

## ***Chapter 1***

### ***INTRODUCTION***

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## 1.0. PURPOSE

The purpose of this Handbook is to provide guidance on the measures necessary to comply with the Virginia Stormwater Management Law and Virginia Stormwater Management Permit (VSMP) Regulations and protect the waters of the Commonwealth of Virginia from the adverse impacts of post-construction stormwater runoff. The guidance provided in this Handbook is applicable to new development, redevelopment, and upgrades to existing development. The Handbook focuses on environmental site planning and design, pollution source control and prevention, runoff volume reduction, stormwater treatment, stream channel protection, and flood protection. Related topics such as erosion and sediment control and watershed management are addressed in the Handbook as secondary considerations. The Handbook does not address agricultural runoff.

### 1.1. WHAT IS NEW IN THIS HANDBOOK?

The last edition of this Handbook was released in 1999. It has been referred to as the “Blue Book” because of the blue plastic binders that contain the two volumes of information. That Handbook was much more basic, addressing only the most basic and important considerations of stormwater management in Virginia.

This edition not only reflects updated stormwater management regulations, but it also covers the topic of stormwater management more comprehensively. DEQ staff incorporated the best information available on each subject area from recent leading state and local stormwater management manuals and other resources from around the country. DEQ also incorporated the work of leading researchers and journalistic contributors. As a result, the DEQ considers this Handbook to be on the cutting edge of guidance about this subject.

The Handbook provides an expanded Glossary of Terms in **Appendix 1-A** of this chapter. Also, the reader will see more photographs and graphics to illustrate points being made in the text. Most chapters include appendices additional helpful information or “tools,” such as checklists, reference tables, etc. Furthermore, each chapter includes a list of helpful reference documents.

The reader will note that some of the charts and cost data are outdated. However, these were borrowed from some of the best stormwater management resources available, and the information included in the older reference charts is still reliable. Older cost data can be updated using standard indices such as the Consumer Price Index provided by the U.S. Bureau of Labor and Statistics, or the Building and Construction Cost Indices provided by *Engineering News-Record* (<http://www.enr.com>).

**Chapter 2** presents the current Virginia Stormwater Management Act and the Virginia Stormwater Management Regulations. The text for each of these documents is provided in its own Appendix to the chapter.

**Chapter 3** describes what a locality must do to implement a qualifying stormwater management program (in compliance with the regulations). A Model Local Stormwater

Management Ordinance is no longer included in the Handbook. However, a Model Ordinance is available on the DEQ website at:

<http://www.deq.virginia.gov/Programs/Water/LawsRegulationsGuidance/Guidance/StormwaterManagementGuidance.aspx>

Several new Appendices have been added, providing useful resources for local programs, as follows.

**Appendix 3-A** discusses the potential elements of a comprehensive local stormwater management program and how to synchronize independent but related local requirements into a more cohesive and efficient program delivery system.

**Appendix 3-B** discusses the considerations involved in developing a local Virginia stormwater management permit (VSMP) program. By the time this edition of the Handbook is released, most Virginia localities will be well on the way to developing their local ordinances and structuring their local program elements. This appendix may still provide helpful advice, and it will be particularly useful to localities, such as independent towns, which are not required at this time to develop a VSMP program but may, in the future, decide to do so.

**Appendix 3-C** discusses various information technology tools, such as databases and GIS, which can be useful in administering a local stormwater management program.

**Appendix 3-D** discusses the value of internal local code and ordinance reviews to ensure that they reinforce one another and do not present internal conflicts to effective implementation of stormwater management requirements. This Appendix also provides checklists that can be used locally to review related codes and ordinances.

**Appendix 3-E** presents a case study of the City of Staunton's creation of a local Stormwater Utility.

**Appendix 3-F** presents sample Site Plan Review Checklists that local staff can use or adapt for that purpose.

**Appendix 3-G** provides useful information about the construction inspection process and the need for verified As-Built drawings of permanent BMPs and other key permanent features, which are important references for long-term inspection and maintenance of these facilities.

**Chapter 4** provides a primer about stormwater, covering important topics such as the hydrologic cycle, the growing scarcity of water, the potential effects of changing precipitation patterns on water availability, and the concept of rainwater harvesting. Other topics covered include the consequences of population growth and development on the hydrologic cycle, stormwater runoff, and our freshwater stream and river systems. Taken together, this collection of information describes why our society should care about managing stormwater effectively and what can happen if we don't.

**Chapter 5** provides a comprehensive set of recommendations regarding how to manage stormwater effectively. The recommendations in this chapter extend beyond managing stormwater on land development sites to the more systemic needs of localities with state/federal permits to manage Municipal Separate Storm Sewer Systems (MS4s). This chapter advocates thinking of natural drainage system in the same way we think of constructed drainageways, as *infrastructure* – but *Green Infrastructure*.

The new regulations represent a paradigm shift in the approach to managing stormwater runoff from land development projects. Most notably, this approach reflects the thinking of a panel of national experts on the subject of stormwater management, as represented in their 2008 report to the USEPA recommending better ways to manage stormwater (NRC, 2008).

This shift involves focusing primarily on reducing the *volume* of stormwater runoff *on* the development site, rather than focusing on merely *treating* the pollution in the runoff. Runoff volume reduction accomplishes the full range of stormwater management goals more effectively and efficiently than in the past. This chapter includes two new Appendices.

**Appendix 5-A** provides updated documentation of the Center for Watershed Protection’s Impervious Cover Model, which can be used as the basis of local stormwater management requirements beyond the basic state regulatory criteria. This model can also be used in watershed planning exercises.

**Appendix 5-B** discusses the process of developing watershed-scale stormwater management plans, providing several local case studies as examples for other localities.

**Appendix 5-C** discusses special stormwater management considerations for redevelopment projects. These typically occur in denser urban areas where there is little or no spare space for LID-type practices to be employed. In addition, redevelopment sites are typically constrained by a high percentage of existing impervious cover and utilities or other infrastructure that may interfere with stormwater management practices. Thus, such sites are tricky, but it is certainly possible to achieve stormwater management goals with the proper approach.

Finally, **Appendix 5-D** discusses the process of stormwater benchmarking, the identification of potential hotspot areas or other issues that can be addressed by special stormwater management practices or “good housekeeping” practices which can prevent toxic pollutants from ever entering runoff and the drainage system. Benchmarking is especially for municipal facilities and large industrial or institutional sites where the same owner owns and operates facilities on large tracts of land.

**Chapter 6** discusses environmental site design as one of the keys to effectively implementing the new approach of integrating stormwater management into the development site’s actual layout by protecting and using the soils and drainageways on the site to capture and infiltrate runoff instead of merely transporting the water off-site. With this new approach, the stormwater designer should be part of the original development team and be involved in determining how to most effectively manage stormwater on the site *before* the site plan is completed, platted and

recorded. When done effectively, this approach will not only result in better runoff management, but it can also significantly reduce site development costs.

This chapter includes multiple Appendices, all new to this Handbook, which elaborate on particular issues or guidance discussed in the chapter.

**Appendix 6-A** provides in-depth guidance about the preparation of site plans.

**Appendix 6-B** discusses special considerations for stormwater management in areas where karst geology occurs. This Appendix replaces the old Virginia DCR *Technical Bulletin 2: Hydrologic Modeling and Design in Karst*.

**Appendix 6-C** discusses special considerations for stormwater management in coastal settings, where there is little topographical relief and the groundwater table is high.

Finally, **Appendix 6-D** discusses the 2009 release of the Sustainable Sites Initiative™ (SSI), an interdisciplinary partnership of the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, and the National Botanic Garden. The SSI is an incentive-based program providing credits for the use of sustainable site design techniques, similar to LEED program credits. The various practices explained in the body of Chapter 6 refer to various SSI credits.

**Chapter 7** provides information about how to retrofit stormwater controls to existing developments that previously had no controls, and how to upgrade older stormwater control measures to make them function more effectively. This information is very important for those who are redeveloping urban sites that already have drainage infrastructure in place. The information will also be useful to MS4 localities, which may need to accomplish greater pollution treatment on previously developed lands. This chapter has two Appendices, both new to this Handbook.

**Appendix 7-A** provides a case study regarding the development of the City of Charlottesville's program to retrofit stormwater management BMPs on public lands there.

**Appendix 7-B** provides Retrofit Reconnaissance Investigation Checklists that local communities can use to identify potential retrofit sites.

**Appendix 7-C** explains the derivation of the Retrofit Pollution Removal Adjustor Curves recommended in the chapter. These curves can be used to determine an appropriate pollution removal amount for retrofit BMPs.

**Chapter 8** provides a broad overview of all the kinds of BMPs applicable to managing stormwater, starting with the hierarchical order of implementing BMPs, from the planning stage pollution prevention/source control, through environmental site design, through concepts of E&S Control, to the sequential classes of post-construction BMPs, etc. There is also a discussion of various manufactured BMPs, their testing and BMP pollutant removal mechanisms. The other categories of BMPs under the MS4 permits (Good Housekeeping, Source Control, Illicit

Connection Detection, etc.) are described. Also discussed are other applicable measures, such as buffers and stream restoration. The 15 post-construction, non-proprietary BMPs for which we provide specs on the Clearinghouse web site are described briefly, with photos.

Additionally, there is a discussion of the categories of information in each of the design specs posted on the Clearinghouse web site, followed by a thorough discussion of BMP selection criteria, based on the following categories:

- Land use;
- Physical feasibility
- Cold climate and winter conditions;
- Critical nearby water resources;
- Stormwater management capability;
- Pollutant removal;
- Community and environmental factors
- Other regulatory restrictions and setbacks; and
- Spatial scale at which the practices are applied

One significant change in the new Handbook is that the design specifications for the various BMPs are *not* incorporated within the Handbook. The BMP specifications have been moved to the **Virginia Stormwater BMP Clearinghouse Web Site**, in order to accomplish several goals:

- To provide easier access to the design specifications
- To allow the Commonwealth to update specifications more quickly and easily
- To allow the Commonwealth to more effectively evaluate and manage the approval of manufactured treatment devices (MTDs) for use in treating stormwater runoff in Virginia

The BMP Clearinghouse web site can be found at <http://www.vwrrc.vt.edu/swc/>. The new design specifications were developed collaboratively by staffs of the Center for Watershed Protection and the Chesapeake Stormwater Network. They reflect the most recent research on BMPs and the best and most current thinking about BMP sizing, design and performance. There are a number of new specifications included that reflect the Low Impact Development (LID) approach to managing stormwater, including specifications for Vegetated Roofs, Bioretention, and Rainwater Harvesting (with a very sophisticated design spreadsheet).

**Appendix 8-A** provides a comprehensive BMP design and plan review checklist for each BMP. These can be used by both project designers and local plan review staff to ensure that selected BMPs have been properly designed.

**Chapter 9** provides extensive information about effective inspection and maintenance of stormwater control measures, including the following:

- The importance of an effective BMP inspection and maintenance program
- A general overview of how to implement an effective program
- The various entities responsible for implementation (public, private, or a combination, etc.)

- The consequences of incorrect implementation
- A step-by-step guide to setting up an effective local inspection and maintenance program element (step-by-step)
- Tracking inspection and maintenance activities
- A summary of typical maintenance tasks that must not be overlooked
- A brief discussion of monitoring associated with maintenance

Just as with an automobile, a power tool, or a major appliance, stormwater control measures must be maintained if they are to continue to function effectively over time. Regular preventive maintenance of stormwater controls can prevent major failures and repair expenses at some later date. However, it is commonly found that needed maintenance has not been performed after BMP construction has been completed, resulting in failure of these devices to perform. Thus, the controls that were intended to protect our local stream systems and drinking water supplies, by managing both the amount and quality of site runoff, do *not* accomplish those purposes.

Additionally, this chapter provides graphic examples of typical results when specific practices are not maintained, as well as describing the most common maintenance mistakes. Finally, this chapter provides a number of new Appendices that provide more guidance on specific aspects of BMP inspection and maintenance.

**Appendix 9A** provides the results of a field survey of BMPs in various regions of the James River watershed, conducted by the James River Association and the Center for Watershed Protection in 2009. This Appendix points out the results of careless design and construction, as well as neglect of BMP maintenance.

**Appendix 9B** provides numerous examples of BMP Maintenance Agreements from a number of localities.

**Appendix 9C** provides a generic BMP Inspection and Maintenance Checklist as well as individual checklists for each non-proprietary BMP provided on the BMP Clearinghouse web site.

**Appendix 9D** provides guidance on how to design BMPs in ways that reduce the risk of failure and the need for maintenance.

**Appendix 9E** provides a method that can be used to estimate sediment accumulation in BMPs such as wet ponds or forebays, so a locality will understand when and how often to schedule sediment removal activities.

**Chapter 10** is an expansion and update of a section of the old Handbook setting forth *Uniform Stormwater BMP Sizing Criteria*.

The material in this chapter was embedded in Chapter 4 or 5 of the 1999 Handbook. However, most states provide this material as a separate chapter. The chapter covers the five standard sizing issues that typically apply to stormwater management and, more specifically, the three sizing criteria that apply in the Virginia regulations: treatment volume, receiving stream channel

protection criteria, and overbank flooding protection criteria. The chapter provides the scientific reasoning for the specific criteria selected for inclusion in the regulations.

These criteria are based on the new Stormwater Management Regulations, so there are some changes. For example, the water quality treatment sizing is now based on the 1-inch *rainfall* over the entire development site, rather than the old “Water Quality Volume” of 0.5 inches of *runoff* from only the impervious area of the site. Also, stream channel protection is now more flexible because it is based on the type and condition of the receiving channel.

DEQ has chosen to NOT include groundwater recharge criteria in the regulations, despite the requests of a number of stakeholders. Several other states in the Bay region do have groundwater recharge criteria. Given that this criterion is a subject of debate here in Virginia, **Appendix 10-A** provides an optional approach to developing a criterion for *recharge volume*, should a locality want to do this under the auspices of more stringent local criteria, which is allowed in the state regulations.

**Appendix 10-A** provides guidance for establishing an optional recharge volume requirement to local stormwater management rules, should the local government decide they want to enact this more stringent requirement into their local program. Currently the state regulations do not include a recharge volume requirement, in deference to the runoff volume reductions achieved by using many of the newer LID-type BMPs. However, several other Chesapeake Bay region states are including recharge volume reduction in their regulations, and the stormwater volume reduction approach is being strongly supported by the USEPA and the National Research Council of the National Academies of Science.

**Appendix 10-B** provides an explanation of why Virginia changed from the 2-year storm to the 1-year storm as the basic sizing criteria for stream channel protection for natural receiving streams.

**Chapter 11** discusses the hydrologic calculations needed to apply the Runoff Reduction Method. The bulk of the text in this chapter appears to still apply, as basic hydrologic methods have not changed. The chapter includes several Appendices.

**Appendix 11-A** covers the Hydrologic Soil Groups assigned to all the Virginia soils. This information reflects the most current update from the USDA-NRCS state office in Virginia.

**Appendix 11-B** provides the 24-hour rainfall depths for Virginia, based on the new NOAA Atlas 14 rainfall data. For a county that has more than one rainfall depth occurring within its jurisdiction, maps have been clipped from the NOAA website to show where the boundaries are for each different annual rainfall depth.

**Appendix 11-C** provides all the rainfall-runoff tables for selected runoff curve numbers. These tables have also reflected the most current data from the USDA-NRCS state office.



**Appendix 11-D** discusses various stormwater computer models that can be used to assist with stormwater management designs. The models discussed apply to hydrologic, hydraulic, and water quality computations.

**Chapter 12** explains the new Virginia Runoff Reduction Method spreadsheet. In the 1999 Handbook, the water quality design equation (*the Simple Method*) was discussed with examples in Chapter 5, along with all the hydraulic equations. However, given that the Runoff Reduction Method (and Spreadsheet) are involves a substantial expansion and improvement of the *Simple Method* equation, the Department believes the explanation of how to use this methodology merits a separate chapter of its own. The text is a step-by-step explanation of how to use the spreadsheet.

**Chapter 13** provides a number of example site plan designs, with explanations about the design decisions and associated calculations involved with these designs. The five examples provided represent institutional, residential, commercial/office, and two redevelopment projects.

### **Important Note**

The Department will retain links to Chapters 3 through 6 of the 1999 Virginia Stormwater Handbook (Blue Book) from the Stormwater Management section of the agency's website. We are doing this for two reasons. First, provisions of the revised (September, 2011) Virginia Stormwater Management Regulations allow "grandfathered" development site plans to use the older regulatory criteria and BMP designs reflected in the Blue Book. So there will be a continued need to reference that material. Second, Chapters 4-6 provide an excellent tutorial on the necessary hydrologic and hydraulic calculation procedures and example site designs using those procedures. Rather than repeat that information in the new Handbook, we have decided to keep the old text as legacy guidance.

## **1.2. HOW TO USE THIS HANDBOOK**

The new Handbook is organized in a logical progression. Therefore, the Handbook can be used in an academic approach to methodically gain an understanding of the subject matter. Even so, each chapter is self-contained, so the reader can turn to specific topics independently, depending upon the type of information or guidance needed. There are comprehensive indexes at the beginning of each chapter showing the location of specific topics, figures and tables and appendices.

Part I includes chapters 1-3. These chapters introduce the Handbook and provide copies of the law and regulations, the model ordinance, and guidance about how to implement an effective local stormwater management program. Part II, including chapters 4-7, provides information to help the reader develop a conceptual understanding of why stormwater management is important and what is involved. Part III, including chapters 8-13, provides more specific tools, methods and examples for designers, local program staffs, etc., to enable them to translate the concepts into specific plans that will result in control measures on the ground, including their long-term inspection and maintenance.

This Handbook focuses on information that supports implementation of and compliance with Virginia's stormwater management law and regulations. However, the BMP design specifications on the BMP Clearinghouse web site, have been designed to apply throughout the Chesapeake Bay/Mid-Atlantic region.

### **1.3. REFERENCES**

NRC, 2008. Water and Science Technology Board, Division of Earth and Life Studies. *Urban Stormwater Management in the United States*. Washington, DC: National Academies Press, 109+. [http://www.nap.edu/catalog.php?record\\_id=12465#toc](http://www.nap.edu/catalog.php?record_id=12465#toc)