Georgia Stormwater Management

BUILD: SANDY SPRINGS

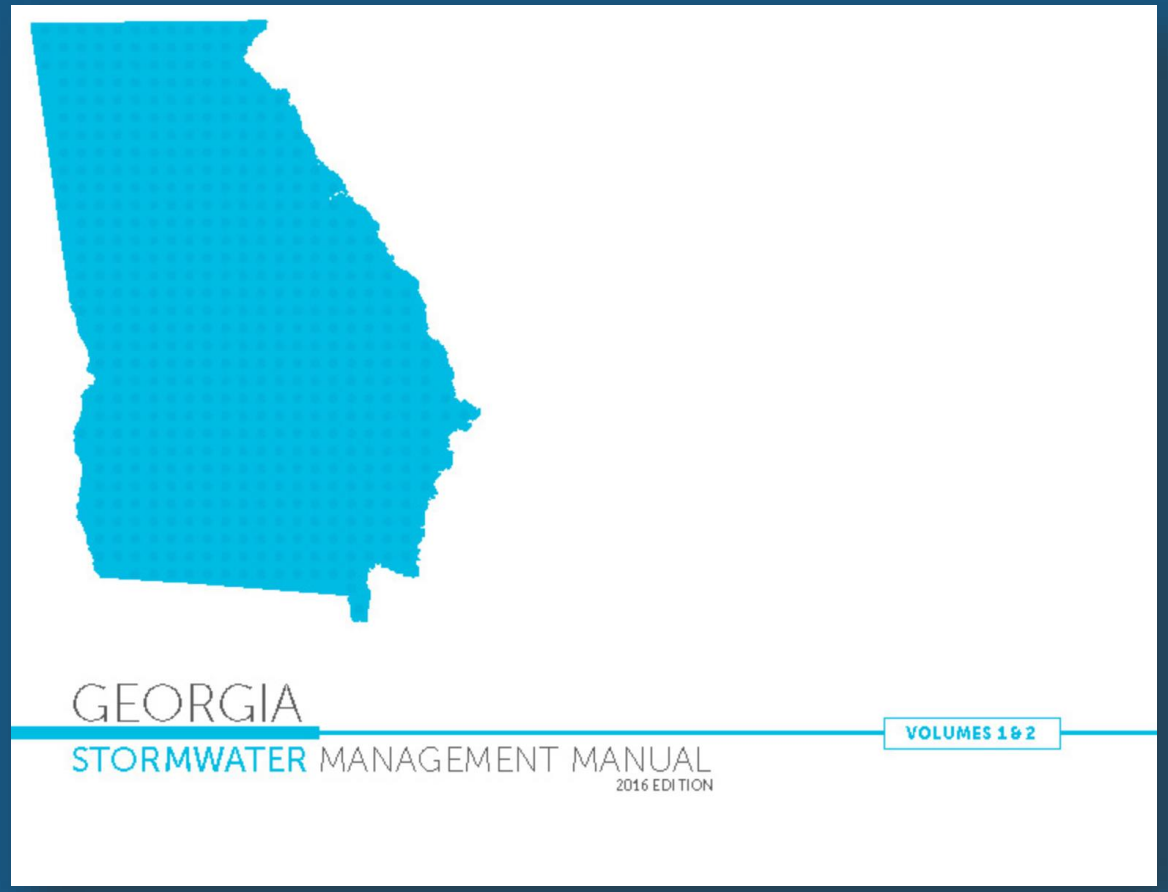
Let's build something great together

Katherine Atteberry

August 19, 2020

Georgia Stormwater Management Manual

Georgia Stormwater Management Manual



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Volume 2: Technical Handbook

GSMM: Volume 2

Design manual for designers, developers, planners, government officials, and other stormwater practitioners to design Best Management Practices

- Provide guidance on the latest and best post-construction stormwater management practices
- Minimize impacts of increasing stormwater runoff

Stormwater Paradigm Shift

Contains 20+ stormwater BMPs including

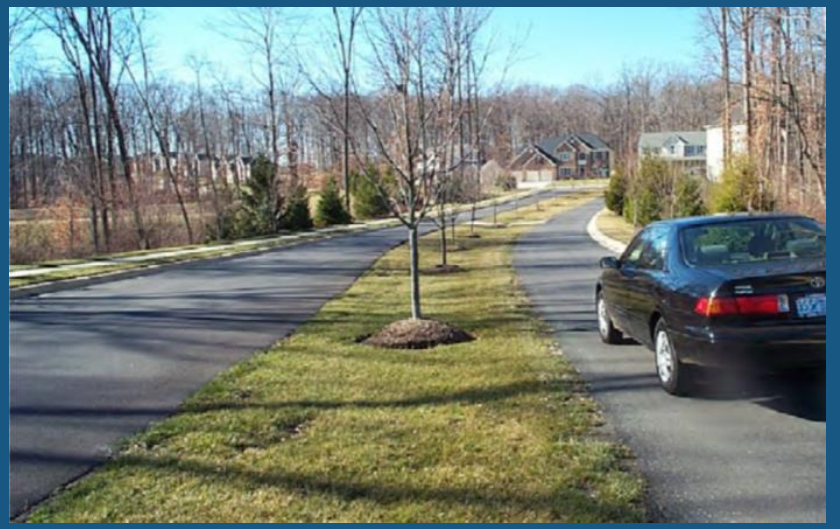
- Bioretention
- Bioslope
- Downspout Disconnect
- Dry Extended Detention Basins
- Dry/Wet Enhanced Swales
- Grass Channel
- Green Roof
- Infiltration Practices
- Permeable Paver Systems
- Porous Asphalt
- Proprietary Systems
- Rainwater Harvesting
- Regenerative Stormwater Conveyance
- Site Reforestation/Revegetation
- Stormwater Wetlands
- Underground Detention
- Vegetated Filter Strip

Proper BMP selection is beneficial

- Improved aesthetics
- Reduces underground piping reducing cost
- One practice can provide multiple benefits
- Provides flexibility for site development
- Reduced irrigation costs by reusing rainwater

GSMM BMP Design Guidance

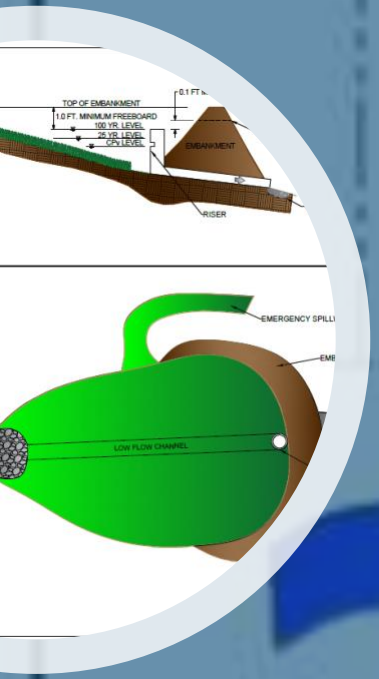
- BMP screening process to assist with BMP selection
- BMP Selection Guide
- Treatment train strategies
- Site applicability standards

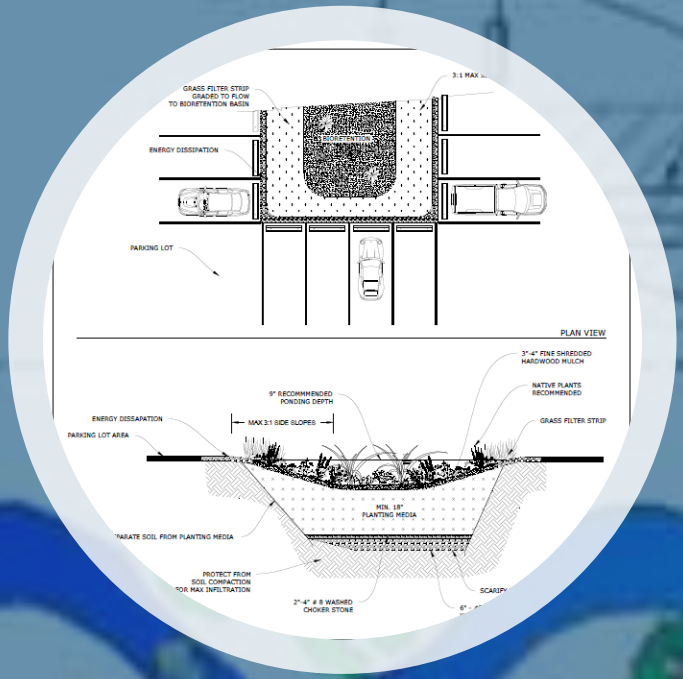


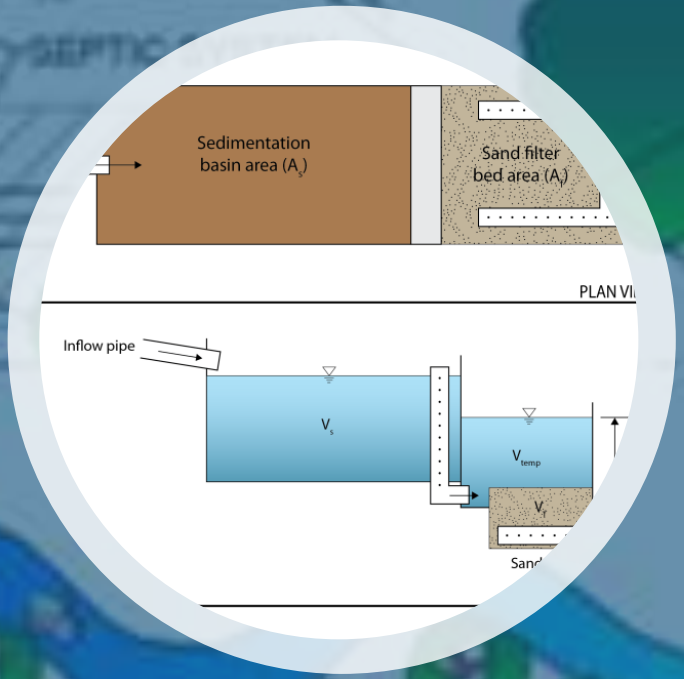
BMP Selection Guide

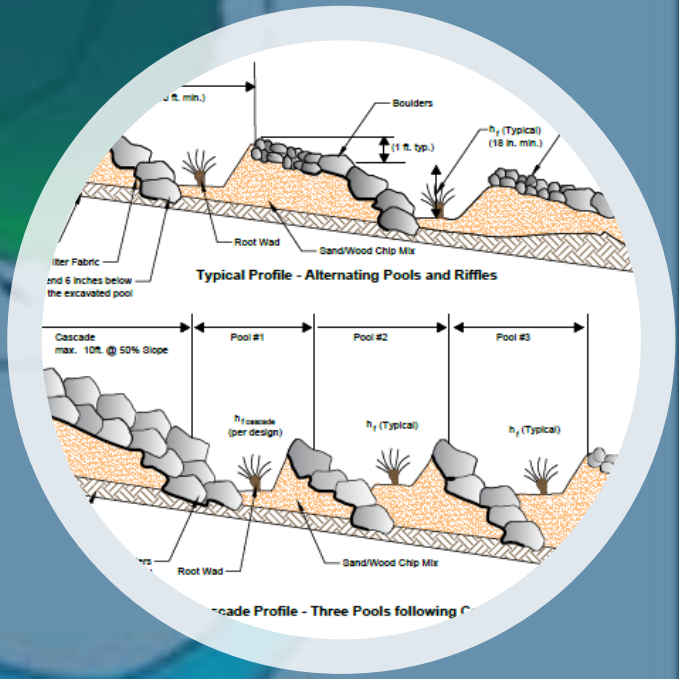
Table 4.1.3-1 BMP Selection Guide

BMP	Runoff Reduction	Stormwater Management & Treatment							Site Applicability						Cost Considerations	
	RR ***	WQ_v / TSS	CP_v	Q_{p25} / Q_f	Total Phosphorus	Total Nitrogen	Fecal Coliform	Metals	LID/GI	Drainage Area (ac)	Space Req'd (% of Im-perv. Drainage Area)	Max Site Slope	Minimum Head (Elevation Difference)	Depth to Water Table	Construction Cost	Maintenance Burden
Bioretention Basins [3,5,6]	Yes	85%	†	†	80%	60%	90%	95%	Yes	5 max	3-6%	20%	3 ft	2 ft	Med-High	Med
Bioslopes [7]	Yes	85%	†	X	60%	25%	60%	75%	Yes	N/A	N/A	5%	N/A	2 ft	Med	Med
Downspout Disconnects [2]	Yes	80%	X	X	25%	25%	N/A**	40%	Yes	2,500 ft²	Min. length of flow path 15'	6%	N/A	No restrictions	Low	Low
Dry Detention Basins [6]	No	60%	X	✓	10%	30%	N/A**	50%	No	75 max	N/A	15%	3 ft	2 ft	Low	Low
Dry Extended Detention Basins [2]	No	60%	✓	✓	10%	30%	N/A**	50%	No	No restrictions	1-3%	15%	4-8 ft	2 ft	Low	Low
Dry Wells [2]	Yes	100%	†	X	100%	100%	100%	100%	Yes	2,500 ft²	5-10%	6%	2 ft	2 ft	Med	Med
Enhanced Dry Swales [1]	Yes	80%	†	X	50%	50%	X	40%	Yes	5 max	10-20%	4%	3-5 ft	2 ft	Med	Low
Enhanced Wet Swales [1]	No	80%	†	X	25%	40%	X	20%	Yes	5 max	10-20%	4%	1 ft	Below	Med	Low
Grass Channels [1]	Minimal	50%	†	X	25%	20%	X	30%	Yes	5 max	10%	4%	<1 ft	2 ft	Low	Low
Gravity (oil-grit) Separators [2]	No	40%	X	X	5%	5%	N/A	N/A	No	5	N/A	6%	4 ft	2 ft	High	High
Green Roofs [2]	Yes	80%	X	X	50%	50%	N/A**	N/A**	Yes	N/A	No restrictions	25%	6-12 in	N/A	High	Low
Infiltration Trenches [10]	Yes	100%	†	†	100%	100%	100%	100%	Yes	5 max	2-3%	6%	1 ft	2 ft	High	High
Multi-Purpose Detention Basins [2]	No	Varies	X	†	N/A**	N/A**	N/A**	N/A**	No	No restrictions	1-3%	15%	4-8 ft	2 ft	Low	Low
Organic Filters [2]	No	80%	†	X	60%	40%	50%	75%	Yes	10	3-5%	6%	5-8 ft	2 ft	High	High
Permeable Paver Systems [2]	Yes	80%	†	†	50%	50%	N/A**	60%	Yes	N/A	No restrictions	6%	2-4 ft	2 ft	High	High
Pervious Concrete [2]	Yes	80%	†	†	50%	65%	N/A**	60%	Yes	N/A	No restrictions	6%	2-4 ft	2 ft	High	High
Porous Asphalt (excludes OGFC) [2]	Yes	80%	†	†	50%	50%	X	60%	Yes	N/A	0%	N/A	N/A	2 ft	Med	Med
Proprietary Systems [2]	Varies	Varies	Varies	Varies	Varies	Varies	Varies	Varies	No	Varies	Varies	Varies	Varies	Varies	Varies	Varies
Rainwater Harvesting [2]	Based on Demand	Varies	†	X	Varies	Varies	Varies	Varies	Yes	No restrictions	Varies	No restritions	N/A	N/A	Med	High
Regenerative Stormwater Conveyance [8]	No	80%	X	X	70%	70%	N/A**	N/A**	Yes	50 max	Varies	10%	Varies	Above	High	Med
Sand Filters [1]	No	80%	†	X	50%	25%	40%	50%	Yes	2-10 max	2-3%	6%	2-5 ft	2 ft	High	High
Site Reforestation/Revegetation [2]	No**	N/A**	N/A**	N/A**	N/A**	N/A**	N/A**	N/A**	Yes	N/A	10,000 ft² Min.	25%	N/A	No restrictions	Med	Low









Graphics incorporate updated BMP research

4.2 Bioretention Areas

Description: Shallow stormwater basin or landscaped area that utilizes engineered soils or native, well-draining soil and vegetation to capture and treat runoff.

LID/GI Consideration: Low land requirement, adaptable to many situations, and often a small BMP used to treat runoff close to the source.

Key Considerations to assist designers in determining what BMP to use

KEY CONSIDERATIONS

DESIGN CRITERIA
- Maximum contributing drainage area of 5 acres
- Treatment area consists of ponding area, organic/mulch layer, planting media, and vegetation
- Requires landscaping plan
- Standing water has a maximum drain time of 24 hours
- Pretreatment recommended to prevent clogging of underdrains or native soil
- Ponding depth should be a maximum of 12 inches, preferably 9 inches

ADVANTAGES / BENEFITS
- Applicable to small drainage areas
- Effective pollutant removals
- Appropriate for small areas with high impervious cover, particularly parking lots
- Natural integration into landscaping for urban landscape enhancement
- Good retrofit capability
- Can be planned as an aesthetic feature and meet local planting requirements

DISADVANTAGES / LIMITATIONS
- Requires landscaping
- Not recommended for areas with steep slopes
- Medium to high capital cost
- Medium cost maintenance burden
- Soils may clog over time (may require cleaning or replacing)

MAINTENANCE REQUIREMENTS
- Inspect and repair or replace treatment area components such as mulch, plants, and scour protection, as needed
- Ensure bioretention area is draining properly so it does not become a breeding ground for mosquitos
- Remove trash and debris
- Ensure mulch is 3-4 inches thick in the practice
- Requires plant maintenance plan

POLLUTANT REMOVAL

85% Total Suspended Solids

95% Metals - Cadmium, Copper, Lead, and Zinc removal

80/60% Nutrients - Total Phosphorus / Total Nitrogen removal

90% Pathogens – Fecal Colifo

STORMWATER MANAGEMENT SUITABILITY

- ✓ Runoff Reduction
- ✓ Water Quality
- ★ Channel Protection
- ★ Overbank Flood Protection
- ★ Extreme Flood Protection

✓ suitable for this practice
★ may provide partial benefits

IMPLEMENTATION CONSIDERATIONS

- L Land Requirement
- M/H Capital Cost
- M Maintenance Burden

Residential Subdivision Use: *Yes*
High Density/Ultra-Urban: *Yes*
Roadway Projects: *Yes*

Soils: *Engineered soil media is composed of sand, fines, and organic matter*

Other Considerations: Use of native plants is recommended

L=Low M=Moderate H=High

RUNOFF REDUCTION CREDIT
- 100% of the runoff reduction volume provided (no underdrain)
- 75% of the runoff reduction volume provided (upturned underdrain system)
- 50% of the runoff reduction volume provided (underdrain)

Landscape format to make easier to read

Runoff Reduction Credit

BACK TO TOC

(Step 4A) Calculate the Target Water Quality Volume

Calculate the Water Quality Volume using the following formula:

$$WQ_v = (1.2)\ (R_v)\ (A) / 12$$

Where:

WQ_v = Water Quality Volume (ft^3)
1.2 = Target rainfall amount to be treated (inches)
R_v = Volumetric runoff coefficient which can be found by:

$$R_v = 0.05+0.009(I)$$

Where:

I = new impervious area of the contribu… drainage area (%)
A = Area draining to this practice (ft^2)
12 = Unit conversion factor (in/ft)

(Step 4B) If using the practice for Water Quality treatment, determine the footprint of the bioretention area practice and the pretreatment volume required

The peak rate of discharge for the water quality design storm is needed for sizing of off-line diversion structures (see Subsection 3.1.7). If designing off-line, follow steps (a) through (d) below:

(a) Using WQ_v, compute CN
(b) Compute time of concentration using TR-55 method
(c) Determine appropriate unit peak discharge from time of concentration
(d) Compute Q_{wq} from unit peak discharge, drainage area, and WQ_v

To determine the minimum surface area of the bioretention area, use the following formula:

$$A_f = (WQ_v)\ (d_f) / [\ (k)\ (h_f + d_f)\ (t_f)]$$

Where:

A_f = surface area of ponding area (ft^2)
WQ_v = water quality volume (ft^3)
d_f = media depth (ft)
k = coefficient of permeability of planting media (ft/day) (use 1 ft/day for silt-loam if engineered soils is being used)
h_f = average height of water above bioretention area bed (ft)
t_f = design planting media drain time (days) (1 day is recommended maximum)

(Step 5) Calculate the adjusted curve numbers for CP_v (1-yr, 24-hour storm), Q_{p25} (25-yr, 24-hour storm), and Q_f (100-yr, 24-hour storm). See Subsection 3.1.7.5 or Appendix B-2 for a deta… bioretention area design example

… Size flow diversion structure, if needed
…ow regulator (or flow splitter diversi… …e) should …lied to divert the WQ_v (or R… …oretention a…

…pass Q_{wq}:

(Step 7…

…s/Geometry)

Design steps incorporate Runoff Reduction calculations AND TSS Calculations

of the BMP, described in this section. By considering the primary function, as well as, topographic and soil conditions, the design elements of the practice can be determined (i.e. planting media, underdrain, inlet/outlet, overflow, etc.)

Complete Step 3A, 3B, and 3C for a runoff reduction approach, or skip Step 3 and complete Steps 4A and 4B for a water quality (treatment) approach. Refer to your local community's guidelines for any additional information or specific requirements regarding the use of either method.

(Step 3A) Calculate the Stormwater Runoff Reduction Target Volume

Calculate the Runoff Reduction Volume using the following formula:

$$RR_v = (P)\ (R_v)\ (A) / 12$$

Where:

RR_v = Runoff Reduction Target Volume (ft^3)
P = Target runoff reduction rainfall (inches)
R_v = Volumetric runoff coefficient which can be found by:

$$R_v = 0.05+0.009(I)$$

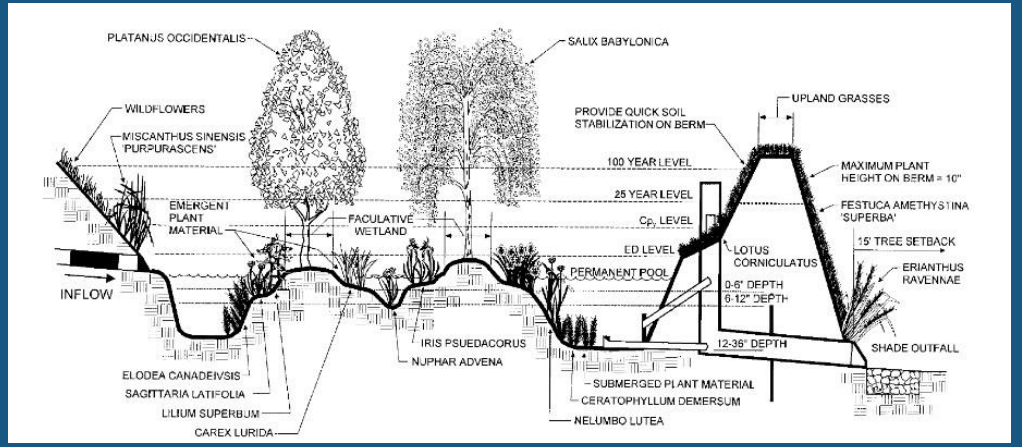
Where:

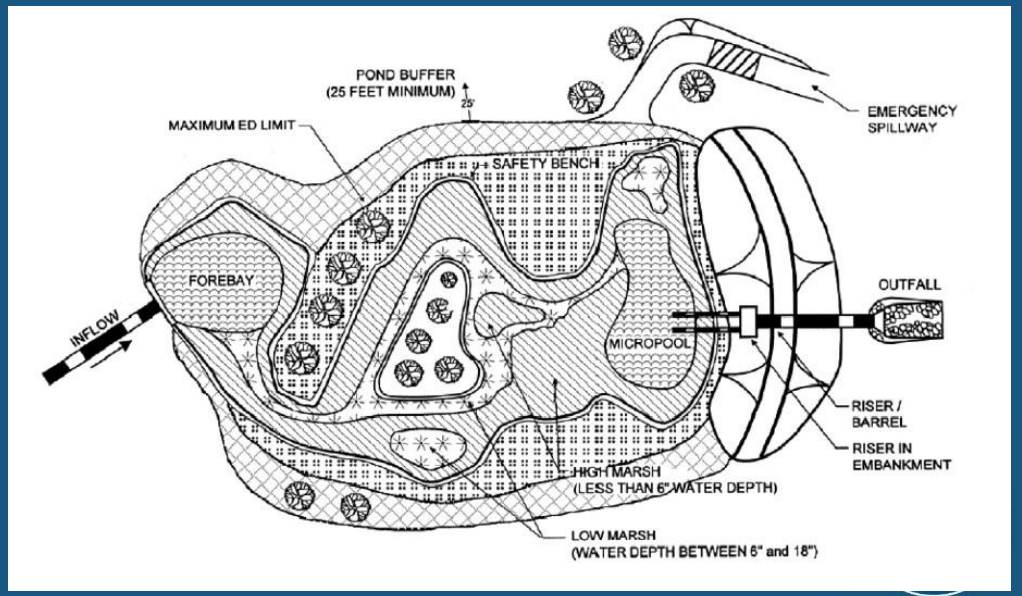
I = new impervious area of the contributing drainage area (%)

A = Area draining to this practice (ft^2)
12 = Unit conversion factor (in/ft)

Appendix D: Planting & Soil Guidance

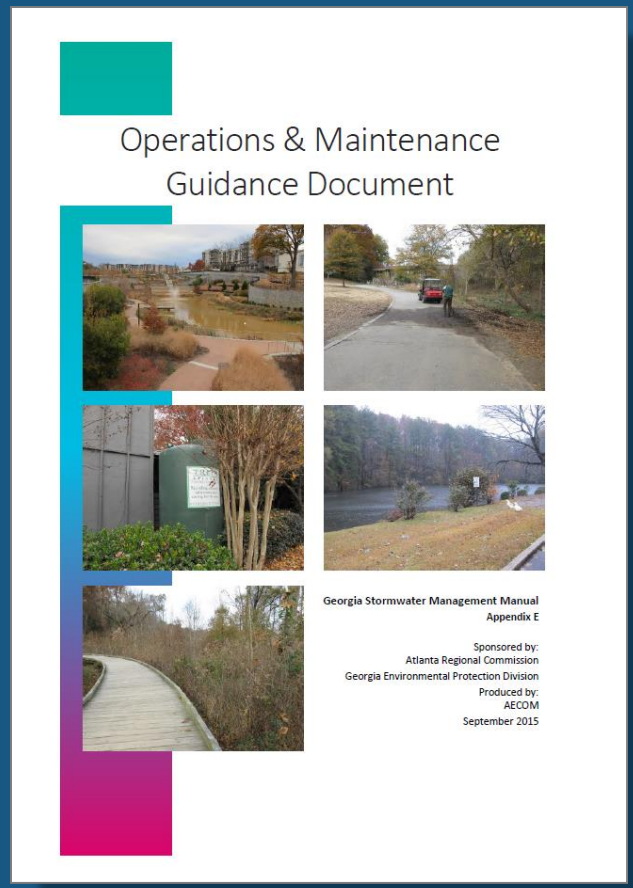
- Planting media characteristics
- Examples of typical profiles for BMPs
- Additional information for establishing vegetation and maintenance
- Infiltration testing information





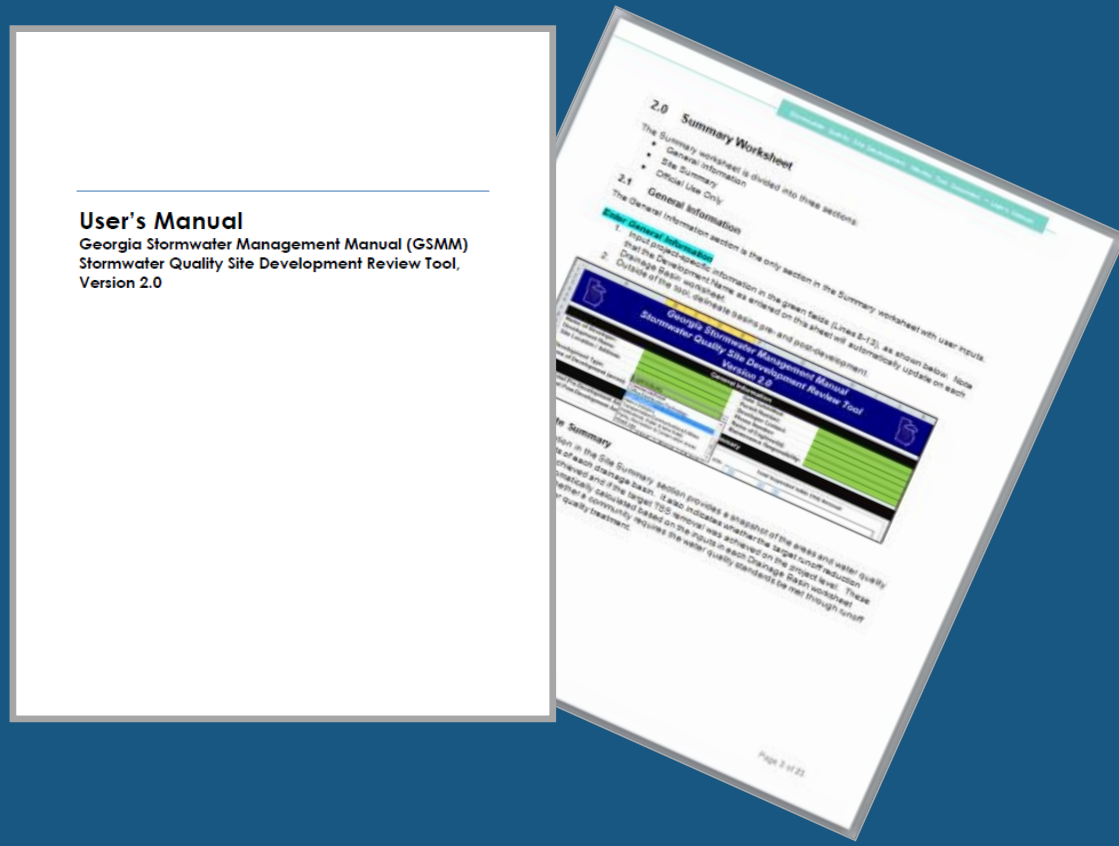
Appendix E:
Operations & Maintenance Guidance Document

- Key Components of a BMP
- Importance of Inspecting a BMP
- Maintenance Agreements
- General Maintenance
- Vegetation Maintenance



Water Quality Design Tool

- Assists designer/ developer with incorporating water quality requirements into design plans
- Provides a visual to show if the water quality standard was met
- User's Manual explains how the tool functions



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Water Quality Design Tool

Shows water quality & runoff reduction achievements on the basin and project level

Georgia Stormwater Management Manual
Stormwater Quality Site Development Review Tool
Version 2.0

General Information

Name of Developer:		Date Submitted:	
Development Name:		Permit Number:	
Site Location / Address:		Developer Contact:	
		Phone Number:	
		Name of Engineer(s):	
Development Type:		Maintenance Responsibility:	

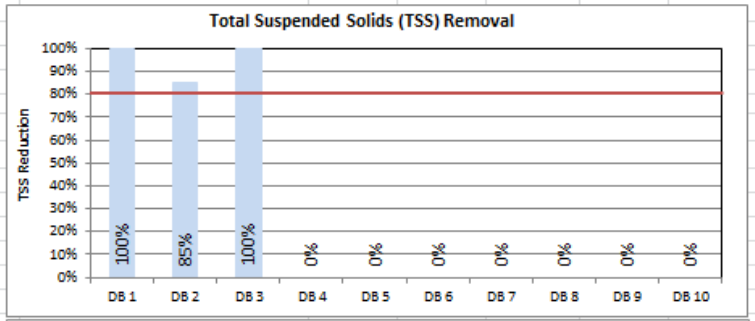
Site Summary

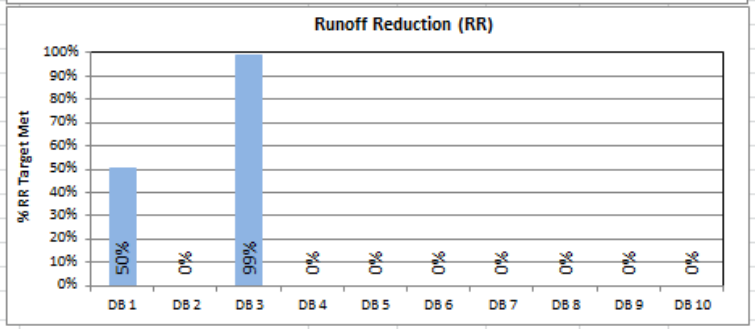
Total Pre-Development Area (ac):	11.00
Total Post-Development Area (ac):	11.00
Total Treated Area (ac):	11.00
Total Untreated Area (ac):	0.00

		I (ac)	P (ac)	CA (ac)
Drainage Basin 1	DB 1	1.90	0.60	0.50
Drainage Basin 2	DB 2	1.90	1.10	0.00
Drainage Basin 3	DB 3	0.00	5.00	0.00
Drainage Basin 4	DB 4	0.00	0.00	0.00
Drainage Basin 5	DB 5	0.00	0.00	0.00
Drainage Basin 6	DB 6	0.00	0.00	0.00
Drainage Basin 7	DB 7	0.00	0.00	0.00
Drainage Basin 8	DB 8	0.00	0.00	0.00
Drainage Basin 9	DB 9	0.00	0.00	0.00
Drainage Basin 10	DB 10	0.00	0.00	0.00
	TOTAL	3.80	6.70	0.50

I - Impervious Area, P - Pervious Area, CA - Conservation Area

Target Runoff Reduction Volume Achieved?	No
Target TSS Removal Achieved?	Yes
Total Target Runoff Reduction Volume (cf)	13,286
Runoff Reduction Volume Achieved (cf)	8,804
Total Target Water Quality Volume (cf)	15,943
% TSS Removal Achieved	95%





Official Use Only

Tracking #:		Conditions of Approval:	
Reviewed By:			
Date Approved:			

A RECORDED CONSERVATION EASEMENT OR SIMILAR FORM OF PROTECTION IS REQUIRED FOR THIS PROJECT

Water Quality Design Tool

Select BMPs for Runoff Reduction and Water Quality

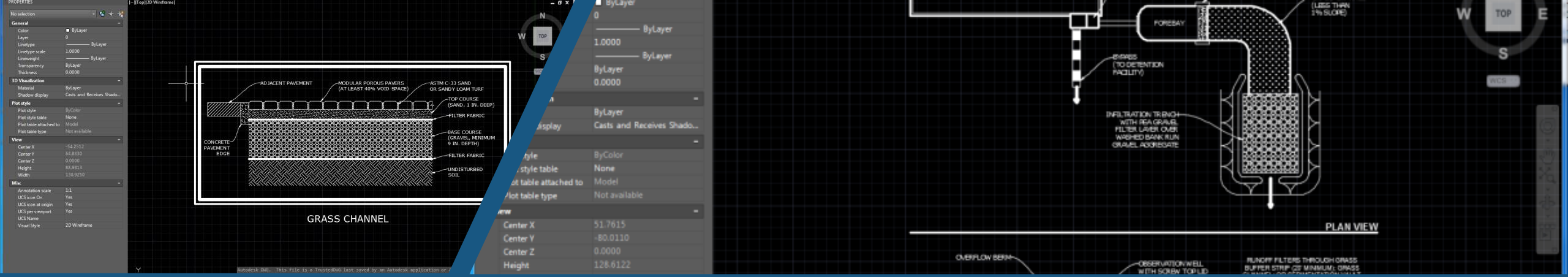
		Area Draining to Each BMP			Storage Volume Provided by BMP (cf)	RR Conveyance Volume Provided by BMP (cf)	Down-stream BMP	Runoff Reduction Calculations						WQ Calculations	
		On-site Pervious Area (acres)	On-site Impervious Area (acres)	Offsite Area (acres)				RR Volume from Direct Drainage (cf)	RR Volume from Upstream Practices (cf)	Total RR Volume Received by BMP (cf)	Runoff Reduction %	RR Achieved (cf)	Remaining RR Volume (cf)	WQ, from Direct Drainage (cf)	Effective TSS Removal %
BMP 1	Downspout Disconnect (C & D hydrologic soils)	0.00	0.30	0.00		1,035	BMP 2	1,035	0	1,035	25%	259	776	1,241	80%
BMP 2	Bioretention Basin (w/ underdrain)	1.10	1.37		5,000			4,924	1,490	6,414	50%	2,500	3,914	5,909	85%
BMP 3	Grass Channel (C & D hydrologic soils)		0.23			793	BMP 2	793	0	793	10%	79	714	952	50%
BMP 4	Select a BMP_							0	0	0	N/A	0	0	0	N/A
BMP 5	Select a BMP_							0	0	0	N/A	0	0	0	N/A
BMP 6	Select a BMP_							0	0	0	N/A	0	0	0	N/A
BMP 7	Select a BMP_								0	0	N/A	0	0	0	N/A
BMP 8	Select a BMP_							0	0	0	N/A	0	0	0	N/A
BMP 9	Select a BMP_							0		0	N/A	0	0	0	N/A
BMP 10	Select a BMP_							0	0	0	N/A	0	0	0	N/A
	TOTAL	1.10	1.90	0.00				6,752				2,838		8,102	
	UNTREATED AREA (acres)	0.00	0.00												

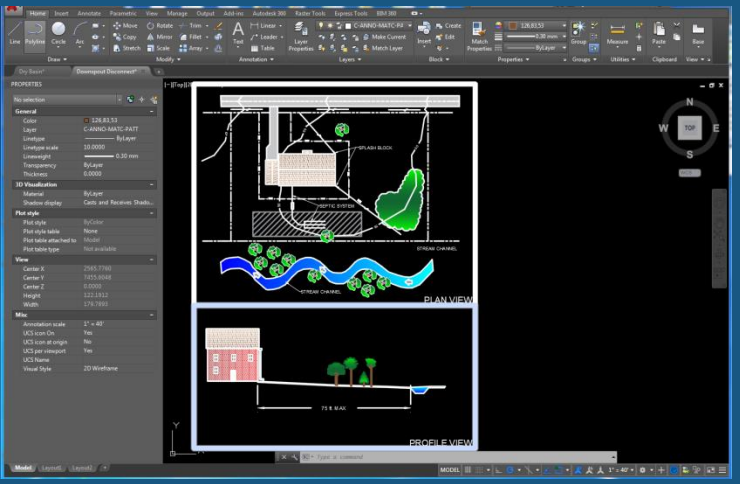
Target Runoff Reduction Volume (cf)	6,752
Target Achieved?	No
Remaining Runoff Reduction Volume (cf)	3,914

Target Water Quality Volume (cf)	8,102
% TSS Removal Achieved	88%
Target Achieved?	Yes!
Remaining TSS Removal %	0%

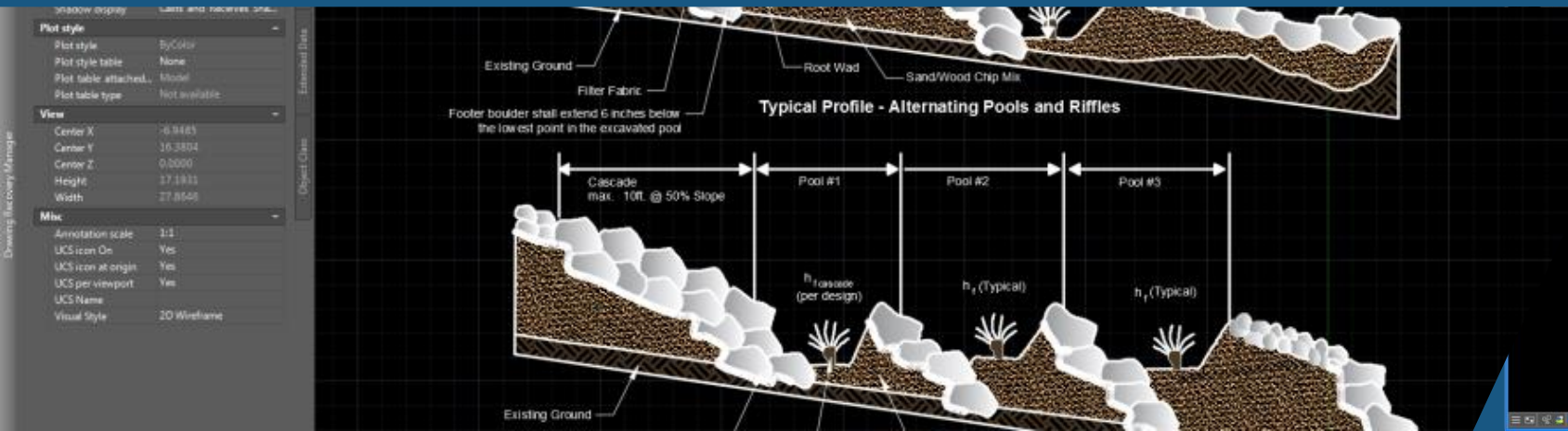
Automatically calculates runoff reduction and TSS removal achieved

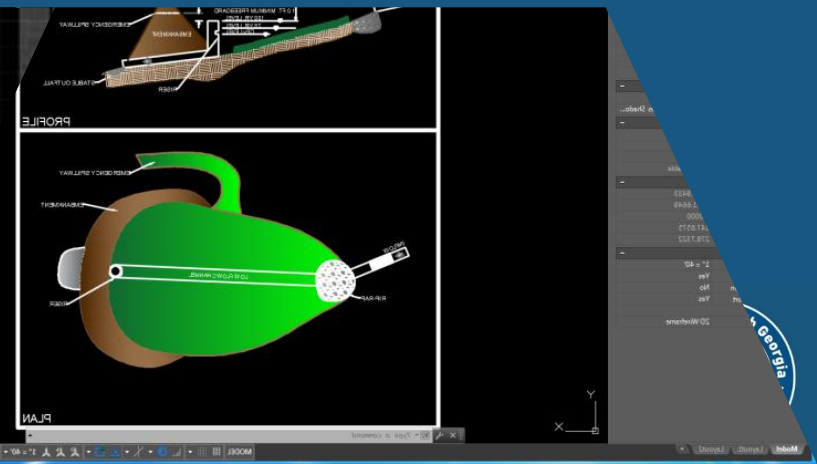
Allows treatment trains or individual BMPs





Digital Design Details





Model Ordinance: Post-Construction Stormwater Management for New Development and Redevelopment

Model Ordinance: Post-Construction Stormwater Management

Establish minimum requirements and procedures for proper management of post-construction stormwater runoff

- Safeguard health, safety, environment and general welfare of the public
- Minimize damage to public and private property and infrastructure
- Protect water and aquatic resources

Will be adopted in Sandy Springs by December 2020

Equivalency

- Jurisdictions may customize the Model Ordinance with appropriate ordinance provisions and administrative program
- What does it take to be “at-least as effective”
  - Compare with substantive provisions
  - Procedural elements up to local discretion
  - GAEPD determines
- Jurisdictions may always be more effective than District and/or MS4 Permit requirements

Model Ordinance Sections

1. Purpose and Intent
2. Definitions
3. Adoption and Implementation of the GSMM; Conflicts and Inconsistencies
4. Designation of Administrator
5. Applicability Criteria for Stormwater Management Standards
6. Exemptions for Stormwater Management Standards

Model Ordinance:
Section [Y]-2 Definitions

- Pre-development hydrology means
  a) For new development, the runoff curve number determined using natural conditions hydrologic analysis based on the natural, undisturbed condition of the site immediately before implementation of the proposed development; and
  b) For redevelopment, the existing conditions hydrograph may take into account the existing development when defining the runoff curve number and calculating existing runoff, unless the existing development causes a negative impact on downstream property.

Model Ordinance Sections

7. Stormwater Management Standards
8. Pre-Submittal Meeting, Stormwater Concept Plan, and Stormwater Management Plan Requirements
9. Application Fee
10. Application Procedures
11. Compliance with the Approved Stormwater Management Plan
12. Inspections to Ensure Plan Compliance During Construction

Model Ordinance:
Section [Y]-7 Stormwater Management Standards

a) Design of the Stormwater Management System
b) Natural Resources Inventory
c) Better Site Design Practices for Stormwater Management
d) Stormwater Runoff Quality/ Reduction
e) Stream Channel Protection
f) Overbank Flood Protection
g) Extreme Flood Protection
h) Downstream Analysis
i) Stormwater Management System Inspection and Maintenance

Model Ordinance:
Section [Y]-7 Stormwater Management Standards

Runoff Reduction	Water Quality
The stormwater management system shall be designed to **retain the first 1.0 inch of rainfall on the site** using runoff reduction methods, to the maximum extent practicable	The stormwater management system shall be designed to remove at least **80% of the calculated average annual post-development total suspended solids (TSS) load** or equivalent as defined in the GSMM for runoff from a **1.2 inch rainfall event**
• Before December 2020, may choose either option • After December 2020, choose Runoff Reduction unless determined infeasible using Practicability Policy, then Water Quality	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Model Ordinance Sections

7. Stormwater Management Standards
8. Pre-Submittal Meeting, Stormwater Concept Plan, and Stormwater Management Plan Requirements
9. Application Fee
10. Application Procedures
11. Compliance with the Approved Stormwater Management Plan
12. Inspections to Ensure Plan Compliance During Construction

Model Ordinance:
Section [Y]-8 Pre-Submittal Meeting, Stormwater Concept Plan, and Stormwater Management Plan Requirements

(c) The stormwater concept plan shall contain:

(i) Common address and legal description of the site,

(ii) Vicinity map, and

(iii) Existing conditions and proposed site layout mapping and plans*

*13 elements listed in this section

Model Ordinance:
Section [Y]-8 Pre-Submittal Meeting, Stormwater Concept Plan, and Stormwater Management Plan Requirements

(d) The stormwater management plan shall contain…

i. Natural Resources Inventory
ii. Stormwater Concept Plan
iii. Existing Conditions Hydrologic Analysis
iv. Post-Development Hydrologic Analysis
v. Stormwater Management System
vi. Downstream Analysis
vii. Erosion and Sedimentation Control Plan
viii. BMP Landscaping Plan
ix. Inspection and Maintenance Agreement
x. Evidence of Acquisition of Applicable Local and Non-Local Permits
xi. Determination of Infeasibility (if applicable)

Model Ordinance:
Section [Y]-8 Pre-Submittal Meeting, Stormwater Concept Plan, and Stormwater Management Plan Requirements

(d) … the items listed in this part and be prepared under the direct supervisory control of either a registered Professional Engineer or a registered Landscape Architect licensed in the state of Georgia. Items (iii), (iv), (v), and (vi) shall be sealed and signed by a registered Professional Engineer licensed in the state of Georgia. The overall site plan must be stamped by a design professional licensed in the State of Georgia for such purpose. (GSMM Section 2.4.2.7)

Model Ordinance Sections

13. Final Inspections; As-Built Drawings; Delivery of Inspection and Maintenance Agreement
14. Violations and Enforcement
15. Maintenance by Owner of Stormwater Management Systems Predating Current GSMM
16. Inspection and Maintenance Agreements
17. Right of Entry for Maintenance Inspections
18. Owner's Failure to Maintain the Stormwater Management System

Model Ordinance:
Section [Y]-16 Inspection and Maintenance Agreements

(a) The owner shall execute an inspection and maintenance agreement with the [local jurisdiction] obligating the owner to inspect, clean, maintain, and repair the stormwater management system; including vegetation in the final BMP landscaping plan. The form of the inspection and maintenance agreement shall be the form provided by the [local jurisdiction]. After the inspection and maintenance agreement has been signed by the owner and the [local jurisdiction], the owner shall promptly record such agreement at the owner's cost in the property record for all parcel(s) that make up the site.

(c) The inspection and maintenance agreement shall run with the land and bind all future successors-in-title of the site.

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