

# Stormwater Management Guidance Manual

Version 1.0

City of Charleston, WV





**This page is intentionally left blank.**

TABLE OF CONTENTS  
City of Charleston Stormwater Manual

Published June 2015

Created by the City of Charleston

Published by:  
City of Charleston  
Engineering Department  
114 Dickinson Street  
Charleston, WV 25301

Phone (304) 348-8106  
Fax (304) 348-8044  
Email: [swm@cityofcharleston.com](mailto:swm@cityofcharleston.com)  
Website: [www.charlestonstormwater.org](http://www.charlestonstormwater.org)



**This page is intentionally left blank.**

## Preface

Welcome to the City of Charleston Stormwater Management Guidance Manual.

This manual was initiated by the City of Charleston to be proactive in stormwater management and to set a shining example as the Capitol City of West Virginia. The intent of this first generation manual is to provide a document that could be easily understood by its end users and provide an introduction to a new era of innovative stormwater management techniques. It will help users identify and implement the use of best management practices to protect our water resources from impacts associated with stormwater runoff. These practices are designed to address the unique site conditions that exist within our region.

Feedback from users of this manual is necessary to gauge the Manual's ease of use and to justify ongoing updates.



**This page is intentionally left blank.**

TABLE OF CONTENTS  
City of Charleston Stormwater Manual

## Table of Contents

### Preface

Section	page
<b>Chapter 1 Introduction to this Manual</b>	<b>1-1</b>
1.0 Purpose of Manual-	1-1
1.1 Why Stormwater Matters	1-3
1.2 Current Stormwater Regulations	1-6
1.2.1 Public Education and Outreach	1-7
1.2.2 Public Involvement and Participation	1-7
1.2.3 Illicit Discharge Detection and Elimination	1-8
1.2.4 Construction Site Runoff Control	1-8
1.2.5 Post Construction Runoff Control	1-8
1.2.6 Pollution Prevention and Operation and Maintenance for Municipal Operations	1-9
1.2.7 The Sanitary Board of the City of Charleston, West Virginia, A Municipal Utility	1-9
<b>Chapter 2 The Permitting Process</b>	<b>2-1</b>
2.0 Introduction	2-1
2.1 Defining Land Disturbance	2-2
2.1.1 Exclusions	2-2
2.1.2 Regulatory Jurisdiction - Physical Limits	2-2
2.2 The Stormwater Review and Permitting Process	2-3
2.2.1 Technical Review Process	2-3
2.2.2 Inspections	2-5
2.2.3 Other Permitting	2-5
2.2.4 Other Permits	2-6
2.2.5 Mitigation in lieu of	2-6
2.2.6 Operation and Maintenance Agreement	2-7
2.2.7 Record Drawings – “As-Builts”	2-7
2.3 Developing the Stormwater Management Plan	2-8
2.3.1 Conceptual Review	2-8
2.3.2 Erosion and Sediment Control	2-8
2.3.3 Stormwater Pollution Prevention Plan	2-9
2.3.4 Post-Construction Stormwater Management	2-9
2.3.5 Special Design Considerations	2-12
2.3.6 Watershed Specific Requirements	2-13
2.3.7 Public Health and Safety Considerations	2-13
<b>Chapter 3 Site Planning and Low Impact Development</b>	<b>3-1</b>
3.0 Introduction	3-1
3.1 Goals of the Site Planning Process	3-2
3.2 Site Inventory and Site Analysis Process	3-2
3.2.1 Site Inventory	3-2
3.2.2 Site Analysis and Conceptual Site Plan	3-2
3.2.3 Final Site Plan	3-3
3.3 Introduction to Low Impact Development (LID)	3-8
3.4 Integrated Site Design	3-9
3.4.1 Conservation of Natural Features and Resources	3-10



**This page is intentionally left blank.**

TABLE OF CONTENTS  
City of Charleston Stormwater Manual

3.4.2	Low Impact Site Design Techniques	-	-	-	-	-	-	3-12
3.4.3	Reduction of Impervious Cover/Impervious Cover Management	-	-	-	-	-	-	3-14
3.4.4	Utilization of Natural Features for Stormwater Management	-	-	-	-	-	-	3-22
3.5	LID Case Study	-	-	-	-	-	-	3-25

<b>Chapter 4 Engineering Calculations</b>	<b>4-1</b>							
4.0	Introduction	-	-	-	-	-	-	4-1
4.1	Acceptable Methods for Calculations	-	-	-	-	-	-	4-1
4.1.1	On-site Storage requirements	-	-	-	-	-	-	4-1
4.1.2	Storage Volume Estimation	-	-	-	-	-	-	4-1
4.1.3	Hydrologic Runoff Calculation Methods	-	-	-	-	-	-	4-2
4.1.3.1	Ration Method	-	-	-	-	-	-	4-2
4.1.3.2	Time of Concentrated Section Flow Method	-	-	-	-	-	-	4-3
4.1.4	Storm Sewer Design	-	-	-	-	-	-	4-17

<b>Chapter 5 Erosion and Sediment Control Practices</b>	<b>5-1</b>							
5.0	Introduction	-	-	-	-	-	-	5-1
5.1	Development of a Storm Water Pollution Protection Plan (SWPPP)	-	-	-	-	-	-	5-2
5.2	Groundwater Pollution Protection Plan	-	-	-	-	-	-	5-2
5.3	Alternative and Dual Use Measures	-	-	-	-	-	-	5-3
5.3.1	Dual Use of BMP's	-	-	-	-	-	-	5-3
5.3.2	Alternative BMP's	-	-	-	-	-	-	5-3
5.4	Vegetative Soil Stabilization	-	-	-	-	-	-	5-4
5.4.1	Control Description	-	-	-	-	-	-	5-4
5.4.2	Control Uses and Applicability	-	-	-	-	-	-	5-4
5.4.3	Design Criteria	-	-	-	-	-	-	5-4
5.4.4	Materials	-	-	-	-	-	-	5-5
5.4.5	Maintenance	-	-	-	-	-	-	5-7
5.5	Construction Entrance Stabilization	-	-	-	-	-	-	5-8
5.5.1	Control Description	-	-	-	-	-	-	5-8
5.5.2	Control Uses and Applicability	-	-	-	-	-	-	5-8
5.5.3	Design Criteria	-	-	-	-	-	-	5-8
5.5.4	Materials	-	-	-	-	-	-	5-9
5.5.5	Maintenance	-	-	-	-	-	-	5-9
5.6	Temporary Berms	-	-	-	-	-	-	5-10
5.6.1	Control Description	-	-	-	-	-	-	5-10
5.6.2	Control Uses and Applicability	-	-	-	-	-	-	5-10
5.6.3	Design Criteria	-	-	-	-	-	-	5-10
5.6.4	Materials	-	-	-	-	-	-	5-10
5.6.5	Maintenance	-	-	-	-	-	-	5-11
5.7	Contour Ditches	-	-	-	-	-	-	5-12
5.7.1	Control Description	-	-	-	-	-	-	5-12
5.7.2	Control Uses and Applicability	-	-	-	-	-	-	5-12
5.7.3	Design Criteria	-	-	-	-	-	-	5-12
5.7.4	Materials	-	-	-	-	-	-	5-13
5.7.5	Maintenance	-	-	-	-	-	-	5-13
5.8	Check Dams	-	-	-	-	-	-	5-14
5.8.1	Control Description	-	-	-	-	-	-	5-14
5.8.2	Control Uses and Applicability	-	-	-	-	-	-	5-14



**This page is intentionally left blank.**

TABLE OF CONTENTS  
City of Charleston Stormwater Manual

5.8.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-14
5.8.4	Materials	-	-	-	-	-	-	-	-	-	-	5-15
5.8.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-16
5.9	Silt Fence and Other Temporary Filtering Devices	-	-	-	-	-	-	-	-	-	-	5-18
5.9.1	Control Description	-	-	-	-	-	-	-	-	-	-	5-18
5.9.2	Control Uses and Applicability	-	-	-	-	-	-	-	-	-	-	5-18
5.9.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-18
5.9.4	Materials	-	-	-	-	-	-	-	-	-	-	5-19
5.9.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-19
5.10	Vegetative Buffer Strip	-	-	-	-	-	-	-	-	-	-	5-24
5.10.1	Control Description	-	-	-	-	-	-	-	-	-	-	5-24
5.10.2	Control Uses and Applicability	-	-	-	-	-	-	-	-	-	-	5-24
5.10.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-24
5.10.4	Materials	-	-	-	-	-	-	-	-	-	-	5-25
5.10.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-25
5.11	Erosion Control Matting	-	-	-	-	-	-	-	-	-	-	5-26
5.11.1	Control Description	-	-	-	-	-	-	-	-	-	-	5-26
5.11.2	Control Uses and Applicability	-	-	-	-	-	-	-	-	-	-	5-26
5.11.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-26
5.11.4	Materials	-	-	-	-	-	-	-	-	-	-	5-27
5.11.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-27
5.12	Outlet Protection	-	-	-	-	-	-	-	-	-	-	5-30
5.12.1	Control Description	-	-	-	-	-	-	-	-	-	-	5-30
5.12.2	Control Uses and Applicability	-	-	-	-	-	-	-	-	-	-	5-30
5.12.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-30
5.12.4	Materials	-	-	-	-	-	-	-	-	-	-	5-32
5.12.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-32
5.13	Level Spreaders	-	-	-	-	-	-	-	-	-	-	5-33
5.13.1	Control Description	-	-	-	-	-	-	-	-	-	-	5-33
5.13.2	Control Uses and Applicability	-	-	-	-	-	-	-	-	-	-	5-33
5.13.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-33
5.13.4	Materials	-	-	-	-	-	-	-	-	-	-	5-34
5.13.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-34
5.14	Sediment Traps	-	-	-	-	-	-	-	-	-	-	5-35
5.14.1	Control Description	-	-	-	-	-	-	-	-	-	-	5-35
5.14.2	Control Uses and Applicability	-	-	-	-	-	-	-	-	-	-	5-35
5.14.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-35
5.14.4	Materials	-	-	-	-	-	-	-	-	-	-	5-36
5.14.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-36
5.15	Sediment Ponds	-	-	-	-	-	-	-	-	-	-	5-38
5.15.1	Control Description	-	-	-	-	-	-	-	-	-	-	5-38
5.15.2	Control Uses and Applicability	-	-	-	-	-	-	-	-	-	-	5-38
5.15.3	Design Criteria	-	-	-	-	-	-	-	-	-	-	5-38
5.15.4	Materials	-	-	-	-	-	-	-	-	-	-	5-39
5.15.5	Maintenance	-	-	-	-	-	-	-	-	-	-	5-39
<b>Chapter 6 Post Construction Runoff Control</b>												<b>6-1</b>
6.0	Introduction	-	-	-	-	-	-	-	-	-	-	6-1
6.1	Stormwater Pollution Prevention Plan (SWPPP) for Post Construction	-	-	-	-	-	-	-	-	-	-	6-2



**This page is intentionally left blank.**

TABLE OF CONTENTS  
City of Charleston Stormwater Manual

6.2	Stormwater Management Facilities Maintenance Agreement	-	-	-	-	6-3
6.3	Post-Construction Measures and Alternative Measures	-	-	-	-	6-4
6.4	Swales -	-	-	-	-	6-5
6.4.1	Device Description	-	-	-	-	6-5
6.4.2	Key Elements	-	-	-	-	6-5
6.4.3	Device Uses and Applicability	-	-	-	-	6-6
6.4.4	Swales in the Urban Landscape	-	-	-	-	6-6
6.4.5	Components of a Filter System	-	-	-	-	6-7
6.4.6	Recommended Design Procedures	-	-	-	-	6-8
6.4.7	Infiltration Credit	-	-	-	-	6-9
6.4.8	Materials	-	-	-	-	6-10
6.4.9	Construction Guidelines	-	-	-	-	6-11
6.4.10	Maintenance	-	-	-	-	6-12
6.5	Filter Strips	-	-	-	-	6-13
6.5.1	Device Description	-	-	-	-	6-13
6.5.2	Key Elements	-	-	-	-	6-13
6.5.3	Device Uses and Applicability	-	-	-	-	6-14
6.5.4	Filter Strips in the Urban Landscape-	-	-	-	-	6-14
6.5.5	Components of a Filter Strip System	-	-	-	-	6-14
6.5.6	Recommended Design Procedures	-	-	-	-	6-15
6.5.7	Infiltration Credit	-	-	-	-	6-16
6.5.8	Materials	-	-	-	-	6-16
6.5.9	Construction Guidelines	-	-	-	-	6-17
6.5.10	Maintenance	-	-	-	-	6-18
6.6	Bioretention	-	-	-	-	6-19
6.6.1	Device Description	-	-	-	-	6-19
6.6.2	Key Elements	-	-	-	-	6-19
6.6.3	Device Uses and Applicability	-	-	-	-	6-20
6.6.4	Bioretention in the Urban Landscape	-	-	-	-	6-20
6.6.5	Components of a Bioretention System	-	-	-	-	6-22
6.6.6	Recommended Design Procedures	-	-	-	-	6-24
6.6.7	Infiltration Credit	-	-	-	-	6-26
6.6.8	Materials	-	-	-	-	6-27
6.6.9	Construction Guidelines	-	-	-	-	6-28
6.6.10	Maintenance	-	-	-	-	6-30
6.7	Filters -	-	-	-	-	6-31
6.7.1	Device Description	-	-	-	-	6-31
6.7.2	Key Elements	-	-	-	-	6-31
6.7.3	Device Uses and Applicability	-	-	-	-	6-31
6.7.4	Filters in the Urban Landscape	-	-	-	-	6-32
6.7.5	Components of Stormwater Filter System	-	-	-	-	6-33
6.7.6	Recommended Design Procedures	-	-	-	-	6-35
6.7.7	Infiltration Credit	-	-	-	-	6-36
6.7.8	Materials	-	-	-	-	6-36
6.7.9	Construction Guidelines	-	-	-	-	6-37
6.7.10	Maintenance	-	-	-	-	6-38
6.6.11	Manufactured Filters	-	-	-	-	6-39
6.8	Infiltration Systems	-	-	-	-	6-41
6.8.1	Device Description	-	-	-	-	6-41



**This page is intentionally left blank.**

TABLE OF CONTENTS  
City of Charleston Stormwater Manual

6.8.2	Key Elements	-	-	-	-	-	-	-	-	-	6-41
6.8.3	Device Uses and Applicability	-	-	-	-	-	-	-	-	-	6-41
6.8.4	Infiltration in the Urban Landscape	-	-	-	-	-	-	-	-	-	6-42
6.8.5	Components of a Infiltration System	-	-	-	-	-	-	-	-	-	6-43
6.8.6	Recommended Design Procedures	-	-	-	-	-	-	-	-	-	6-45
6.8.7	Infiltration Credit	-	-	-	-	-	-	-	-	-	6-46
6.8.8	Materials	-	-	-	-	-	-	-	-	-	6-46
6.8.9	Construction Guidelines	-	-	-	-	-	-	-	-	-	6-47
6.8.10	Maintenance	-	-	-	-	-	-	-	-	-	6-48
6.9	Green Roofs	-	-	-	-	-	-	-	-	-	6-49
6.9.1	Device Description	-	-	-	-	-	-	-	-	-	6-49
6.9.2	Key Elements	-	-	-	-	-	-	-	-	-	6-49
6.9.3	Uses and Applicability	-	-	-	-	-	-	-	-	-	6-50
6.9.4	Green Roofs in the Urban Landscape	-	-	-	-	-	-	-	-	-	6-50
6.9.5	Components of a Green Roofs	-	-	-	-	-	-	-	-	-	6-50
6.9.6	Recommended Design Procedures	-	-	-	-	-	-	-	-	-	6-52
6.9.7	Infiltration Credit	-	-	-	-	-	-	-	-	-	6-52
6.9.8	Materials	-	-	-	-	-	-	-	-	-	6-53
6.9.9	Construction Guidelines	-	-	-	-	-	-	-	-	-	6-53
6.8.10	Maintenance	-	-	-	-	-	-	-	-	-	6-55
6.10	Rainwater Harvesting	-	-	-	-	-	-	-	-	-	6-57
6.10.1	Device Description	-	-	-	-	-	-	-	-	-	6-57
6.10.2	Key Elements	-	-	-	-	-	-	-	-	-	6-57
6.10.3	Device Uses and Applicability	-	-	-	-	-	-	-	-	-	6-57
6.10.4	Rainwater Harvesting in the Urban Landscape	-	-	-	-	-	-	-	-	-	6-58
6.10.5	Recommended Design Procedures	-	-	-	-	-	-	-	-	-	6-59
6.10.6	Infiltration Credit	-	-	-	-	-	-	-	-	-	6-60
6.10.7	Maintenance	-	-	-	-	-	-	-	-	-	6-60
6.11	Permeable Pavement	-	-	-	-	-	-	-	-	-	6-61
6.11.1	Device Description	-	-	-	-	-	-	-	-	-	6-61
6.11.2	Key Elements	-	-	-	-	-	-	-	-	-	6-61
6.11.3	Device Uses and Applicability	-	-	-	-	-	-	-	-	-	6-62
6.11.4	Permeable Pavement in the Urban Landscape	-	-	-	-	-	-	-	-	-	6-62
6.11.5	Components of a Permeable Pavement System	-	-	-	-	-	-	-	-	-	6-63
6.11.6	Recommended Design Procedures	-	-	-	-	-	-	-	-	-	6-65
6.11.7	Infiltration Credit	-	-	-	-	-	-	-	-	-	6-66
6.11.8	Materials	-	-	-	-	-	-	-	-	-	6-67
6.11.9	Construction Guidelines	-	-	-	-	-	-	-	-	-	6-68
6.11.10	Maintenance	-	-	-	-	-	-	-	-	-	6-71
6.12	Impervious Surface Disconnection	-	-	-	-	-	-	-	-	-	6-73
6.12.1	Device Description	-	-	-	-	-	-	-	-	-	6-73
6.12.2	Key Elements	-	-	-	-	-	-	-	-	-	6-73
6.12.3	Device Uses and Applicability	-	-	-	-	-	-	-	-	-	6-73
6.12.4	Impervious Surface Disconnection in the Urban Landscape	-	-	-	-	-	-	-	-	-	6-73
6.12.5	Recommended Design Procedures	-	-	-	-	-	-	-	-	-	6-75
6.12.6	Infiltration Credit	-	-	-	-	-	-	-	-	-	6-77
6.12.7	Construction Guidelines	-	-	-	-	-	-	-	-	-	6-77
6.12.8	Maintenance	-	-	-	-	-	-	-	-	-	6-78
6.13	Detention Basins	-	-	-	-	-	-	-	-	-	6-79



**This page is intentionally left blank.**

TABLE OF CONTENTS  
City of Charleston Stormwater Manual

6.14	Stormwater Wetlands	- - - - -	6-81
6.15	Subsurface Vaults	- - - - -	6-83

<b>Chapter 7 Illicit Discharge Detection and Elimination Program</b>	<b>7-1</b>		
7.0	Introduction	- - - - -	7-1
7.1	Types of Direct Illicit Discharge	- - - - -	7-2
7.1.1	Direct Discharges	- - - - -	7-2
7.1.2	Indirect Discharges	- - - - -	7-3
7.1.3	Excluded Discharges	- - - - -	7-4
7.1.4	Watercourse Protection	- - - - -	7-5
7.1.5	Requirement	- - - - -	7-5
7.1.6	Notification of spill	- - - - -	7-6
7.1.7	Notice of Violation	- - - - -	7-6
7.1.8	Violations Deemed a Public Nuisance	- - - - -	7-7
7.2	Components of the City's IDDE Program	- - - - -	7-8

<b>Chapter 8 Pollution Prevention and Operation and Maintenance and Municipal Operations</b>	<b>8-1</b>		
8.0	Introduction	- - - - -	8-1
8.1	Pollution Prevention/Good Housekeeping Plan	- - - - -	8-3

<b>Chapter 9 The Sanitary Board of The City of Charleston, West Virginia, A Municipal Utility</b>	<b>9-1</b>		
9.0	Introduction	- - - - -	9-1
9.1	Connection to CSB Sanitary Sewer System (other than new subdivision)	- - - - -	9-3
9.2	Connection to CSB Combined Sewer System (other than new subdivision)	- - - - -	9-5
9.3	Connection to Subdivisions to CSB Sewers	- - - - -	9-7
9.4	Demolition of Existing Structures Connected to CSB Sanitary and Combined Sewers	- - - - -	9-9

**Abbreviations & Acronyms**

**Glossary**

**References**

**List of Appendices**

Appendix A	Homeowner's Guide
Appendix B	Stormwater Permitting Matrix & Forms
Appendix C	Planting list
Appendix D	Land Use Development Procedures
Appendix E	Landslide Prone Area Maps from WVGES Geologic Bulletin No. 15
Appendix F	Infiltration Test Smaller Sites
Appendix G	Infiltration Test Larger Sites



**This page is intentionally left blank.**