

STORMWATER MANAGEMENT DESIGN MANUAL

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LIST OF REVISIONS

The following table presents a summary of revisions to the Stormwater Management Design Manual as approved by the City Manager's Office. The date of any revision is indicated on the footer of each affected page.

Date of Revision	Revisions Made
January 30, 2008	<ul style="list-style-type: none">• Added Chapter 9, Residential Drainage• Updated Appendix 15A, Maintenance Agreements
August 16, 2010	<ul style="list-style-type: none">• Chapter 1, Introduction – added second Linear Development Exemption• Chapter 2, use of LID/Green Infrastructure – added guidance for Interceptor Trees
July 1, 2014	- Revision of manual to comply with new VSMP requirements

1.0 INTRODUCTION

1.1 Stormwater Management Goals

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

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 City 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 Environmental Quality Stormwater Management Handbook, First Edition 1999 & Second Edition 2013
- Virginia Department of Transportation Drainage Manual
- Virginia Department of Environmental Quality 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.

1.2 Contents of the Manual

The Design Manual is divided into 16 chapters. An overview of each chapter is presented below.

Chapter 1 – Introduction - 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 – Reserved for Future Use

Chapter 3 – Stormwater Management Plan Review and Approval - presents the process that the applicant and the City follow to assure that the requirements of the stormwater management program and the Storm water Management Ordinance are met. The chapter covers the conception, construction, submittal, review, and approval of the stormwater pollution prevention plan as a part of the overall Development Plan package.

Chapter 4 – Easements - establishes the requirements for easements for stormwater management facilities and storm drainage systems.

Chapter 5 – Stormwater Hydrology - 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 6 – Open Channels - presents the requirements for open channel hydraulics, including cross section requirements, side slopes, widths, slopes, channel linings, and calculation methods.

Chapter 7 – Culverts - presents the requirements for culverts, including materials, slopes, headwater and tailwater limitations, and design calculation methods.

Chapter 8 – Storm Drains - presents the requirements for storm drains, including storm drain piping sizes, and lengths, and storm drain inlet hydraulics.

Chapter 9 – Reserved

Chapter 10 – Detention and Retention Storage - presents requirements and design criteria for stormwater storage facilities. Design criteria include location, sizing requirements, site access, release rates, and spillway requirements.

Chapter 11 – Energy Dissipation - 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 12 – Stormwater Pollutant Removal Practices – includes information on BMPs.

Chapter 13 – Reserved for Future Use

Chapter 14 – Reserved for Future Use

Chapter 15 – Maintenance of Stormwater Management Facilities - 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 16 – Inspection and Enforcement - 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 City 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 subdivision, site plan, land development or land redevelopment 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:

- (1) Permitted surface or deep mining operations and projects, or oil and gas operations and projects conducted under the provisions of Title 45.1 of the Code of Virginia;
- (2) Clearing of lands specifically for agricultural purposes and the management, tilling, planting, or harvesting of agricultural, horticultural, or forest crops, livestock feedlot operations, or as additionally set forth by the State Board in regulations, including engineering operations as follows: construction of terraces, terrace outlets, check dams,

CHAPTER 1 - INTRODUCTION

desilting basins, dikes, ponds, ditches, strip cropping, lister furrowing, contour cultivating, contour furrowing, land drainage, and land irrigation; however, this exception shall not apply to harvesting of forest crops unless the area on which harvesting occurs is reforested artificially or naturally in accordance with the provisions of Chapter 11 (§ 10.1-1100 et seq.) of Title 10.1 of the Code of Virginia or is converted to bona fide agricultural or improved pasture use as described in Subsection B of § 10.1-1163 of Article 9 of Chapter 11 of Title 10.1 of the Code of Virginia;

- (3) Single-family residences separately built and disturbing less than one acre and not part of a larger common plan of development or sale, including additions or modifications to existing single-family detached residential structures
- (4) Land disturbing activities that disturb less than ten thousand square feet (10,000 sf) of land area, except for activities that are a part of a larger common plan of development or sale that is 1 acre or greater of disturbance.
- (5) Linear Development projects, provided that less than 1 acre of land will be disturbed.
- (6) Discharges to a sanitary sewer or a combined sewer system;
- (7) Activities under a State or federal reclamation program to return an abandoned property to an agricultural or open land use;
- (8) Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original construction of the project. The paving of an existing road with a compacted or impervious surface and reestablishment of existing associated ditches and shoulders shall be deemed routine maintenance if performed in accordance with this Subsection; and
- (9) Conducting land-disturbing activities in response to a public emergency where the related work requires immediate authorization to avoid imminent endangerment to human health or the environment. In such situations, the Administrator shall be advised of the disturbance within seven days of commencing the land-disturbing activity and compliance with the administrative requirements of Subsection (a) is required within 30 days of commencing the land-disturbing activity.

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, or modifications to a development which was previously exempt under item 4 of this section, shall provide stormwater management for the entire combined development when the exemption limitations are exceeded. This applies only to additions, extensions, or modifications to a development within two years of completion of the originally proposed development. This time frame limitation does not apply to single family or two family dwellings.

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 Program Administrator in the City's Department of Planning Building and Development. The Administrator shall be the Director or other staff appointed by the Director.

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 City website, www.roanokeva.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 Exceptions

Requests for variance exceptions of any provisions of this Design Manual shall be made in writing to the Administrator. The exception request shall clearly identify the Design Manual provision that is desired to be modified; the justification to support the issuance of an exception, and the alternative measures that are proposed to meet the intent of the Design Manual. All requests for an exception will receive a written response outlining the reasons for approval, or denial, within 30 days of receipt of all information requested by the

Administrator. In reviewing the request, the Administrator shall closely examine the proposed development and evaluate the exception request based on the conditions set forth in Chapter 11.6, Stormwater Management, Article III, Section 11.6-302 of the Code of the City (1979), as amended.

1.5.4 Appeal of Decisions

Appeals of decisions may be filed in accordance with the procedures provided in Chapter 11.6, Stormwater Management, Article III, Section 11.6-501 of the Code of the City of Roanoke (1979), as amended.

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 3.

1.7.2 VSMP Permit

As of September 13, 2011 new stormwater management regulations became effective. These regulations require that all MS-4 localities in Virginia adopt local Virginia Stormwater Management Programs (VSMPs). The City of Roanoke's VSMP authority is effective July 1, 2014. The Department of Environmental Quality's role in the approval of land disturbing activities will be to provide coverage under the General Permit for Discharges of Stormwater

from Construction activities, for projects over 1 acre of disturbance. Once general permit coverage is obtained, if required, the City of Roanoke will be authorized to issue a VSMP Authority Permit for land disturbance activities.

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). This permit must be obtained prior to issuance of a VSMP Authority Permit. VMRC will distribute the joint permit application to The U.S. Army Corps of Engineers (USACE) and the Virginia Department of Environmental Quality (DEQ). The USACE 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:

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

1.8 Reference Sources

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 Environmental Quality, first edition dated 1999 and second edition dated 2013, as amended. Hereafter throughout this Design Manual referred to as the VA SWM Handbook first edition or second edition.

- 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 Environmental Quality, dated 1992 or latest version, as amended. Hereafter throughout this Design Manual referred to as the VA E&SC Handbook.

- Virginia Stormwater BMP Clearinghouse Website, prepared by the Virginia Department of Environmental Quality, located at <http://vwrrc.vt.edu/SWC/index.html>

1.9 Acronyms and Abbreviations Used

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)

Administrator – Program Administrator for the City of Roanoke or designee as appointed by the Director to administer and enforce the requirements of Chapter 11.4, Stormwater Management of the Code of the City of Roanoke (1979), as amended and this Manual.

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)

City – City, Virginia

CMP – Corrugated metal pipe

CN – Curve Number (stormwater hydrology)

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

Director – Director of the City's Department of Planning Building and Development

E – VDOT rainfall coefficient, no units (stormwater hydrology)

FEMA –	Federal Emergency Management Agency
g –	Gravity coefficient, 32.2 feet/s ²
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
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)
Responsible party –	land owner or other individual(s) or organization(s) (e.g., home owners association) responsible for maintaining stormwater management facilities including but not limited to basins, other BMPs, storm drains, culverts, ditches and swales in accordance with a maintenance agreement.
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)
USACE –	U.S. Army Corps of Engineers

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- V, V_i , V_o – Velocity, feet per second (open channel and pipe hydraulics)
- VA E&SC Handbook – Virginia Erosion and Sediment Control Handbook, Current Edition
- VA SWM Handbook – Virginia Stormwater Management Handbook, Current Edition
- VDOT – Virginia Department of Transportation
- VDOT Drainage Manual – Virginia Department of Transportation, Drainage Manual, Current Edition
- VDOT Specifications – Virginia Department of Transportation, Road and Bridge Specifications, Current Edition
- VDOT Standards – Virginia Department of Transportation, Road and Bridge Standards, Current Edition
- VMRC – Virginia Marine Resources Commission
- VSMP – Virginia Stormwater Management Program, as administered by DEQ
- Difference in water surface elevation from the inside curve to the outside curve of an open channel, feet (open channel hydraulics)