

Chapter 1 - Introduction

1.1 Stormwater Management Goals

As land is developed and woodlands and pastures are converted to more intensive commercial and residential uses, the increase in impervious surfaces (pavements and buildings) cause adverse effects including:

- Increased flooding
- Increased erosion and deposition of sediment in streams
- Increased property damage due to flooding, erosion, or deposition
- Less base flow in streams due to less groundwater recharge
- Increased runoff of pollutants (nutrients, sediment, bacteria, oil)
- Decreased stream biodiversity

The County of Roanoke stormwater management goals are to minimize and mitigate these adverse effects of land development by implementing effective stormwater management Best Management Practices as required by the County Code.

The County of Roanoke Stormwater Management Design Manual, hereafter called the Design Manual, was developed to provide guidance to developers, property owners, and design professionals and to assist them in meeting the Stormwater Management Ordinance requirements. It serves as a local supplement to, and not as a replacement for, existing State guidance manuals that address proper stormwater management design techniques. These manuals include:

- Virginia Department of Conservation and Recreation Stormwater Management Handbook
- Virginia Department of Transportation Drainage Manual
- Virginia Department of Conservation and Recreation Erosion and Sediment Control Handbook

The use of the Design Manual and generally accepted references should ensure that standard, acceptable design practices are used for stormwater management designs. However, the County of Roanoke encourages the development and use of innovative stormwater management practices that meet the requirements of the Stormwater Management Ordinance and that can be demonstrated to perform equivalent to the standards set forth in this Design Manual.

1.2 Contents of the Manual

The Design Manual is divided into 15 chapters. An overview of each chapter is presented below.

Chapter 1 – Introduction. Chapter 1 presents the general background and purpose behind the Design Manual. The chapter documents the goals of the program, the applicable requirements for stormwater management, variance requests and the administration of the program.

Chapter 2 – Stormwater Management Plan Review and Approval. Chapter 2 presents the process that the applicant and the County of Roanoke follow to assure that the requirements of the stormwater management program and the Stormwater Management Ordinance are met. The chapter covers the conception, construction, submittal, review, and approval of the stormwater management plan as a part of the overall Development Plan package.

Chapter 3 – Easements. Chapter 3 establishes the requirements for easements for stormwater management facilities and storm drainage systems.

Chapter 4 – Stormwater Hydrology. Chapter 4 documents the hydrologic design practices used to establish design flows necessary to design storm drainage systems and stormwater management facilities. Calculation design methodologies and event frequencies are established.

Chapter 5 – Open Channels. Chapter 5 presents the requirements for open channel hydraulics, including cross section requirements, side slopes, widths, slopes, channel linings, and calculation methods.

Chapter 6 – Culverts. Chapter 6 presents the requirements for culverts, including materials, slopes, headwater and tailwater limitations, and design calculation methods.

Chapter 7 – Storm Drains. Chapter 7 presents the requirements for storm drains, including storm drain piping sizes, and lengths, and storm drain inlet hydraulics.

Chapter 8 – Residential Lot Drainage. (RESERVED)

Chapter 9 – Detention and Retention Storage. Chapter 9 presents requirements and design criteria for stormwater storage facilities. Design criteria include location, sizing requirements, site access, release rates, and spillway requirements. The use of stormwater facilities as best management practices for use in stormwater quality design is covered in Chapter 11.

Chapter 10 – Energy Dissipation. Chapter 10 includes the requirements for velocity and energy reduction devices at the discharge from storm drains, culverts, open channels, and other stormwater management systems. Energy dissipation is required to prevent excessive velocities and erosion in downstream channels.

Chapter 11 – Stormwater Pollutant Removal Practices. Chapter 11 presents the design and calculation requirements for best management practices (BMPs). The section includes BMP selection, structural BMP requirements and limitations, and encouragement in the use of low-impact design and non-structural BMP practices.

Chapter 12 – Environmentally Sensitive Areas. Chapter 12 presents requirements for development of environmentally sensitive areas including floodplains, stream buffers, steep slopes, erodible soils, and stormwater pollutant hot spots.

Chapter 13 – Geotechnical Studies. (RESERVED)

Chapter 14 – Maintenance of Stormwater Management Facilities. Chapter 14 presents the requirements for establishing a maintenance program for stormwater management facilities, and the establishment of a maintenance agreement to assure that stormwater management facilities are properly maintained.

Chapter 15 – Inspection and Enforcement. Chapter 15 presents the inspection and enforcement procedures to ensure that construction of stormwater management facilities comply with the approved plans and are properly maintained post-construction.

1.3 Authority

The Design Manual provides the policies and procedures that implement the provisions of the County Code as they pertain to stormwater management, including storm drainage.

In the event that any part of this Design Manual is held to be illegal or void, this shall not have the effect of making illegal or void the Design Manual in its entirety, or any section thereof, which shall remain effective.

1.4 Applicability

The requirements of this Design Manual apply to all land disturbance activities that require a site development plan submittal, stormwater management plan submittal, or zoning, building, or land disturbance permit, except as exempted below.

The following activities are exempt from the stormwater performance criteria set by the Stormwater Management Ordinance and are not required to submit a stormwater management plan:

- Permitted surface or deep mining operations and projects, oil and gas operations, and projects conducted under the provisions of Title 45.1 of the Clean Water Act;
- Tilling, planting, or harvesting of agricultural, horticultural, or silvicultural crops;
- Single-family residences separately built and not part of a subdivision, including additions or modifications to existing single-family detached residential structures.
- Land disturbance activities that disturb less than 5,000 square feet of land area.

- Linear development projects, provided that (i) less than 5,000 square feet of land will be disturbed per outfall, (ii) the resulting increase in the peak flow discharge from a 10-year frequency, 24-hour storm event is less than 0.5 cubic feet per second (cfs), and (iii) there are no existing or anticipated flooding or erosion problems downstream of the discharge point as determined by the County of Roanoke.

The design criteria for stormwater management facilities and storm drainage systems apply to both public and private facilities unless the Design Manual specifically states otherwise.

Any additions, extensions, and/or modifications to development which were previously exempt shall provide stormwater management for the entire combined development when the acreage limitations are exceeded.

Portions of this Design Manual apply to maintenance and repair of stormwater management facilities and other best management practices after construction is completed.

1.5 Administration

1.5.1 General

The policies and procedures contained within this Design Manual shall be administered by the County of Roanoke, Director of Community Development (Director), or designee, or by the administrator otherwise identified in this Design Manual.

1.5.2 Manual Amendments

This Design Manual will be periodically amended, as necessary to address:

- Changes in technology
- Changes in accepted construction practices
- Changes in Federal and/or State requirements
- Items that require clarification to avoid confusion
- Development issues that potentially impact public health, safety and welfare

Amendments to this Design Manual will be posted on the County website, www.roanokecountyva.gov, and will become effective on the date listed on the website. It is the manual user's responsibility to check the website and verify that they have the latest requirements.

1.5.3 Variances

Requests for variance of any provisions of this Design Manual shall be made in writing to the County of Roanoke, Director of Community Development. The variance request shall clearly identify the Design Manual provision that is desired to be modified; the justification to support the issuance of a variance, and the alternative measures that are proposed to meet the intent of the Design Manual. All requests for a variance will receive a written response outlining the reasons for approval, or denial, within 30 days of receipt of all information requested by the Director. In reviewing the request, the Director shall closely examine the proposed development and evaluate the variance request based on the conditions set forth in the County of Roanoke Code, Stormwater Management Ordinance, [Section XX-4.1](#).

1.5.4 Appeal of Decisions

Appeals of decisions may be filed in accordance with the procedures provided in the County of Roanoke Code, Stormwater Management Ordinance, [Section XX-4.2](#).

1.6 Erosion and Sediment Control

Effective erosion and sediment control during land development and redevelopment activities is important to support the goals of minimizing and mitigating adverse effects and to allow the proper long-term operation of many stormwater management facilities.

Erosion and sediment control shall comply with the Erosion and Sediment Control Ordinance and the requirements of the Virginia Erosion and Sediment Control Handbook, Current Edition, as amended.

1.7 Approvals and Permits

The applicant is responsible for acquiring all required approvals and permits.

1.7.1 Local Approvals and Permits

The review and approval of stormwater management plans shall be an integral part of the overall review of site plans. For preparation and submittal of stormwater management plans and the approval process, see Chapter 2.

1.7.2 VSMP Permit

As of January 2005, the Virginia Department of Environmental Quality (DEQ) no longer administered the Virginia Pollution Discharge Elimination System (VPDES) construction permit program. These permits are administered by the Virginia Department of Conservation and Recreation's (DCR) Virginia Stormwater Management Program (VSMP). DCR is responsible for the issuance, denial, revocation, termination and enforcement of VSMP permits for the control of stormwater discharges from land disturbing activities regulated under the Virginia Stormwater Management Program.

Owners and operators of land disturbing activities equal to or larger than one acre are required to apply for registration coverage under the General Permit for Discharges of Stormwater from Construction Activities.

For additional information, permit application and checklist, and fee registration forms, visit the DCR website: <http://www.dcr.virginia.gov/sw/vsmp>.

1.7.3. Joint Permit Application

Wetlands and streams are protected under several Federal and State programs. Whenever jurisdictional wetlands or streams are impacted by land disturbing activities, a Joint Permit Application must be completed and filed with the Virginia Marine Resources Commission (VMRC). VMRC will distribute the joint permit application to The U.S. Army Corps of Engineers (COE) and the Virginia Department of Environmental Quality (DEQ). The COE and DEQ will consult with other Federal and State agencies in processing the permit application. Upon receipt of an acceptable application the following permits may be issued:

- COE Federal Section 404 Permit
- DEQ Water Protection Permit
- VMRC Permit

1.8 Reference Documents

This Design Manual was written to serve as a supplement to existing state design manuals that address proper stormwater management design techniques, and not to replace them. In the case of a contradiction or conflict, the more stringent requirement shall apply.

The requirements of the following state design manuals and standards are incorporated into this Design Manual by reference.

- Virginia Stormwater Management Handbook, Volumes I and II, prepared by the Virginia Department of Conservation and Recreation, dated 1999 or latest version, as amended. Hereafter throughout this Design Manual referred to as the VA SWM Handbook.
- Virginia Department of Transportation Drainage Manual, prepared by the Hydraulics Section of the Virginia Department of Transportation, dated 2002 or latest version, as amended. Hereafter throughout this Design Manual referred to as the VDOT Drainage Manual.

- Virginia Department of Transportation Road and Bridge Standards, Volumes I and II, prepared by the Virginia Department of Transportation, dated 2001 or latest version, as amended. Hereafter throughout this Design Manual referred to as the VDOT Standards.
- Virginia Department of Transportation Road and Bridge Specifications, prepared by the Virginia Department of Transportation, dated 2002 or latest version, as amended. Hereafter throughout this Design Manual referred to as the VDOT Specifications.
- Virginia Erosion and Sediment Control Handbook, prepared by the Virginia Department of Conservation and Recreation, dated 1992 or latest version, as amended. Hereafter throughout this Design Manual referred to as the VA E&SC Handbook.

In addition, the following documents provide guidance on low-impact development and non-structural best management practices, which applicants are encouraged to practice when developing or redeveloping sites.

- Design Manual for Use of Bioretention in Stormwater Management, Prince George's County, Maryland, prepared by Engineering Technologies Associates, Inc., dated 1993.
- Better Site Design, An Assessment of the Better Site Design Principles for Communities Implementing Virginia's Chesapeake Bay Preservation Act, prepared by Center for Watershed Protection, Inc., no date.
- Low-Impact Development Design Strategies, An Integrated Design Approach, prepared by Prince George's County, Maryland, dated 1999.

1.9 Acronyms and Abbreviations

For clarification, the following is a listing of abbreviations, and acronyms used in stormwater management and throughout this Design Manual.

A – Drainage area, acres (stormwater hydrology)
A – Cross section area, square feet (open channel or pipe hydraulics)
B – VDOT rainfall coefficient, no units (stormwater hydrology)
BMP – Best management practice
C – Runoff coefficient, no units (stormwater hydrology)
C_f – Saturation factor, no units (stormwater hydrology)
CMP – Corrugated metal pipe
CN – Curve Number (stormwater hydrology)
COE – U.S. Army Corps of Engineers
D – VDOT rainfall coefficient, no units (stormwater hydrology)
DCR – Virginia Department of Conservation and Recreation
D_e – Critical duration, minutes (stormwater hydrology)
DEQ – Virginia Department of Environmental Quality

E – VDOT rainfall coefficient, no units (stormwater hydrology)
FEMA – Federal Emergency Management Agency
g – Gravity coefficient, 32.2 feet/s²
H – Height or depth of water, feet
H_f, H_i, H_m, H_o, H_Δ – Head losses in piping and structures, feet (storm drain hydraulics)
HDPE – High density polyethylene
HGL – Hydraulic grade line
I – Rainfall intensity, inches per hour (stormwater hydrology)
I_{post} – Post-development impervious cover, percentage (water quality Simple Method calculation)
I_{existing} – Existing impervious cover, percentage (water quality Simple Method calculation)
K, K_i, K_o – Head loss coefficients for piping, no units
L_{pre} – Pre-development pollutant loading, pounds per year (water quality Simple Method calculation)
L_{post} – Post-development pollutant loading, pounds per year (water quality Simple Method calculation)
MS4 – Municipal Separate Storm Sewer System
n – Manning’s equation roughness coefficient, no units (open channel and pipe hydraulics)
NFIP – National Flood Insurance Program
Q – Stormwater flow, gallons per minute (gpm) or cubic feet per second (cfs)
R – Hydraulic radius, feet (open channel hydraulics)
r_c – Stream bend radius, center, feet (open channel hydraulics)
r_i – Stream bend radius, inside bank, feet (open channel hydraulics)
r_o – Stream bend radius, outside bank, feet (open channel hydraulics)
S – Slope, feet per feet (open channel or pipe hydraulics)
SCS – Soil Conservation Service
t_c – Time of concentration, hours (stormwater hydrology)
T_p – Time to peak flow, hours (stormwater hydrology)
T_r – Time to recede, hours (stormwater hydrology)
T_t – Travel time, hours (stormwater hydrology)
V, V_i, V_o – Velocity, feet per second (open channel and pipe hydraulics)
VA E&SC Handbook – Virginia Erosion and Sediment Control Handbook, latest version, as amended
VA SWM Handbook – Virginia Stormwater Management Handbook, latest version, as amended
VDOT – Virginia Department of Transportation
VDOT Drainage Manual – Virginia Department of Transportation, Drainage Manual, latest version, as amended
VDOT Specifications – Virginia Department of Transportation, Road and Bridge Specifications, latest version, as amended
VDOT Standards – Virginia Department of Transportation, Road and Bridge Standards, latest version, as amended
VMRC – Virginia Marine Resources Commission
VSMP – Virginia Stormwater Management Program, as administered by DCR
ΔZ = Difference in water surface elevation from the inside curve to the outside curve of an open channel, feet (open channel hydraulics)