Chapter 1

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What's in this Chapter?

Section 1.1 provides an overview of permanent stormwater management.

Section 1.2 addresses the purpose of this manual and its intended audiences.

Section 1.3 outlines the permanent stormwater management requirements specified in Municipal Separate Storm Sewer System (MS4) permits and the sections of the manual that provide more detailed guidance on meeting these requirements.

Section 1.4 explains how MS4 permit requirements intersect with other regulatory drivers for site design and stormwater management.

Section 1.5 directs the user to parts of the manual that outline the design methodology for the various permanent stormwater control measures (SCMs) that can be used to comply with the standards specified in MS4 permits under regionally-variable conditions.

Section 1.6 points to the detailed design guidance and pictorial explanation for the SCMs contained in the manual.

Section 1.7 includes a table with a brief overview of each chapter and appendix of the manual.

1.1 Permanent Stormwater Management

The transition from native landscapes to a built environment often results in increased pollutant loadings into receiving waters, erosion of stream channels, downstream flooding, as well as decreased infiltration and recharge of groundwater. The traditional design approach to managing these impacts has been based on the peak rate of discharge to control downstream flooding. Unfortunately, this approach doesn't take into account the increased frequency, volume, and duration of discharges, among other changes in the hydrologic response of the contributing watershed, and fails to protect the ecological (the combined physical, chemical, and biological) characteristics of receiving waters.

Traditional permanent stormwater management controls have proven to be inadequate due to the inherent limitations of insufficient pollutant removal, increased runoff volume, and increased duration of peak flow (NRC, 2009). Without adequate controls, urban runoff can degrade the water quality of our natural water resources; negatively affecting our drinking water, aquatic life, and outdoor recreation.

The **permanent stormwater control measures (SCMs)** identified in this manual, are best management practices that are primarily intended to address pollutant removal. Some of the SCMs have a secondary benefit of addressing the other limitations of traditional permanent stormwater management controls

mentioned above by reducing stormwater runoff volume and/or peak flow. There are two major categories of SCMs: non-structural and structural.

Non-structural SCMs are techniques that tend to be source control or pollution prevention actions that reduce the opportunity for stormwater to be generated or be exposed to potential pollutants. Non-structural SCMs minimize the amount of stormwater generated on a site. Chapter 3 of this manual focuses on using site planning as a nonstructural SCM.

Structural SCMs are physical structures that are primarily designed to receive stormwater and remove pollutants, but that can also serve to protect receiving stream channels and promote groundwater recharge. A suite of structural SCMs are described in Chapter 5 of this manual.

There is a large body of research demonstrating that structural SCMs that are designed to infiltrate, evapotranspirate, and harvest stormwater serve to mimic the way natural vegetated landscapes respond to precipitation events. This approach is simultaneously advantageous for protecting the channel stability and ecological characteristics of receiving waters.

1.2 Purpose and Intended Audiences for this Manual

The primary purpose of this manual is to serve as design guidance and technical reference for designated and non-designated (unregulated) MS4 communities in Tennessee. It is intended to provide the information necessary to properly meet minimum permanent stormwater management requirements as specified in MS4 permits.

The target audiences who will use this manual include:

1. Local officials and administrators in designated MS4 communities that must comply with Permanent Stormwater Management requirements.
2. Other localities or entities in Tennessee that choose to develop a stormwater management program or implement stormwater SCMs to protect their water resources.
3. Designers, consultants, or other individuals or companies that engage in regulated new and/or redevelopment activities.
4. Others interested in stormwater management technical criteria (e.g. businesses, state agency staff, watershed groups and citizens).

The design professional is responsible for the proper design of a functioning system that meets all the applicable requirements and considers all unique conditions of individual sites. It is the construction operator that is responsible for proper installation of the approved design. Ultimately, it is the property owner/operator's responsibility to ensure that all permanent SCMs are functioning as designed at all times.

This manual does not cover every aspect of engineering necessary for proper SCM system design, construction, and implementation, nor does it cover every possible design scenario. Where the designer determines that conformance with this manual would not be technically or financially feasible, alternative design approaches, materials, and methods should be considered on a case-by-case basis.

Throughout this manual, the words "should" and "recommended" are used for items that are recommended for good design practice and optimal performance. The words "shall," "must," and "required" indicate items that are required to achieve approval of a design based on the requirements specified in MS4 permits.

Table 1.1: Suggested Use of Manual for Intended Audiences.

End User	Objective: Suggested Use of this Manual
MS4 Operator or Program Manager	To Create an Effective Program: Chapter 2 explains the MS4 Permanent Stormwater Management requirements, Chapter 3 describes the self-crediting "Smart Site Design" technique, and Chapter 5 lays out the range of approved structural stormwater SCMs. It is important for program managers to understand how these combine to create an effective permanent stormwater management program.
MS4 Plan Reviewer	To Effectively and Efficiently Review Plans: Chapters 3 and 4 describe the technical aspects of design for meeting regulatory standards, and Appendix E provides checklists to assist in plans review.
Designer/Consultant	To Produce Successful Designs that Achieve Site Compliance: Chapter 3 explains how to use "Smart Site Design" to maintain hydrologically functional landscapes to minimize the need for structural stormwater SCMs, and Chapter 5 provides specifications for the suite of approved structural SCMs.
Tennessee Department of Environment and Conservation (TDEC) Staff	To Provide Technical Assistance to Local Programs: The manual allows TDEC to gauge how site plans translate to achieving performance standards. This manual is an important outreach and technical assistance tool to MS4s.
Non-Regulated Local Government or Other Entity	To Set Up A Local Program: Chapter 2 provides a framework for implementing a local program for stormwater management, and the subsequent chapters may be used to provide design options for the development community.
Interested Stakeholder (Businesses, Watershed Groups, Citizens)	To Be Engaged: The manual is an education, outreach and technical assistance tool for stakeholder use as guidance in SCM selection, site development and public education.

1.3 Permanent Stormwater Management Requirements

Permanent stormwater management is required at new development and redevelopment projects that disturb one acre or greater of land, or less than one acre if part of a larger common plan of development, and are located within a designated MS4. These requirements protect water quality by addressing stormwater and pollutant removal at different scales of application:

1. Watershed Protection Scale
2. Site and Neighborhood Scale

1. The watershed protection scale includes a series of SCMs that serve to influence land use decisions that minimize water quality impact on a watershed scale. The approaches identified in this manual include evaluating and revising local land use regulations in an effort to prevent or reduce the impacts of stormwater runoff through policy.

- *Chapter 2 provides a brief overview of the regulatory drivers associated with protecting water quality at the watershed scale.*
- *Chapter 3 describes "Smart Site Design" techniques that can be applied at multiple scales to minimize the need for structural SCMs.*

2. The site and neighborhood scale includes a series of SCMs and site design decisions that can be implemented in an effort to protect receiving waters. This manual provides guidance on "Smart Site Design" techniques that maintain a hydrologically functional site by managing stormwater runoff and reducing pollution.

- *Chapter 3 provides a general design objective for "Smart Site Design" and associated runoff reduction credits as well as SCM implementation.*
- *Chapter 5 provides detailed guidance on the design and performance criteria for each structural SCM.*

1.4 Other Regulatory Drivers that Influence Site Design and Stormwater Management

It is important to acknowledge that, for many sites, there are overlapping regulations at the local, state, and federal levels. In addition to managing stormwater runoff, new development and redevelopment projects may need to comply with other requirements related to stormwater, such as but not limited to floodplains, wetlands, streams, flood control, karst features and dam safety. Any new development or redevelopment project that disturbs one acre or greater of land or less than one acre that is part of a larger plan of development will also be required to obtain coverage under the Construction Stormwater General Permit (CGP) that provides the details for erosion prevention and sediment control (among other construction-related measures) during the construction process. The CGP and the Tennessee Erosion and Sediment Control Handbook can be found at the following website:

http://www.tn.gov/environment/article/permit-water-npdes-stormwater-construction-permit

While this manual makes reference to flood control aspects of stormwater management for larger storms, this is not its intended use. In Tennessee, flood control (also called stormwater detention) remains under the purview of local government codes, ordinance, and policy. Flooding is not regulated through MS4 Permits. As such, it should be understood that the practices in this manual are not intended to solve existing flooding and drainage issues in Tennessee communities. The practices identified here may provide additional benefit of mitigating water quantity issues, but only when they are used in conjunction with other stormwater control and floodplain management measures.

Some local governments have instituted other requirements that also affect site design, such as landscaping or setback requirements. While there are overlapping regulations in some cases, there are also opportunities for overlapping benefits. That is, a single site feature can be used to meet multiple requirements. For example, a filter strip might be used to satisfy requirements for pollutant removal, landscaping, and setbacks; or, the outer zone of a riparian water quality buffer can be used for infiltration-based pollutant removal SCMs and meet local floodplain requirements.

For MS4s, this manual is not intended to supersede existing procedures and policies for the review of site, drainage, or infrastructure plans. This manual can complement existing procedures by specifying the types of practices that can be used to comply with permanent stormwater management requirements.

- *Chapter 2 contains an overview of how MS4 permits intersect with other regulatory programs. MS4 managers, plan reviewers, and designers should be cognizant of the array of programs that may affect a particular site throughout the entire development or redevelopment process.*

1.5 Site Design Drivers and Their Regional Variability

Successful Smart Site Designs address stormwater management and pollutant removal by first minimizing the generation of runoff, and then managing the resultant runoff volume and quality as directed in the site water balance approach and the SCM selection process detailed in Chapter 4 of this manual. Site design standards apply to relatively small storm events (one inch of rainfall or less), as these are the high frequency storms that have the greatest potential for water quality impact (Pitt, 1999). Therefore, selected SCMs tend to fit into the development infrastructure and require careful consideration of the limiting design elements such as depth, volume and long-term maintenance.

Incentives for redevelopment or exceeding performance standards may be available and will vary dependent on the local MS4 program. Also, MS4s are required to allow the use of a reasonable suite of SCMs, which might not consist of all those identified in this manual. Consult applicable local ordinances or guidance materials for MS4-specific requirements.

Once all the requirements for the development or redevelopment project have been determined, the designer must establish the site layout and select the appropriate SCMs that fit the physical characteristics of the site and meet permanent stormwater management performance standards.

- *Chapter 3 describes "Smart Site Design" and outlines how to use this technique to retain an existing hydrologically functional landscape in order to minimize the need for structural SCMs.*

- *Chapter 4 explains the design methodology and selection process for SCMs as well as the basis for technical design (sizing and design storms) that will influence the selection process. This chapter also references a runoff assessment tool that is available on the internet (www.tnpermanentstormwater.org) and a Site Assessment and Inventory Checklist found in Appendix E. These tools will help the designer and the plan reviewer gauge compliance with the performance standards identified in MS4 permits.*

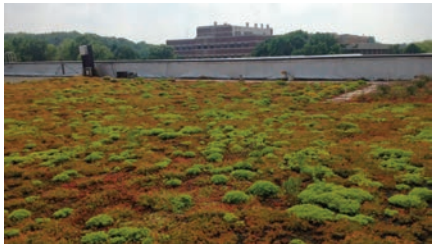
1.6 Detailed Design Guidance for Permanent Stormwater Control Measures

The use of Smart Site Design techniques and selection of SCMs require the site designer to be familiar with the factors that influence performance.

- *Chapter 3 provides detailed instruction and practical guidance on implementing "Smart Site Design" techniques on sites and various scales.*
- *Chapter 5 provides detailed design specifications for structural and nonstructural SCMs. Table 1.2 provides an overview of several practices.*

Table 1.2: An overview of several SCM practices described in the manual that are appropriate for implementation in Tennessee.

Permanent Stormwater Control Measures	Example
Bioretention Measure that treats runoff through physical, chemical, and biological processes; sized for a target storage volume, designed with specific vegetation and engineered media.	
Urban Bioretention Application of bioretention measure at a sub-basin scale or linear space, which often necessitates the use of an underdrain to route treated water to a receiving drainage system.	
Dry Detention A basin that temporarily ponds runoff, enabling particulate pollutants to settle out. This measure is mainly used for peak flow attenuation and receives less credit for pollutant removal than infiltration-based SCMs; therefore, these basins should be designed in combination with other treatment practices.	

Permanent Stormwater Control Measures	Example
Wet Pond A basin that treats stormwater in a permanent pool of water to remove common pollutants from urban stormwater runoff through sedimentation, biological uptake, and plant filtration.	
Filter Strip Vegetated strip with uniform grade used to slow runoff and facilitate deposition of sediment in runoff before runoff reaches surface water.	
Grass Channel A vegetated, shallow drainage conveyance with relatively gentle side slopes and longitudinal grade that generally conveys flows of less than one foot of water depth.	
Green Roof A rooftop that is covered with a single bed or beds of soil and vegetation and is designed to infiltrate and evapotranspire precipitation. Also known as a vegetated roof.	
Infiltration Areas Measures that receive, filter and temporarily store runoff before allowing it to infiltrate into the underlying soil.	

Permanent Stormwater Control Measures	Example
Stormwater Treatment Wetland An area that contains hydric soils, hydrophilic vegetation, and a shallow water table and is designed specifically to capture and remove pollutants.	
Manufactured/Proprietary Treatment Devices Manufactured systems that use proprietary settling, filtration, absorption/adsorption, vortex principles, vegetation, and other processes to meet the Stormwater Management Standards.	
Permeable Pavement Measure used to provide a hard surface and consists of layers designed to allow water to percolate through the surface, into a sub-base, and potentially infiltrate into the ground.	
Rainwater Harvesting Collecting and storing rainfall for later use. If managed appropriately, these systems slow and reduce runoff and provide a source of water for vegetation.	

1.7 How to Use This Manual for Design

The primary objective of this manual is to provide tools for the design community and municipalities to achieve requirements for permanent stormwater management as identified in MS4 permits. Table 1.3 provides an overview of the content of each chapter of the manual.

Table 1.3: Content of the Tennessee Permanent Stormwater Management and Design Guidance Manual.

Chapter	Content
Introduction (Chapter 1)	Purpose, scope, and content of this design manual.
Background and Legal (2)	Overview of legal programs and regulations related to MS4 permits.
"Smart Site Design" (3)	Detailed description and step-by-step process of this self-crediting design technique that preserves natural hydrologic function to minimize the need for SCMs; site assessment protocols; how to handle design on challenging or special sites (e.g. karst, brownfields, shallow bedrock or groundwater, stormwater hotspots, outstanding water resources, impaired waterways, etc.).
Addressing the Water Quality Treatment Volume (4)	Instructions on how to determine project needs for storage/treatment volume in geographic regions.
Permanent Stormwater Control Measures (5)	Detailed specifications for recommended SCMs used to achieve design goals. Specifications include feasibility, sizing, design, materials, construction, and maintenance.
Using the Design Tool Package (6)	Step-by-step instructions with examples on how to use the sizing calculator and other available resources to ensure project success.
Long-Term Operation and Maintenance (7)	Guidance on how to create the regulatory framework and legal foundation to ensure SCMs and site design elements function within a site as intended for the lifetime of the facility.

REFERENCES

National Research Council (NRC). 2009. Urban Stormwater Management in the United States. Washington, DC: The National Academies Press. doi:10.17226/12465.

Pitt, Robert. 1999. Small Storm Hydrology and Why It Is Important for the Design of Stormwater Control Practices. Advances in Modeling the Management of Stormwater Impacts, Volume 7. Edited by W. James. Computational Hydraulics International, Guelph, Ontario, and Lewis Publishers/CRC Press.