental Quality (DEQ) -- <http://www.deq.virginia.gov/>
  - a. Virginia Pollutant Discharge Elimination System (VPDES) Storm Water Permitting -- <http://www.deq.virginia.gov/vpdes/stormwater.html>
  - b. Water Quality Assessment (includes 305(b)/303(d) Water Quality Assessment Integrated Reports and associated maps) -- <http://www.deq.virginia.gov/wqa/>
  - c. Total Maximum Daily Loads (TMDLs) in Virginia -- <http://www.deq.virginia.gov/tmdl>
4. Virginia Regulatory Town Hall (search “stormwater”) -- <http://townhall.virginia.gov/>

## B. Maps and Data

### 1. Federal Sources for Maps and Data

- a. Federal Emergency Management Agency (FEMA) -- <http://www.fema.gov/>
  - i. FEMA Flood Maps -- <http://www.fema.gov/hazard/index.shtm>
  - ii. FEMA Map Service Center --  
<http://www.msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1>
- b. National Oceanic and Atmospheric Administration (NOAA) -- <http://www.noaa.gov/>
  - i. Hydrometeorological Design Studies Center (HDSC) -- <http://www.nws.noaa.gov/oh/hdsc/index.html>
    1. NOAA HDSC Precipitation Frequency Data Server (PFDS) -- <http://hdsc.nws.noaa.gov/hdsc/pfds/>
    2. NOAA Atlas 14 Point Precipitation Frequency Estimates for Virginia --  
[http://hdsc.nws.noaa.gov/hdsc/pfds/pfds\\_map\\_cont.html?bkmrk=va](http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=va)
  - ii. NOAA Advanced Hydrologic Prediction Service, Precipitation Data -- <http://water.weather.gov/precip/>
- c. U.S. Department of Agriculture (USDA) -- <http://www.usda.gov/>
  - i. Web Soil Survey -- <http://websoilsurvey.nrcs.usda.gov/app/>
- d. U.S. Environmental Protection Agency (EPA) -- <http://www.epa.gov/>
  - i. Surf Your Watershed -- <http://cfpub.epa.gov/surf/locate/index.cfm>
  - ii. Water Quality Assessment and Total Maximum Daily Loads (TMDL) Information --  
<http://www.epa.gov/waters/ir/index.html>
- e. U.S. Geological Survey (USGS) -- <http://www.usgs.gov/>
  - i. Hydrologic Unit Maps -- <http://water.usgs.gov/GIS/huc.html>
  - ii. National Elevation Dataset -- [http://seamless.usgs.gov/about\\_elevation.php](http://seamless.usgs.gov/about_elevation.php)
  - iii. National Land Cover Dataset -- [http://seamless.usgs.gov/about\\_landcover.php](http://seamless.usgs.gov/about_landcover.php)
  - iv. National Water Information System Web site (NWISWeb) Tutorial --  
<http://nwis.waterdata.usgs.gov/tutorial/index.html>
  - v. Science in Your Watershed -- <http://water.usgs.gov/wsc/>
  - vi. Water Watch for Virginia -- <http://waterwatch.usgs.gov/new/?m=real&r=va>

### 2. State Sources for Maps and Data

- a. Virginia Department of Environmental Quality -- <http://www.deq.virginia.gov/>
  - i. 305(b)/303(d) Water Quality Assessment Integrated Report Maps --  
<http://www.deq.virginia.gov/wqa/ir2010.html#maps>
  - ii. Virginia Environmental Geographic Information Systems (VEGIS) (includes impaired waters) --  
[http://www.deq.virginia.gov/mapper\\_ext/](http://www.deq.virginia.gov/mapper_ext/)
- b. Virginia Department of Mines, Minerals and Energy (DMME) -- <http://www.dmme.virginia.gov/>
  - i. Topographic Maps -- <https://www.dmme.virginia.gov/DMR3/topoindex.shtml>
  - ii. Sinkholes and Karst Terrain -- <http://www.dmme.virginia.gov/DMR3/sinkholes.shtml>
    1. Hubbard, D. A., Jr., 1983, Selected karst features of the northern Valley and Ridge province, Virginia: Virginia Division of Mineral Resources, Publication 44, one sheet. (not available online)
    2. Hubbard, D. A., Jr., 1988, Selected karst features of the central Valley and Ridge province, Virginia: Virginia Division of Mineral Resources, Publication 83, one sheet --  
<https://www.dmme.virginia.gov/Commerce/ProductDetails.aspx?ProductID=1452>
    3. Hubbard, D. A., Jr., 2001, Selected karst features of the southern Valley and Ridge province, Virginia: Virginia Division of Mineral Resources, Publication 167, one sheet --  
<https://www.dmme.virginia.gov/Commerce/ProductDetails.aspx?ProductID=1446>
- c. Virginia Water Resources Research Center (VWRRC), Water Status Information --  
[http://vwrrc.vt.edu/water\\_status.html](http://vwrrc.vt.edu/water_status.html)

### 3. Other Sources for Maps and Data

- a. Google Maps -- <http://maps.google.com/>

- b. International Stormwater BMP Database -- <http://bmpdatabase.org/>
- c. Massachusetts Stormwater Technology Evaluation Project (MASTEP) Database -- <http://mastep.net/database/data.cfm>
- d. New Jersey Department of Environmental Protection, Stormwater Manufactured Treatment Devices Certifications and Guidance -- <http://www.state.nj.us/dep/stormwater/treatment.html>
- e. Washington Department of Ecology, Types of Stormwater Treatment Technologies Approved through TAPE and CTAPE -- <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html>

### C. Tools

- 1. Green Values National Stormwater Management Calculator -- <http://greenvalues.cnt.org/national/calculator.php>
- 2. Nonlinear Least Squares Regression (Curve Fitter) (an interactive statistics page on the website of John C. Pezzullo, retired associate professor, Departments of Pharmacology and Biostatistics, Georgetown University) - <http://statpages.org/nonlin.html>
- 3. U.S. Department of Agriculture, Soil Conservation Service (now Natural Resources Conservation Service) Technical Release 55 (TR-55) --
- 4. U.S. Environmental Protection Agency, Urban BMP Tool -- <http://cfpub.epa.gov/npdes/stormwater/urbanbmp/bmpeffectiveness.cfm>

### D. References

- 1. Federal, Regional, and State Agencies and Partnerships
  - a. Chesapeake Bay Program -- <http://www.chesapeakebay.net/>
  - b. U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) – Virginia -- <http://www.va.nrcs.usda.gov/>
    - i. Hydrology -- <http://www.va.nrcs.usda.gov/technical/hydrology.html>
  - c. U.S. Environmental Protection Agency (EPA) -- <http://www.epa.gov/>
    - i. Impaired Waters and Total Maximum Daily Loads -- <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/index.cfm>
    - ii. *National Management Measures to Control Nonpoint Source Pollution from Urban Areas* -- <http://water.epa.gov/polwaste/nps/urban/index.cfm>
    - iii. Water Quality Criteria for Nitrogen and Phosphorus Pollution -- <http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/index.cfm>
    - iv. Watershed Academy Webcast Seminars -- [http://water.epa.gov/learn/training/wacademy/webcasts\\_index.cfm](http://water.epa.gov/learn/training/wacademy/webcasts_index.cfm)
  - d. Virginia Department of Conservation and Recreation (DCR) -- <http://www.dcr.virginia.gov/>
    - i. *Virginia Stormwater Management Handbook* -- [http://www.dcr.virginia.gov/stormwater\\_management/stormwat.shtml#vswmhnbk](http://www.dcr.virginia.gov/stormwater_management/stormwat.shtml#vswmhnbk)
  - e. Virginia Department of Environmental Quality (DEQ) -- <http://www.deq.virginia.gov/>
    - i. Nutrient Credit Exchange Study -- <http://www.deq.virginia.gov/vpdes/NutCrdExStudy.html>
    - ii. Total Maximum Daily Loads (TMDLs) in Virginia -- <http://www.deq.virginia.gov/tmdl>
  - f. Virginia Department of Transportation (VDOT) -- [www.virginiadot.org](http://www.virginiadot.org)
    - i. *VDOT Drainage Manual* -- <http://www.virginiadot.org/business/locdes/hydra-drainage-manual.asp>
- 2. Universities
  - a. North Carolina State University (NCSU)
    - i. NCSU Low Impact Development (LID) Group -- <http://www.bae.ncsu.edu/topic/lid/>
    - ii. NCSU Stormwater Engineering Group -- <http://www.bae.ncsu.edu/stormwater/>



- 1. William F. Hunt III, Ph.D., PE -- <http://www.bae.ncsu.edu/people/faculty/hunt/>
- iii. NCSU Stormwater Publications -- <http://www.bae.ncsu.edu/stormwater/pubs.htm>
- b. University of Alabama
  - i. Bob Pitt's Teaching and Research Webpage -- <http://unix.eng.ua.edu/~rpitt/>
  - ii. MS4 Project (includes National Stormwater Quality Database) -- <http://rpitt.eng.ua.edu/Research/ms4/mainms4.shtml>
- c. University of New Hampshire (UNH)
  - i. UNH Stormwater Center -- <http://www.unh.edu/unhsc>
- d. Villanova University
  - i. Villanova Urban Stormwater Partnership -- <http://www3.villanova.edu/vusp/>
- e. Virginia Tech
  - i. Biological Systems Engineering (BSE) Stormwater Management Research -- <http://www.bse.vt.edu/08/research/pages.php?event=Research%20Program%20Areas%20Stormwater>
  - ii. Virginia Cooperative Extension, Publications and Educational Resources (search "stormwater," etc.) -- <http://pubs.ext.vt.edu/>

### 3. Organizations

- a. American Society of Agricultural and Biological Engineers -- <http://www.asabe.org/>
- b. American Society of Civil Engineers -- <http://www.asce.org/>
- c. American Society of Landscape Architects -- <http://www.asla.org/>
- d. Center for Watershed Protection -- <http://cwp.org/>
  - i. Publications: Free Downloads -- <http://www.cwp.org/store/free-downloads.html>
    - 1. *Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program* -- [http://www.cwp.org/documents/cat\\_view/76-stormwater-management-publications/90-managing-stormwater-in-your-community-a-guide-for-building-an-effective-post-construction-program.html](http://www.cwp.org/documents/cat_view/76-stormwater-management-publications/90-managing-stormwater-in-your-community-a-guide-for-building-an-effective-post-construction-program.html)
    - 2. *National Pollutant Removal Performance Database, Version 3*, September, 2007 -- <http://www.stormwaterok.net/CWP%20Documents/CWP-07%20Nat%20Pollutant%20Removal%20Perform%20Database.pdf>
    - 3. *National Pollutant Removal Performance Database for Stormwater Treatment Practices, Version 2* -- [http://cwp.org/documents/cat\\_view/76-stormwater-management-publications.html](http://cwp.org/documents/cat_view/76-stormwater-management-publications.html)
  - ii. Publications: Store -- <http://www.cwp.org/store/publications.html>
  - iii. Simple Method to Calculate Urban Stormwater Loads -- <http://www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm>
  - iv. Stormwater Management -- <http://www.cwp.org/your-watershed-101/stormwater-management.html>
- e. National Institute for Building Sciences -- <http://nibs.org/>
  - i. Program: Whole Building Design Guide -- <http://www.wbdg.org/>
  - ii. Unified Facilities Criteria (UFC) -- [http://www.wbdg.org/ccb/browse\\_cat.php?o=29&c=4](http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- f. Interlocking Concrete Pavement Institute -- <http://www.icpi.org/>
- g. National Concrete Masonry Association -- [www.ncma.org](http://www.ncma.org)
- h. Stormwater Equipment Manufacturers Association (SWEMA) -- <http://stormwaterassociation.com/>
- i. U.S. Green Building Council -- <http://www.usgbc.org/>
  - i. Leadership in Energy and Environmental Design (LEED) -- <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=51>
  - ii. LEED for Neighborhood Development -- <http://www.usgbc.org/displaypage.aspx?CMSPageID=148>

### 4. Other

- a. International Stormwater BMP Database -- <http://bmpdatabase.org/>

## E. Demonstration/Example Sites

1. EPA's Stormwater Case Studies -- <http://cfpub.epa.gov/npdes/stormwater/casestudies.cfm>
2. Virginia Tech
  - a. Biological Systems Engineering, Center for Watershed Studies, Projects: Stormwater Management/Low Impact Development --  
[http://www.cws.bse.vt.edu/index.php/research/overview/stormwater\\_management\\_low\\_impact\\_development](http://www.cws.bse.vt.edu/index.php/research/overview/stormwater_management_low_impact_development)
  - b. Forest Resources and Environmental Conservation, Project: Stormwater Management with Trees and Structural Soils -- <http://urbanforestry.frec.vt.edu/stormwater/index.html>
3. Links to Local Governments – Cities, Towns, and Counties

## **F. Journals and Other Periodicals**

Listed alphabetically by title.

1. *Biological Engineering Transactions* -- <http://asae.frymulti.com/toc.asp> or [http://asae.frymulti.com/toc\\_volume.asp?volume=4&conf=biee2011](http://asae.frymulti.com/toc_volume.asp?volume=4&conf=biee2011)
2. *The Chesapeake Bay Journal* -- <http://www.bayjournal.com/>
3. *Journal of Environmental Engineering* -- <http://ascelibrary.org/eeo/> or <http://www.asce.org/Journal.aspx?id=2147486638>
4. *Journal of Environmental Engineering and Science* -- <http://www.nrcresearchpress.com/loi/jees>
5. *Journal of Environmental Management* -- [http://www.elsevier.com/wps/find/journaldescription.cws\\_home/622871/description](http://www.elsevier.com/wps/find/journaldescription.cws_home/622871/description)
6. *Journal of Hydraulic Engineering* -- <http://ascelibrary.org/hyo/> or <http://www.asce.org/Journal.aspx?id=2147486644>
7. *Journal of Hydrologic Engineering* -- <http://ascelibrary.org/heo/> or <http://www.asce.org/Journal.aspx?id=2147486671>
8. *Journal of Hydrology* -- [http://www.elsevier.com/wps/find/journaldescription.cws\\_home/503343/description#description](http://www.elsevier.com/wps/find/journaldescription.cws_home/503343/description#description)
9. *Journal of Irrigation and Drainage* -- <http://ascelibrary.org/iro/> or <http://www.asce.org/Journal.aspx?id=2147486702>
10. *Journal of Soil and Water Conservation* -- <http://www.jswconline.org/>
11. *Journal of the American Water Resources Association* -- <http://www.awra.org/jawra/>
12. *Journal of Water Resources Planning and Management* -- <http://ascelibrary.org/wro/> or <http://www.asce.org/Journal.aspx?id=2147486786>
13. *Resources, Conservation and Recycling* -- <http://www.sciencedirect.com/science/journal/09213449>
14. *River Research and Applications* -- [http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1535-1467](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1535-1467)

15. *Stormwater* -- <http://www.stormh2o.com/>
16. *Transactions of the ASABE* (American Society of Agricultural and Biological Engineers) -- <http://asae.frymulti.com/toc.asp> or [http://asae.frymulti.com/toc\\_volume.asp?volume=54&conf=t2011](http://asae.frymulti.com/toc_volume.asp?volume=54&conf=t2011)
17. *Urban Water Journal* -- <http://www.urbanwater.net/>
18. *Virginia Water Central* -- <http://vwrrc.vt.edu/watercentral.html>
19. *Water Environment & Technology* -- <http://www.wef.org/publications/default.aspx>
20. *Water Environment Research* -- <http://www.wef.org/wer/>
21. *Water Policy* - <http://www.worldwatercouncil.org/index.php?id=31>
22. *Water Resources Research* -- <http://www.agu.org/journals/wr/>
23. *Water Science and Technology* -- <http://www.iwaponline.com/wst/toc.htm>

## G. Online Sources in *Virginia Technology Assessment Protocol* (VTAP)

### 1. Web sites cited in VTAP:

- a. American Society for Testing and Materials (ASTM) Standards -- <http://www.astm.org/>
- b. The National Environmental Laboratory Accreditation Conference (NELAC) Institute (TNI) -- <http://www.nelac-institute.org/>
- c. National Oceanic and Atmospheric Administration (NOAA), National Weather Service -- <http://weather.gov/>
- d. Virginia Division of Consolidated Laboratory Services (VDCLS), Virginia Environmental Laboratory Accreditation Program (VELAP) -- <http://www.dgs.virginia.gov/DivisionofConsolidatedLaboratoryServices/Services/EnvironmentalLaboratoryCertification/tabid/1059/Default.aspx>
- e. Virginia State Climatology Office -- [http://climate.virginia.edu/virginia\\_climate.htm](http://climate.virginia.edu/virginia_climate.htm)
- f. Virginia Stormwater BMP Clearinghouse -- <http://www.vwrrc.vt.edu/swc>
  1. Non-proprietary Stormwater BMPs (Table 4.1) -- <http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html>

### 2. Online documents cited in VTAP (alphabetical by author):

- a. American Society of Civil Engineers (ASCE) and United States Environmental Protection Agency (EPA). 2002. ***Urban Stormwater BMP Performance Monitoring: a Guidance Manual for Meeting the National Stormwater BMP Database Requirements***. EPA-821-B-02-001. Office of Water, U.S. Environmental Protection Agency, Washington D.C. -- <http://water.epa.gov/scitech/wastetech/guide/stormwater/monitor.cfm>
- b. California Department of Transportation (Caltrans). 2003. ***Caltrans Comprehensive Protocols: Guidance Manual***. CTSW-RT-03-105.51.42. California Department of Transportation, Sacramento, CA. 36 pp. -- <http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-03-105.pdf>
- c. Center for Watershed Protection (CWP). 2008. ***Tool 8: BMP Performance Verification Checklist Appendices***. CWP, Ellicott City, MD. 20 pp. -- <http://www.cwp.org>

- d. Federal Highway Administration (FHWA). 2001. **Guidance Manual for Monitoring Highway Runoff Water Quality**. Report No. FHWA-EP-01-022. Office of Natural Environment, FHWA, Washington, D.C. -- [http://www.fhwa.dot.gov/environment/h2o\\_runoff/index.htm](http://www.fhwa.dot.gov/environment/h2o_runoff/index.htm) or [http://www.environment.fhwa.dot.gov/ecosystems/h2o\\_runoff/index.asp](http://www.environment.fhwa.dot.gov/ecosystems/h2o_runoff/index.asp)
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- f. Natural Resources Conservation Service (NRCS). 2003. **National Water Quality Handbook**. 450-VI-NWQH. NRCS, U.S. Department of Agriculture. -- <http://directives.sc.gov.usda.gov/OpenNonWebContent.aspx?content=17843.wba>
- g. New Jersey Department of Environmental Protection (NJDEP). 2009. **Protocol for Total Suspended Solids Removal Based on Field Testing Amendments to TARP Protocol**, Dated August 5, 2009, Revised December 15, 2009. 8 pp. -- [http://www.state.nj.us/dep/stormwater/pdf/field\\_protocol\\_12\\_15\\_09.pdf](http://www.state.nj.us/dep/stormwater/pdf/field_protocol_12_15_09.pdf)
- h. Pitt, R. 2008. **The National Stormwater Quality Database (NSQD) Version 3 Spreadsheet**. Updated: February 3, 2008. -- <http://rpitt.eng.ua.edu/Research/ms4/mainms4.shtml>
- i. Technology Acceptance Reciprocity Partnership (TARP). 2003. **The Technology Acceptance Reciprocity Partnership Protocol for Stormwater Best Management Practice Demonstrations**. 37 pp. -- <http://www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp/>
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- k. U.S. EPA. 2001. **EPA Requirements for QA Project Plans** (EPA QA/R-5). EPA/240/B-01/003. U.S. EPA, Office of Environmental Information, Washington, D.C. -- [http://www.epa.gov/quality/qa\\_docs.html](http://www.epa.gov/quality/qa_docs.html)
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- m. U.S. EPA. 2002b. **Guidance for Quality Assurance Project Plans** (EPA QA/G-5). EPA/240/R-02/009. U.S. EPA, Office of Environmental Information, Washington, D.C. -- [http://www.epa.gov/quality/qa\\_docs.html](http://www.epa.gov/quality/qa_docs.html)
- n. U.S. EPA. 2006a. **Data Quality Assessment: A Reviewer's Guide** (EPA QA/G-9R). EPA/240/B-06/002. U.S. EPA, Office of Environmental Information, Washington, D.C. 55 pp. -- [http://www.epa.gov/quality/qa\\_docs.html](http://www.epa.gov/quality/qa_docs.html)
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- p. U.S. EPA. 2006c. **Guidance on Systematic Planning Using the Data Quality Objectives Process** (EPA QA/G-4). EPA/240/B-06/001. U.S. EPA, Office Environmental Information, Washington, D.C. 111 pp. -- [http://www.epa.gov/quality/qa\\_docs.html](http://www.epa.gov/quality/qa_docs.html)

q. U.S. Geological Survey (USGS). variously dated. *National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water Resources Investigations*. Book 9, Chapters A1-A9. -- <http://water.usgs.gov/owq/FieldManual/>

r. Virginia Department of Conservation and Recreation. 2011. *Virginia Stormwater Management Handbook*. -- [http://www.dcr.virginia.gov/soil\\_and\\_water/stormwat.shtml](http://www.dcr.virginia.gov/soil_and_water/stormwat.shtml) or <http://www.vwrrc.vt.edu/swc/>

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## H. BMP Evaluation Programs in Other States

1. New Jersey Corporation for Advanced Technology (NJCAT) -- <http://njcat.org/>
2. New Jersey Department of Environmental Protection -- <http://www.state.nj.us/dep/>
  - a. Division of Science, Research & Technology; Technical Guidance Documents -- <http://www.state.nj.us/dep/dsr/bscit/Documents.htm>
  - b. Stormwater Manufactured Treatment Devices Certifications and Guidance -- <http://www.state.nj.us/dep/stormwater/treatment.html>
3. Massachusetts -- Stormwater Technology Evaluation Project (MASTEP) -- <http://mastep.net/>
4. Washington Department of Ecology -- <http://www.ecy.wa.gov/>
  - a. Evaluation of Emerging Stormwater Treatment Technologies -- <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html>
    - i. Technology Assessment Protocol - Ecology (TAPE)
    - ii. Chemical Technology Assessment Protocol - Ecology (CTAPE)
  - b. Types of Stormwater Treatment Technologies Approved through TAPE and CTAPE -- <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html>