

# Southern Lowcountry Stormwater Design Manual

Stormwater Best Management Practices

Prepared by



September 14, 2021

**Lead Authors:**

Bill Hodgins, P.E., Center for Watershed Protection

Greg Hoffmann, P.E., Center for Watershed Protection

Kathryn Ellis, EIT, McCormick Taylor

**Southern Lowcountry Stormwater Technical Subcommittee:**

Neil Desai, P.E., Beaufort County/ formerly City of Beaufort

Nate Farrow, City of Beaufort

Katie Herrera, CEPSCI, CSPR, Beaufort County

Kimberly Jones, MS, CEPSCI, Town of Bluffton

Eric Larson, P.E., formerly Beaufort County

Rhett Lott, City of Hardeeville

Bryan McIlwee, P.E., Town of Bluffton

Neal Pugliese, City of Beaufort

Daniel Rybak, Town of Bluffton/ formerly Beaufort County

Lisa Wagner, CFM, Jasper County

Van Willis, Town of Port Royal

**Consultant Team:**

Jordan Fox, Center for Watershed Protection

Laura Gardner, P.E., formerly Center for Watershed Protection

Jason Hetrick, P.E., CFM, McCormick Taylor

Sarah Ryan, formerly Center for Watershed Protection

Nehemiah Stewart, McCormick Taylor

Ellen Zagrobelny, Center for Watershed Protection

# Table of Contents

<b>CHAPTER 1. INTRODUCTION, BACKGROUND, PURPOSE, AND ADMINISTRATION .....</b>	<b>1</b>
1.1 INTRODUCTION .....	1
1.2 BACKGROUND.....	1
1.3 PURPOSE.....	2
1.4 APPLICABILITY AND EXEMPTIONS.....	2
1.4.1 <i>Applicability</i> .....	2
1.4.2 <i>Exemptions</i> .....	2
1.5 ADMINISTRATION .....	3
1.5.1 <i>Approval Requirements</i> .....	3
1.5.2 <i>Fees</i> .....	3
<b>CHAPTER 2. DESIGN, REVIEW, &amp; PERMITTING PROCESS .....</b>	<b>4</b>
2.1 SATISFYING THE STORMWATER MANAGEMENT, SITE PLANNING, & DESIGN CRITERIA.....	4
2.1.1 <i>Overview</i> .....	4
2.1.2 <i>Better Site Design in the Planning Process</i> .....	4
2.1.3 <i>Natural Resources Inventory</i> .....	6
2.1.4 <i>Conservation Development</i> .....	8
2.1.5 <i>Residential Streets &amp; Parking Lots</i> .....	9
2.1.6 <i>Lot Development Principles to Meet Requirements</i> .....	10
2.1.7 <i>Site Planning &amp; Design Process</i> .....	12
2.1.8 <i>Integrating Natural Resource Protection &amp; Stormwater Management with the Site Planning &amp; Design Process</i> .....	15
2.2 SUBMITTAL & REVIEW PROCESS OF STORMWATER MANAGEMENT PLANS .....	19
2.2.1 <i>Components of a Stormwater Management Plan</i> .....	20
2.2.2 <i>Resubmission of Stormwater Management Plans</i> .....	23
2.2.3 <i>Design Certifications</i> .....	24
2.2.4 <i>Performance Bonds</i> .....	24
2.3 CONSTRUCTION INSPECTION REQUIREMENTS.....	25
2.3.1 <i>Inspection Schedule &amp; Reports</i> .....	25
2.3.2 <i>Inspection Requirements Before &amp; During Construction</i> .....	25
2.3.3 <i>Final Construction Inspection Reports</i> .....	27
2.3.4 <i>Inspection for Preventative Maintenance</i> .....	27
2.4 INSPECTIONS & MAINTENANCE.....	28
2.4.1 <i>Inspections &amp; Maintenance Responsibilities</i> .....	28
2.4.2 <i>Inspection &amp; Maintenance Agreements</i> .....	28
2.5 AS-BUILT SUBMITTALS .....	29
2.6 REFERENCES.....	30
<b>CHAPTER 3. MINIMUM CONTROL REQUIREMENTS.....</b>	<b>32</b>
3.1 INTRODUCTION .....	32
3.2 REGULATED SITE DEFINITION .....	32
3.3 INFILL & REDEVELOPMENT .....	34
3.4 STORMWATER RUNOFF QUALITY & PEAK DISCHARGE CONTROL.....	34
3.5 SOUTHERN LOWCOUNTRY STORMWATER MANAGEMENT PERFORMANCE REQUIREMENTS.....	35
3.5.1 <i>Watershed Protection Area Designations</i> .....	35
3.5.2 <i>Overall Performance Requirements</i> .....	38

3.5.3	<i>Southern Lowcountry Stormwater Precipitation &amp; Runoff</i> .....	40
3.5.4	<i>Savannah River Watershed Protection Area</i> .....	40
3.5.5	<i>Bacteria &amp; Shellfish Watershed Protection Area</i> .....	41
3.5.6	<i>General Stormwater Management Watershed Area</i> .....	41
3.5.7	<i>Runoff Reduction &amp; Pollutant Removal</i> .....	41
3.6	EROSION & SEDIMENT CONTROL (ESC) REQUIREMENTS.....	43
3.7	RETENTION STANDARD & VOLUME.....	43
3.7.1	<i>Total Suspended Solids, Nutrients, &amp; Bacteria</i> .....	45
3.7.2	<i>Hydrologic &amp; Hydraulic Analysis</i> .....	45
3.7.3	<i>Maintenance Easements</i> .....	47
3.8	EXTREME FLOOD REQUIREMENT: 10% RULE.....	48
3.9	MAXIMUM EXTENT PRACTICABLE.....	49
3.10	OFF-SITE STORMWATER MANAGEMENT.....	50
3.11	FEE-IN-LIEU.....	51
3.12	WAIVERS.....	51
3.13	REFERENCES.....	52
<b>CHAPTER 4. STORMWATER BEST MANAGEMENT PRACTICES (BMPS)</b> .....		<b>54</b>
4.1	STANDARD STORMWATER BMP DESIGN SECTIONS.....	54
4.1.1	<i>Format of Standard Stormwater BMP Design Sections</i> .....	54
4.1.2	<i>Standard Nomenclature</i> .....	54
4.2	SUMMARY OF BMP STORMWATER MANAGEMENT CAPABILITIES, SITE APPLICABILITY, & PHYSICAL FEASIBILITY.....	54
4.2.1	<i>Stormwater Retention &amp; Water Quality Treatment</i> .....	55
4.2.2	<i>Site Applicability</i> .....	55
4.2.3	<i>Site Conditions &amp; Physical Feasibility</i> .....	56
4.3	BIORETENTION.....	58
4.3.1	<i>Bioretention Feasibility Criteria</i> .....	62
4.3.2	<i>Bioretention Conveyance Criteria</i> .....	65
4.3.3	<i>Bioretention Pretreatment Criteria</i> .....	67
4.3.4	<i>Bioretention Design Criteria</i> .....	68
4.3.5	<i>Bioretention Landscaping Criteria</i> .....	82
4.3.6	<i>Bioretention Construction Sequence</i> .....	88
4.3.7	<i>Bioretention Maintenance Criteria</i> .....	90
4.3.8	<i>Bioretention Stormwater Compliance Calculations</i> .....	92
4.3.9	<i>References</i> .....	93
4.4	PERMEABLE PAVEMENT SYSTEMS.....	96
4.4.1	<i>Permeable Pavement Feasibility Criteria</i> .....	99
4.4.2	<i>Permeable Pavement Conveyance Criteria</i> .....	102
4.4.3	<i>Permeable Pavement Pretreatment Criteria</i> .....	102
4.4.4	<i>Permeable Pavement Design Criteria</i> .....	102
4.4.5	<i>Permeable Pavement Landscaping Criteria</i> .....	109
4.4.6	<i>Permeable Pavement Construction Sequence</i> .....	109
4.4.7	<i>Permeable Pavement Maintenance Criteria</i> .....	114
4.4.8	<i>Permeable Pavement Stormwater Compliance Calculations</i> .....	115
4.4.9	<i>References</i> .....	117
4.5	INFILTRATION PRACTICES.....	118
4.5.1	<i>Infiltration Feasibility Criteria</i> .....	123
4.5.2	<i>Infiltration Conveyance Criteria</i> .....	125
4.5.3	<i>Infiltration Pretreatment Criteria</i> .....	126

4.5.4	<i>Infiltration Design Criteria</i>	126
4.5.5	<i>Infiltration Landscaping Criteria</i>	130
4.5.6	<i>Infiltration Construction Sequence</i>	130
4.5.7	<i>Infiltration Maintenance Criteria</i>	132
4.5.8	<i>Infiltration Stormwater Compliance Calculations</i>	133
4.5.9	<i>References</i>	134
4.6	<b>GREEN ROOFS</b>	135
4.6.1	<i>Green Roof Feasibility Criteria</i>	137
4.6.2	<i>Green Roof Conveyance Criteria</i>	139
4.6.3	<i>Green Roof Pretreatment Criteria</i>	139
4.6.4	<i>Green Roof Design Criteria</i>	139
4.6.5	<i>Green Roof Landscaping Criteria</i>	145
4.6.6	<i>Green Roof Construction Sequence</i>	147
4.6.7	<i>Green Roof Maintenance Criteria</i>	148
4.6.8	<i>Green Roof Stormwater Compliance Calculations</i>	149
4.6.9	<i>References</i>	150
4.7	<b>RAINWATER HARVESTING</b>	151
4.7.1	<i>Rainwater Harvesting Feasibility Criteria</i>	154
4.7.2	<i>Rainwater Harvesting Conveyance Criteria</i>	157
4.7.3	<i>Rainwater Harvesting Pretreatment Criteria</i>	157
4.7.4	<i>Rainwater Harvesting Design Criteria</i>	159
4.7.5	<i>Rainwater Harvesting Landscaping Criteria</i>	170
4.7.6	<i>Rainwater Harvesting Construction Sequence</i>	170
4.7.7	<i>Rainwater Harvesting Maintenance Criteria</i>	171
4.7.8	<i>Rainwater Harvesting Stormwater Compliance Calculations</i>	172
4.7.9	<i>References</i>	173
4.8	<b>IMPERVIOUS SURFACE DISCONNECTION</b>	175
4.8.1	<i>Impervious Surface Disconnection Feasibility Criteria</i>	176
4.8.2	<i>Impervious Surface Disconnection Conveyance Criteria</i>	177
4.8.3	<i>Impervious Surface Disconnection Pretreatment Criteria</i>	177
4.8.4	<i>Impervious Surface Disconnection Design Criteria</i>	177
4.8.5	<i>Impervious Surface Disconnection Landscaping Criteria</i>	178
4.8.6	<i>Impervious Surface Disconnection Construction Sequence</i>	178
4.8.7	<i>Impervious Surface Disconnection Maintenance Criteria</i>	179
4.8.8	<i>Impervious Surface Disconnection Stormwater Compliance Calculations</i>	179
4.8.9	<i>References</i>	180
4.9	<b>OPEN CHANNEL SYSTEMS</b>	181
4.9.1	<i>Open Channel Feasibility Criteria</i>	186
4.9.2	<i>Open Channel Conveyance Criteria</i>	189
4.9.3	<i>Open Channel Pretreatment Criteria</i>	189
4.9.4	<i>Open Channel Design Criteria</i>	190
4.9.5	<i>Open Channel Landscaping Criteria</i>	203
4.9.6	<i>Open Channel Construction Sequence</i>	204
4.9.7	<i>Open Channel Maintenance Criteria</i>	206
4.9.8	<i>Open Channel Stormwater Compliance Calculations</i>	207
4.9.9	<i>References</i>	209
4.10	<b>FILTERING SYSTEMS</b>	211
4.10.1	<i>Filtering System Feasibility Criteria</i>	220
4.10.2	<i>Filtering System Conveyance Criteria</i>	221

4.10.3	<i>Filtering System Pretreatment Criteria</i>	222
4.10.4	<i>Filtering System Design Criteria</i>	222
4.10.5	<i>Filtering System Landscaping Criteria</i>	227
4.10.6	<i>Filtering System Construction Sequence</i>	227
4.10.7	<i>Filtering System Maintenance Criteria</i>	229
4.10.8	<i>Filtering System Stormwater Compliance Calculations</i>	230
4.10.9	<i>References</i>	230
4.11	<b>STORAGE PRACTICES</b>	232
4.11.1	<i>Storage Feasibility Criteria</i>	235
4.11.2	<i>Storage Conveyance Criteria</i>	237
4.11.3	<i>Storage Pretreatment Criteria</i>	238
4.11.4	<i>Storage Design Criteria</i>	239
4.11.5	<i>Storage Landscaping Criteria</i>	240
4.11.6	<i>Storage Construction Sequence</i>	241
4.11.7	<i>Storage Maintenance Criteria</i>	243
4.11.8	<i>Storage Stormwater Compliance Calculations</i>	244
4.11.9	<i>References</i>	244
4.12	<b>PONDS</b>	245
4.12.1	<i>Pond Feasibility Criteria</i>	249
4.12.2	<i>Pond Conveyance Criteria</i>	250
4.12.3	<i>Pond Pretreatment Criteria</i>	252
4.12.4	<i>Pond Design Criteria</i>	252
4.12.5	<i>Pond Landscaping Criteria</i>	257
4.12.6	<i>Pond Construction Sequence</i>	258
4.12.7	<i>Pond Maintenance Criteria</i>	259
4.12.8	<i>Pond Stormwater Compliance Calculations</i>	261
4.12.9	<i>References</i>	261
4.13	<b>STORMWATER WETLANDS</b>	264
4.13.1	<i>Stormwater Wetland Feasibility Criteria</i>	268
4.13.2	<i>Stormwater Wetland Conveyance Criteria</i>	270
4.13.3	<i>Stormwater Wetland Pretreatment Criteria</i>	270
4.13.4	<i>Stormwater Wetland Design Criteria</i>	271
4.13.5	<i>Stormwater Wetland Construction Sequence</i>	273
4.13.6	<i>Stormwater Wetland Landscaping Criteria</i>	276
4.13.7	<i>Stormwater Wetland Maintenance Criteria</i>	281
4.13.8	<i>Stormwater Wetland Stormwater Compliance Calculations</i>	282
4.13.9	<i>References</i>	282
4.14	<b>TREE PLANTING &amp; PRESERVATION</b>	283
4.14.1	<i>Preserving Existing Trees during Construction</i>	284
4.14.2	<i>Planting Trees</i>	287
4.14.3	<i>Tree Inspection Criteria</i>	292
4.14.4	<i>Tree Maintenance Criteria</i>	292
4.14.5	<i>Tree Stormwater Compliance Calculations</i>	293
4.14.6	<i>References</i>	293
4.15	<b>PROPRIETARY PRACTICES</b>	297
4.15.1	<i>Proprietary Practice Feasibility Criteria</i>	298
4.15.2	<i>Proprietary Practice Conveyance Criteria</i>	298
4.15.3	<i>Proprietary Practice Pretreatment Criteria</i>	298
4.15.4	<i>Proprietary Practice Design Criteria</i>	298

4.15.5	<i>Proprietary Practice Landscaping Criteria</i> .....	299
4.15.6	<i>Proprietary Practice Construction Sequence</i> .....	299
4.15.7	<i>Proprietary Practice Maintenance Criteria</i> .....	299
4.15.8	<i>Proprietary Practice Stormwater Compliance Calculations</i> .....	299
4.15.9	<i>References</i> .....	299
4.16	CONSERVATION AREA .....	301
4.16.1	<i>Scenario 1: Natural Conservation Area</i> .....	301
4.16.2	<i>Scenario 2: Reforestation/Revegetation</i> .....	301
4.16.3	<i>Scenario 3: Soil Restoration</i> .....	301
4.16.4	<i>Scenario 4: Reforestation/Revegetation &amp; Soil Restoration</i> .....	301
<b>CHAPTER 5. EROSION &amp; SEDIMENT CONTROL</b> .....		<b>302</b>
5.1	SEDIMENTATION CYCLE.....	302
5.2	FACTORS INFLUENCING EROSION .....	302
5.3	CONCEPTS OF EROSION & SEDIMENT CONTROL .....	302
5.4	GENERAL CRITERIA.....	303
5.5	REFERENCES.....	304
<b>CHAPTER 6. ENFORCEMENT &amp; VIOLATIONS</b> .....		<b>305</b>

## List of Figures

### Chapter 2

Figure 2.1.	Conservation (i.e., cluster) development versus conventional development.....	8
Figure 2.2.	Site planning & design process (source: Center for Watershed Protection, Inc.) .....	12
Figure 2.3.	Conventional Site Design (source: Merrill et al., 2006). .....	14
Figure 2.4.	Conservation Site Design (source: Merrill et al., 2006). .....	14
Figure 2.5.	New Urbanist Site Design (source: Merrill et al., 2006).....	15
Figure 2.6.	Integrating Natural Resource Protection & Stormwater Management with the Site Planning & Design Process (source: Center for Watershed Protection, Inc.) .....	17
Figure 2.7.	Buildable Area and Primary/Secondary Conservation Areas (source: Merrill et al., 2006).....	18

### Chapter 3

Figure 3.1.	Southern Lowcountry Stormwater Design Manual applicability diagram.....	33
Figure 3.2.	Watershed Protection Areas of the Southern Lowcountry. ....	37

### Chapter 4

Figure 4.1.	Bioretention in parking lot (photo credit: Center for Watershed Protection, Inc.).....	59
Figure 4.2.	Example bioretention design without an underdrain.....	60
Figure 4.3.	Example bioretention design with internal water storage (IWS). .....	61
Figure 4.4.	Example standard bioretention design.....	61
Figure 4.5.	Example streetscape bioretention.....	62
Figure 4.6.	Example design of an on-line bioretention with an overflow structure.....	67
Figure 4.7.	Example design of a bioretention with an observation well/cleanout device. ....	74
Figure 4.8.	Example design of a tree box.....	78
Figure 4.9.	Example design of a tree box with compacted media extending below sidewalk. ....	79
Figure 4.10.	Example design of a stormwater planter (B-4). ....	80

Figure 4.11. Cross-section of permeable pavement (source: ICPI).....	97
Figure 4.12. Cross-section of a standard permeable pavement design. ....	98
Figure 4.13. Cross-section of an enhanced permeable pavement design with an underdrain.....	99
Figure 4.14. Cross-section of an enhanced permeable pavement design without an underdrain. ....	99
Figure 4.15. Use of flow barriers to encourage infiltration on sloped sites. ....	103
Figure 4.16. Infiltration practice in median strip. ....	119
Figure 4.17. Example design of an infiltration trench.....	120
Figure 4.18. Example design of an infiltration practice with supplemental pipe storage. ....	121
Figure 4.19. Example design of an infiltration basin.....	122
Figure 4.20. Green roof (photo: Center for Watershed Protection, Inc.).....	136
Figure 4.21. Green roof layers (note: the relative placement of various layers may vary depending on the type and design of the green roof system). ....	140
Figure 4.22. Design requirements for structures constructed above green roofs. ....	144
Figure 4.23. Example cistern application (photo: Marty Morganello).....	152
Figure 4.24. Example of a rainwater harvesting system detail.....	154
Figure 4.25. Diagram of a first flush diverter (photo: Texas Water Development Board, 2005). ....	158
Figure 4.26. Diagram of a roof washer (photo: Texas Water Development Board, 2005).....	159
Figure 4.27. Cistern Design 1: Storage associated with the design storm volume only. ....	163
Figure 4.28. Cistern Design 2: Storage associated with design storm, channel protection, and flood volume. ....	164
Figure 4.29. Cistern Design 3: Constant drawdown version where storage is associated with design storm, channel protection, and flood volume. ....	165
Figure 4.30. Incremental design volumes associated with cistern sizing. ....	167
Figure 4.31. Example of graph showing Average Available Storage Volume and Overflow Volume for an example cistern design. ....	169
Figure 4.32. Rooftop disconnection (photo: Center for Watershed Protection, Inc.).....	176
Figure 4.33. Open channel (photo: Center for Watershed Protection, Inc.).....	182
Figure 4.34. Grass channel typical plan, profile, and section views (O-1).....	183
Figure 4.35. Example of a dry swale/bioswale (O-2). ....	184
Figure 4.36. Example of a wet swale (O-3). ....	185
Figure 4.37. Example of Regenerative Stormwater Conveyance (O-4). ....	186
Figure 4.38. Typical Width and Depth of Riffle Sections (Anne Arundel County, 2011).....	202
Figure 4.39. Typical schematic for a nonstructural or surface sand filter (note: material specifications are found in Table 4.44). ....	213
Figure 4.40. Example of a three-chamber underground sand filter (F-3) for separate sewer options. Part A. Note: material specifications are indicated in Table 4.44. ....	214
Figure 4.41. Example of a three-chamber underground sand filter (F-3) for separate sewer areas. Part B. Note: material specifications are indicated in Table 4.44. ....	215
Figure 4.42. Example of a three-chamber underground sand filter (F-3) for separate sewer areas. Part C. Note: material specifications are indicated in Table 4.44. ....	216
Figure 4.43. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part A. Note: Material specifications are indicated in Table 4.44. ....	217
Figure 4.44. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part B. Note: Material specifications are indicated in Table 4.44. ....	218



Figure 4.45. Example of a three-chamber underground sand filter (F-3) for combined sewer areas. Part C. Note: Material specifications are indicated in Table 4.44. ....	219
Figure 4.46. Example of a perimeter sand filter (F-4). Note: material specifications are indicated in Table 4.44. ....	220
Figure 4.47. Dry Extended Detention Pond (Photo: Center for Watershed Protection, Inc.) .....	233
Figure 4.45 Example of an underground detention vault and/or tank (S-1). ....	234
Figure 4.46 Example of a dry detention pond (S-2). ....	235
Figure 4.47 Wet Pond (photo: Denise Sanger) .....	246
Figure 4. 48 Design schematics for a wet pond (C-2).....	247
Figure 4. 49 Typical extended detention pond (C-3) details.....	248
Figure 4.50 Stormwater Wetland at Carolina Forest Recreation Center, Myrtle Beach (photo: Kathryn Ellis). ....	265
Figure 4.51 Example of extended detention shallow wetland. ....	267
Figure 4.52 Cross section of a typical stormwater wetland.....	268
Figure 4.53 Interior wetland zones. Adapted from Hunt et al. (2007). ....	268
Figure 4.54 Tree Planting and Preservation in Bioretention (photo: Center for Watershed Protection, Inc.). ....	284
Figure 4.55. Tree planting guidelines. Adapted from Flott, 2004 and ISA, 2003b.....	290
Figure 4.56 Trees planted on steep slopes require a constructed level planting surface. ....	291

## List of Tables

### Chapter 2

Table 2. 1. Summary of land cover changes in Southern Lowcountry from 1996 to 2010. ....	5
Table 2.2. Resources to be identified and mapped during the Natural Resources Inventory.....	7
Table 2. 3. Better Site Design principles for conservation. ....	9
Table 2.4. Better Site Design principles for streets and parking to meet <local jurisdiction> requirements. ....	10
Table 2. 5. Better Site Design principles for lot development. ....	11

### Chapter 3

Table 3.1. Watershed Protection Area HUC-12 Codes. ....	38
Table 3.2. Watershed Area Overall Performance Requirements. ....	39
Table 3.3. Pollutant Removal Efficiencies of Structural BMPs.....	42
Table 3.4. Rainfall depth (inches) for the Southern Lowcountry.....	46
Table 3.5. Drainage maintenance access easements. ....	48

### Chapter 4

Table 4.1. Site applicability for BMPs.....	55
Table 4.2. Feasibility limitations for BMPs.....	57
Table 4.3. Maximum contributing drainage area (CDA) to bioretention.....	63
Table 4.4. Filter media grain size distribution.....	71
Table 4.5. Summary of filter media criteria for bioretention. ....	72
Table 4.6. Bioretention material specifications. ....	76
Table 4.7. Bioretention-appropriate plants: perennial and grass.....	83

Table 4.8. Bioretention-appropriate plants: shrubs and bushes .....	86
Table 4.9. Typical maintenance tasks for bioretention practices. ....	91
Table 4.10. Retention and pollutant removal for bioretention practices without underdrains. ....	92
Table 4.11. Retention and pollutant removal for bioretention practices with IWS design.....	93
Table 4.12. Retention and pollutant removal for standard bioretention practices. ....	93
Table 4.13. Permeable pavement specifications for a variety of typical surface materials. ....	105
Table 4.14. Material specifications for typical layers beneath the surface of permeable pavements.....	106
Table 4.15. Typical maintenance tasks for permeable pavement practices.....	115
Table 4.16. Retention and pollutant removal for enhanced permeable pavement practices. ....	116
Table 4.17. Retention and pollutant removal for standard permeable pavement practices.....	116
Table 4.18. Infiltration practice material specifications. ....	128
Table 4.19. Maximum facility depth for infiltration practices. ....	129
Table 4.20. Typical maintenance activities for infiltration practices. ....	133
Table 4.21. Retention and pollutant removal for infiltration practices.....	133
Table 4.22. Extensive Green Roof Material Specifications .....	142
Table 4.23. Ground Covers Appropriate for Green Roofs in the State of South Carolina .....	145
Table 4.24. Typical Maintenance Activities Associated with Green Roofs .....	149
Table 4.25. Retention and pollutant removal of green roofs. ....	149
Table 4. 26. Advantages and Disadvantages of Typical Cistern Materials.....	161
Table 4.27. Design Specifications for Rainwater Harvesting Systems .....	162
Table 4.28. Typical Maintenance Tasks for Rainwater Harvesting Systems .....	172
Table 4.29. Rainwater Harvesting Retention and Pollutant Removal .....	173
Table 4.30. Feasibility Criteria for Disconnection .....	177
Table 4.31. Disconnection Retention and Pollutant Removal .....	180
Table 4.32. Typical Check Dam Spacing to Achieve Effective Channel Slope .....	191
Table 4.33. Grass Channel Material Specifications.....	193
Table 4.34. Dry Swale Material Specifications.....	194
Table 4.35. Regenerative Stormwater Conveyance System Material Specifications .....	196
Table 4.36. Maximum Allowable Velocity.....	203
Table 4.37. Recommended Vegetation for Open Channels .....	204
Table 4.38. Typical Maintenance Activities and Schedule for Open Channels.....	207
Table 4.39. Grass Channel Retention and Pollutant Removal .....	207
Table 4.40. Grass Channel on Amended Soils Retention and Pollutant Removal .....	208
Table 4.41. Dry Swale Retention and Pollutant Removal .....	208
Table 4.42. Wet Swale Retention and Pollutant Removal .....	208
Table 4.43. RSC Retention and Pollutant Removal .....	209
Table 4.44. Filtering Practice Material Specifications.....	225
Table 4.45. Typical Annual Maintenance Activities for Filtering Practices .....	229
Table 4.46. Filter Retention and Pollutant Removal.....	230
Table 4.47. Typical Maintenance Activities for Storage Practices. ....	243
Table 4.48. Storage Retention and Pollutant Removal.....	244
Table 4.49. Clay Liner Specifications.....	254
Table 4.50. Pond Maintenance Tasks and Frequency.....	260
Table 4.51. Ceiling Levels Governing Management of Accumulated Sediment <sup>1</sup> .....	260

Table 4.52. Pond Retention and Pollutant Removal.....	261
Table 4.53. Popular, Versatile, and Available Native Trees and Shrubs for Stormwater Wetlands .....	278
Table 4.54. Popular, Versatile, and Available Native Emergent and Submergent Vegetation for Stormwater Wetlands.....	279
Table 4.55. Stormwater Wetland Retention and Pollutant Removal .....	282
Table 4.56. Selecting Priority Trees and Forests for Preservation .....	286
Table 4.57. Methods for Addressing Urban Planting Constraints .....	288
Table 4.58. Tree Planting Techniques .....	289
Table 4.59. T-1 Preserved and Planted Tree Retention .....	293

## List of Equations

### Chapter 3

Equation 3.1. Curve number runoff equation.....	43
Equation 3.2. Stormwater retention volume (SWRv) equation.....	44

### Chapter 4

Equation 4.1. Bioretention storage volume.....	81
Equation 4.2. Bioretention infiltration rate check equation.....	81
Equation 4.3. Reservoir layer or infiltration sump depth. ....	107
Equation 4.4. Drawdown time. ....	108
Equation 4.5. Permeable pavement storage volume. ....	108
Equation 4.6. Maximum surface basin depth for infiltration basins. ....	128
Equation 4.7. Maximum underground reservoir depth for infiltration trenches. ....	128
Equation 4.8. Surface basin surface area for infiltration basins. ....	129
Equation 4.9. Underground reservoir surface area for infiltration trenches. ....	129
Equation 4.10. Storage volume for surface basin area for infiltration basins. ....	130
Equation 4.11. Storage volume for underground reservoir surface area for infiltration trenches. ....	130
Equation 4.12. Storage Volume for Green Roofs.....	144
Equation 4.13 Manning’s Equation.....	197
Equation 4.14 Continuity Equation .....	198
Equation 4.15 Minimum Width.....	198
Equation 4.16 Corresponding Velocity .....	198
Equation 4.17 Grass Channel Length for Hydraulic Residence Time of 9 minutes (540 seconds).....	199
Equation 4.18 Grass Channel Storage Volume .....	199
Equation 4.19 Dry Swale Storage Volume .....	199
Equation 4.20 Wet Swale Storage Volume .....	200
Equation 4.21 Riffle Pool Length.....	202
Equation 4.22 RSC Systems Storage Volume .....	203
Equation 4.23 Minimum Filter Surface Area for Filtering Practices .....	226
Equation 4.24 Required Ponding Volume for Filtering Practices.....	226
Equation 4.25 Storage Volume for Filtering Practices .....	227
Equation 4.26 Pond Storage Volume .....	256
Equation 4.27 Water Balance Equation for Acceptable Water Depth in a Wet Pond .....	256

Equation 4.28 Baseflow Conversion .....	257
Equation 4.29 Stormwater Wetland Storage Volume .....	272
Equation 4.30 Water Balance for Acceptable Water Depth in a Stormwater Wetland .....	273
Equation 4.31 Minimum Depth of the Permanent Pool .....	273

## List of Appendices

- Appendix A – Regional Southern Low Country Stormwater Ordinance
- Appendix B – Infiltration and Geotechnical Requirements
- Appendix C – Soil Compost Requirements
- Appendix D – Design Checklist
- Appendix E – Stormwater Construction Inspection Form
- Appendix F – Maintenance Checklist
- Appendix G – Compliance Calculator Spreadsheet Instructions
- Appendix H – Compliance Calculator
- Appendix I – General Design Criteria
- Appendix J – Rainwater Harvesting Treatment & Management Requirements
- Appendix K – Rainwater Harvesting Calculator
- Appendix L – Glossary
- Appendix M – References & Resources
- Appendix N – Summary of Federal & State Regulations
- Appendix O – Maintenance Agreement Template
- Appendix P – (Reserved)
- Appendix Q – (Reserved)
- Appendix R – Land Cover Designations
- Appendix S – (Reserved)
- Appendix T – Beaufort County Single Family Lot Volume Control

## Acronym Definitions

Acronym/Abbreviation	Definition
ARC	Antecedent Runoff Condition
BMP	Best Management Practice
BSD	Better Site Design
CDA	Contributing Drainage Area
CN	Curve Number
C-SWPPP	Construction Stormwater Pollution Prevention Plan
EGL	Energy Grade Line
EPA	United States Environmental Protection Agency
ESC	Erosion and Sediment Control
FHWA	Federal Highway Administration
GI	Green Infrastructure
HDS	Hydraulic Design Services
HGL	Hydraulic Grade Line

HUC	Hydrologic Unit Code
IWS	Internal Water Storage
LID	Low-Impact Development
LOD	Limits of Disturbance
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NC DEQ	North Carolina Department of Environmental Quality
NEH	National Engineering Handbook
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PROW	Public Right-of-Way
PUD	Planned Unit Development
SC DHEC	South Carolina Department of Health and Environmental Control
SC DOT	South Carolina Department of Transportation
SDA	Site Drainage Area
SWMP	Stormwater Management Plan
SWRv	Stormwater Retention Volume