

1. Introduction

1.1. Background

As land is developed, the impervious surfaces that are created increase the amount of runoff during rainfall events, disrupting the natural hydrologic cycle. Without stormwater controls, the increased runoff can erode stream channels, increase pollutant loadings, cause downstream flooding, and prevent groundwater recharge. The increased runoff can degrade water quality in all types of waters, including those classified as water supply watersheds, shellfish areas, and nutrient-sensitive waters. Protecting these waters is vital for a number of reasons, including the protection of fish and wildlife habitat, human health, recreation, and drinking water supplies.

The management of all water pollution sources is a stated goal of the 1987 amendments to the Clean Water Act. To fulfill the requirements of the Clean Water Act, the North Carolina Department of Environment and Natural Resources, Division of Water Quality (DWQ) has examined water pollution in each of its 17 river basins and has developed corresponding plans to address that pollution. Some of the plans have resulted in the promulgation of specific stormwater regulations to address overall water pollution issues. In addition, there are several county and local governments that have also implemented stormwater regulations to address specific local water pollution issues. Most of these programs attempt to protect, maintain, and restore water uses to the surface waters through the use of narrative based effluent limitations in the form of "best management practices" (BMPs).

1.2. Introduction to BMPs

Stormwater BMPs are implemented as a way of treating or limiting pollutants and other damaging effects of stormwater runoff in order to meet legislative and North Carolina Administrative Code requirements. There are two major categories of BMPs: non-structural and structural. In North Carolina, the management of stormwater runoff through non-structural BMPs is the preferred method of reducing pollution from developing urban and suburban areas. In cases where the preferred methods are not feasible or sufficient, or where stormwater controls are being used to retrofit existing development, engineered or structural BMPs are viable solutions to reducing pollution. Both non-structural and structural BMPs are discussed in more detail in the following sections.

1.2.1. Non-Structural BMPs

Non-structural BMPs are typically passive or programmatic and tend to be source control or pollution prevention BMPs that reduce pollution in runoff by reducing the opportunity for the stormwater runoff to be exposed to the pollutants. In many circumstances it may be easier and less costly to prevent the pollutants from entering the drainage system rather than to control them with end-of-pipe structural BMPs. Used properly, the non-structural BMPs can be very effective in controlling pollutants and in

greatly reducing the need for structural BMPs. In addition, non-structural BMPs tend to be less costly and easier to design and implement. Typically, the measures do not require maintenance but do require administrative resource commitments to ensure that they are continually implemented. Non-structural BMPs normally do not have technical or engineering designs associated with them. Some typical non-structural BMPs are listed below:

- Public education and participation.
- Land use planning and management (vegetative controls, reduced impervious areas, disconnected impervious areas).
- Material use controls (housekeeping practices, safer alternative products, pesticide and fertilizer use).
- Material exposure controls (material storage control, vehicle-use reduction).
- Illegal dumping controls (storm drain stenciling, household hazardous waste collection, used oil collection).
- Spill prevention and cleanup (vehicle spill control, aboveground tank spill control).
- Connection controls (illicit connection detection, removal, and prevention, leaking sanitary sewer control).
- Street and storm drain maintenance (roadway cleaning, catch basin cleaning, vegetation controls, storm drain flushing, roadway/bridge maintenance, , drainage channel and creek maintenance).

1.2.2. Structural BMPs

Structural BMPs refer to physical structures designed to remove pollutants from stormwater runoff, reduce downstream erosion, provide flood control, and promote groundwater recharge. Structural BMPs typically require engineering design and engineered construction. The several types of structural BMPs vary greatly in their design and they each have advantages and disadvantages relative to each other. Some structural BMPs provide considerable stormwater quantity handling capability through the use of infiltration and/or detention/retention facilities (e.g. infiltration devices, stormwater wetlands, wet detention basins). Others provide many types of pollutant removal mechanisms such as sedimentation, filtration, microbial action, and plant uptake (e.g. bioretention, stormwater wetlands). Some BMPs provide high levels of both stormwater quantity handling and pollutant removal ability. In addition, structural BMPs can be divided into those that help reduce the pollutants or quantity of stormwater entering a collection system (e.g. permeable pavement, filter strips, rooftop runoff management), and those that treat the stormwater at the “end of pipe” (e.g. sand filter, stormwater wetlands, wet detention basins). The following structural BMPs are discussed in detail within this design manual:

- Bioretention
- Sand Filter
- Stormwater Wetlands
- Wet Detention Basin

- Filter Strip
- Grassed Swale
- Infiltration Devices
- Restored Riparian Buffer
- Dry Extended Detention Basin
- Permeable Pavement Systems
- Rooftop Runoff Management
- Proprietary Systems

1.3. About This Manual

The purpose of this manual is to assist designers, developers, owners, contractors, and local officials in determining what stormwater regulations apply to their situation, what the best stormwater BMP to meet those regulations might be, and how to then design and maintain that particular stormwater BMP. It is intended to provide the competent design professional with the information necessary both to properly meet the minimum requirements of the various North Carolina stormwater programs, and to be able to design a stormwater BMP that meets the water quality objectives. However, it does not cover every aspect of the civil engineering and structural design necessary for proper BMP system design and construction, nor does it cover every site situation that may occur, or every possible stormwater solution. The design professional is responsible for the design and construction of a properly functioning stormwater BMP that meets all of the applicable regulations, including the water quality objectives, and that considers all the unique conditions of an individual site. Where the designer determines that conformance with this manual would create an unreasonable hardship or where an alternative design may be more appropriate, alternative designs, materials, and methodologies will be considered on a case-by-case basis.

This manual is meant to supplement (not supplant) North Carolina's stormwater regulations by explaining the stormwater BMPs that will be allowed, their design criteria, and their assumed pollutant removal efficiencies in an easy-to-understand manner. In addition, local communities are free to adopt more stringent requirements than those presented in this manual (local standards that are more stringent do not result in increased removal credits). In general, if any part of this manual lists requirements different from those imposed by any other ordinance, rule, regulation, or other provision of law, whichever provision is more restrictive or imposes higher protective standards for human or environmental health, safety, and welfare, shall control. It should be noted, however, that some Environmental Management Commission rules, such as the Universal Stormwater Management Program, do allow substitution of portions of one program for another.

There are figures, example calculations, operation and maintenance items, etc., used throughout this manual. The intention is to provide the reader with visual assistance in device functions, siting, and concepts, as well as guidance on designing, operating, and maintaining specific BMPs. The figures, example calculations, operation and maintenance items, etc., will not represent the proper solution for every situation, and

they may contain items that may not exactly fit the requirements listed in the section. The user of this manual must look at these items and use his or her professional judgment as to their proper use in a specific situation (however, any variance from a requirement must be clearly indicated). In the event of a conflict or inconsistency between the text of this manual and any heading, caption, figure, illustration, table, map, etc., the text shall control.

Throughout the text of this manual, the words “should” and “recommended” are used for items that are recommended for good design practices and optimum performance of the BMP. The words “shall”, “must”, and “required” are used for items that are required for receiving approval of the design and for that design to receive the listed pollutant removal rates. In each design section, the required items are broken into 2 groups: those that are required for approval of a design based on requirements in the North Carolina Administrative Code, and those that are required for a design to receive full credit listed in this manual for pollutant removal rates. Those designs not meeting all of the requirements of the first group will not be approved for construction, and those designs not meeting all of the requirements of both the first and second group will not receive the stated removal rates.

Also used throughout this manual is the phrase “design professional”. This phrase is a generic title for a qualified, registered, North Carolina professional engineer, surveyor, soil scientist, or landscape architect, performing services only in his or her area of competence. Other individuals may be authorized as a “design professional”, if they can demonstrate proper knowledge and ability to DWQ.

Knowledge about stormwater management is continually advancing. This manual, or individual sections of this manual, will be regularly updated to keep up with advances in research and practice. Each section has a date on the header of each page so that all users can be sure which version of the manual they are using. At the end of each chapter, there will a “Revisions” note added when changes are made which notes the reason for the change. Please refer to the DWQ Stormwater Permitting Unit webpage on a regular basis to check for the most current version of each section. There is also an opportunity provided on the Division’s stormwater web site to add your email address so you will be notified of updates to this manual.

1.4. Must the Manual be Followed Explicitly?

The Stormwater BMP Manual contains what the Division of Water Quality believes to be the technologies and specifications that: 1) will meet the state minimum regulatory requirements for stormwater BMPs, 2) will perform in a manner most likely to protect the state’s water quality standards and 3) will continue to function as designed to protect water quality.

The specifications contained in this Manual were based on the most recent and recognized research and guidance from professionals in academia, research organizations, regulatory agencies and design practitioners across the state. Although we

believe that following the conditions of the Manual will provide compliant and permissible design, some professionals may desire to design stormwater treatment devices in a manner different from that specified in this Manual. This is acceptable if the design and implementation meets the state's minimum regulatory requirements and can be shown to provide equal or better protection than those specified in the Manual. Design professionals desiring to deviate from the provisions contained in this Manual must provide full technical justification that their recommendation is as protective as or better than the recommendations contained in this Manual. Although at times, unique situations provide obvious evidence that a deviation from the Manual is justified, most recommendations for deviations will require technical documentation that provides convincing evidence of the acceptability of the alternative. Vague, anecdotal or isolated evidence of the acceptability of an alternative solution cannot be used to supplant the considered recommendations of this Manual.

Because our review staff must consider all deviations from this Manual on a case-by-case basis, requesting approval of BMP designs different from those recognized in the Manual will almost always slow down the permit review process. One benefit of having a Manual is to provide BMP recommendations that have been recognized and accepted and can be readily approved. Projects requesting deviations from the specifications contained in the Manual will require additional staff resources for review. Therefore, project proponents desiring an expedited review should strive to use the accepted specifications in the Manual.

1.5. Acknowledgements

This manual was prepared with the help of many individuals from a variety of affiliations, including: NCDENR, North Carolina State University, private consultants, and various North Carolina municipalities. It also relies on concepts, presentation style, and even text material that were found in BMP design manuals from other states, regional authorities, and municipalities. Most of this material has been reworked extensively and is therefore difficult to reference precisely. Exact referencing has been attempted when possible, and those documents that have been utilized in general have been included in the reference list.

1.6. Disclaimer

To the best of their ability, the authors have insured that material presented in this manual is accurate and reliable. The design of engineered facilities, however, requires considerable judgment on the part of designer. It is the responsibility of the design professional to insure that techniques utilized are appropriate for a given situation. Therefore, neither the State of North Carolina, Department of Environment and Natural Resources, nor any author or other individual, group, business, etc., associated with production of this manual, accepts any responsibility for any loss, damage, or injury as a result of the use of this manual.