



Stormwater Best Management Practices on the Coast (Chapter 4)

About Us

- ❖ Non-profit 501(c)3, non-advocacy organization
- ❖ Work with local watershed groups, local, state, and federal governments
- ❖ Provide tools communities need to protect streams, lakes, and rivers



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Chapter 4

1. Discussion of Coastal Conditions
2. Summary of Stormwater Regulations
3. BMP Specifications & Calculation Methods

Coastal Conditions

- Poorly Drained Soils
- Well-Drained Soils
- Flat Terrain
- High Groundwater
- Tidally Influenced Drainage Systems
- Pollutants of Concern: sediment, phosphorus, nitrogen, and bacteria

Stormwater Treatment Requirements

- Coastal Zone (1/2 mile from receiving water):
 - 1/2 inch of runoff from site or 1 inch from impervious cover
- Shellfish Beds (1,000 feet from shellfish bed):
 - 1 1/2 inches retained on site.
- Water Quality Treatment
 - Wet ponds: 1/2" of runoff
 - Dry ponds: 1" of runoff
 - Infiltration/LID: 1" of runoff from impervious cover
- Water Quantity Control
 - 2-year and 10-year post- to pre- peak flow

Table 4.1-1-1

BMP	Coastal Zone Requirements	Shellfish Bed Requirements	Water Quality Treatment	Water Quantity Control
Bioretention	Yes	Yes	1" runoff from impervious cover	Partial
Permeable Pavement	Yes	Yes	1" runoff from impervious cover	Yes
Infiltration	Yes	Yes	1" runoff from impervious cover	Partial
Green Roof	Yes	Yes	1" runoff from impervious cover	Partial
Rainwater Harvesting	Yes	Yes	1" runoff from impervious cover	Partial

Table 4.1-1-1 (continued)

BMP	Coastal Zone Requirements	Shellfish Bed Requirements	Water Quality Treatment	Water Quantity Control
Disconnection	Partial	Partial	1" runoff from impervious cover	Partial
Open Channels	Partial	Partial	1" runoff from impervious cover	Partial
Filtration	Yes	No	1" runoff from impervious cover	No
Dry Ponds	Yes	No	1" runoff from site	Yes
Wet Ponds	Yes	No	½" of runoff from site	Yes
Stormwater Wetlands	Yes	No	½" of runoff from site	Yes

MS4 Permit Requirements

- Section 4.2.5.2.2:

“The first 1” of runoff must be managed.”

Table 4.2.5.2.2.1 Examples of Site Performance Standards

- Design, construct, and maintain stormwater management practices that manage rainfall on-site, and prevent the off-site discharge of 1 inch of runoff from the site’s disturbed area.

BMP Specifications

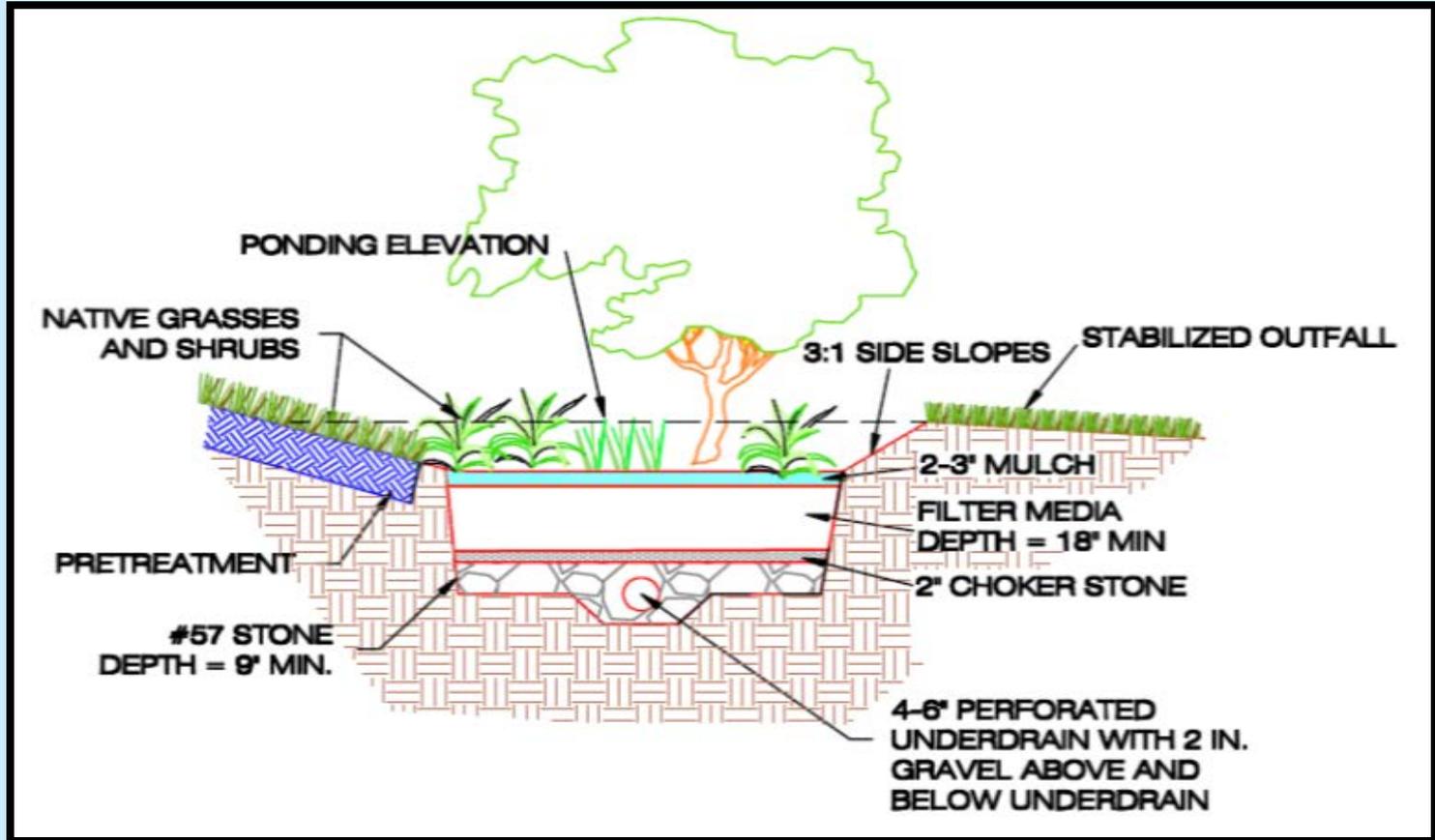
“Should” vs. “Must”

In Chapter 4, “should” means “should,”
and “must” means “must.”

4.2 Bioretention

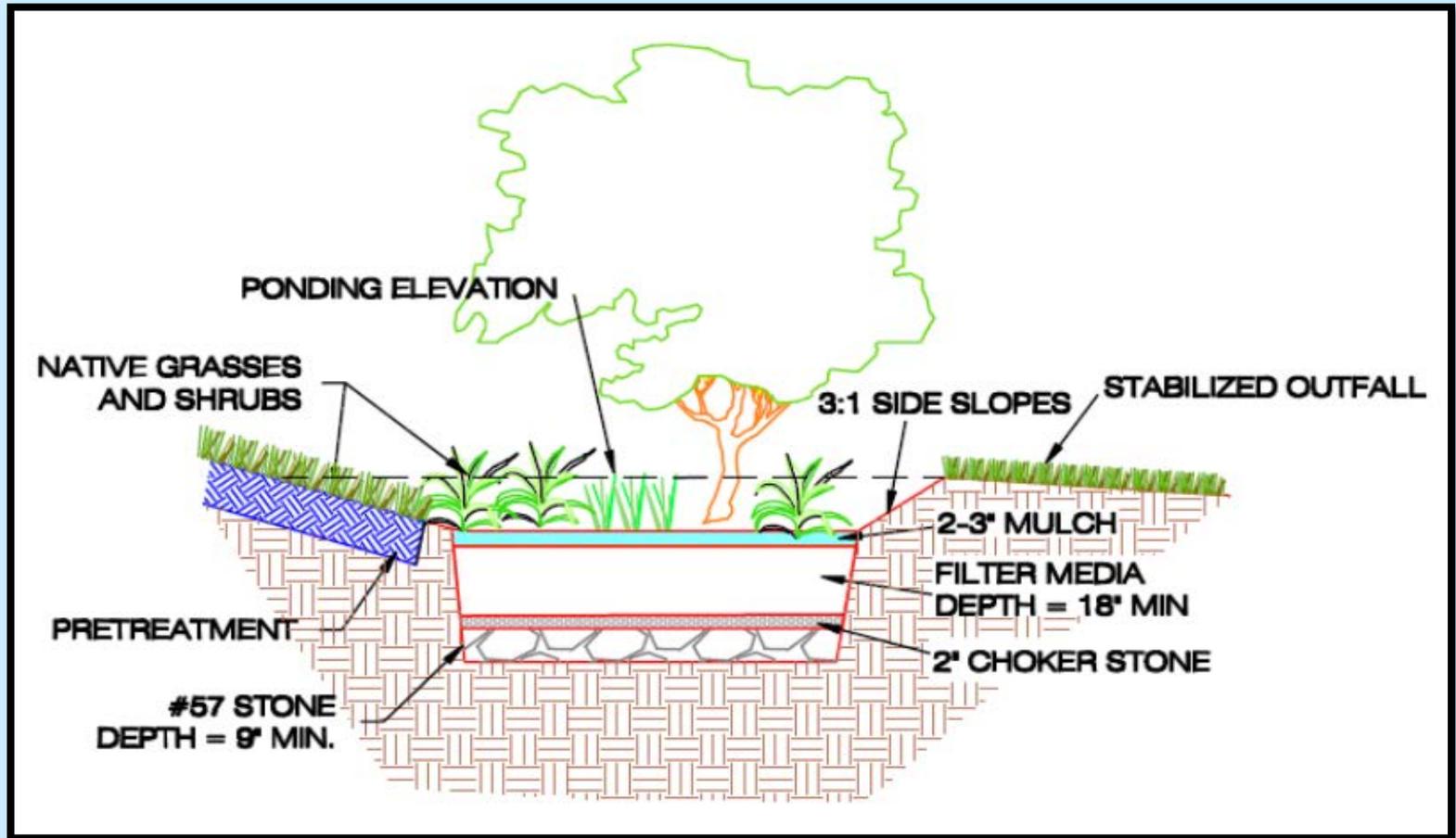


Bioretention Standard Design



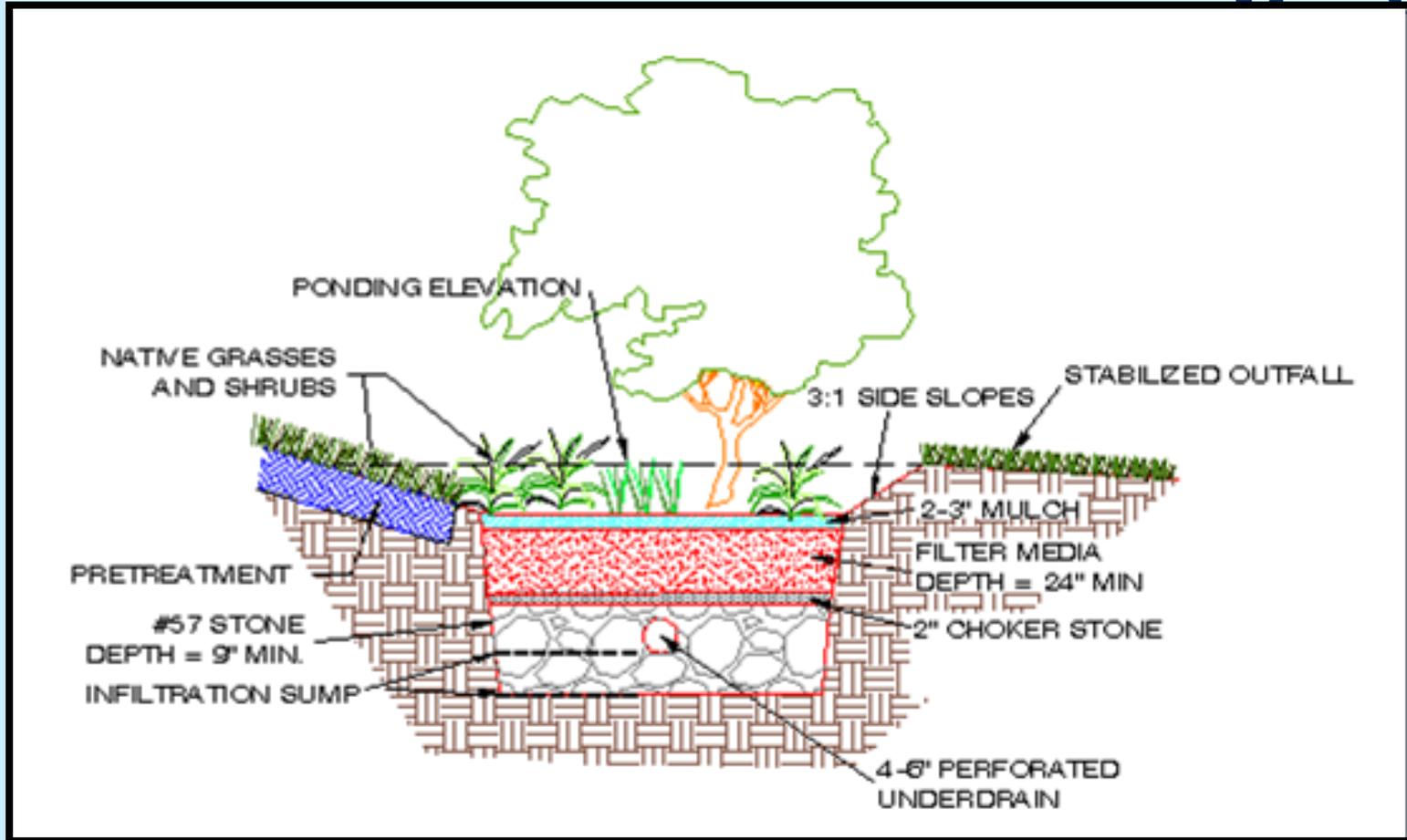
- 18" – 24" media
- 60% credit for the volume captured
- Oversizing allowed to meet full criteria

Bioretention Enhanced Design (1)



- 24" media, no underdrain
- 100% credit for the volume captured
- Must infiltrate within 72 hours

Bioretention Enhanced Design (2)



- 24" media, underdrain
- 100% credit for the volume captured
- Sump must infiltrate within 72 hours

Conveyance Criteria and Pretreatment

- Conveyance: Off-line vs. On-line
 - On-line requires overflow device
- Pretreatment Required
 - Pretreatment Cell
 - Grass Filter Strips
 - Stone Diaphragm
 - Etc.



Bioretention Design Criteria

- Filter Media Specifications
 - 80%-90% sand (at least 75% is classified as coarse or very coarse sand)
 - 10%-20% soil fines (silt and clay; maximum 10% clay)
 - 3%-5% organic matter (leaf compost)
 - P concentrations between 5 and 15 mg/kg (Mehlich I) or 18 and 40 mg/kg (Mehlich III)

Bioretention Landscaping Criteria

- Surface Cover Options
 - Mulch and perennial vegetation
 - Turf
 - Stone with perennial vegetation



Questions?



4.3 Permeable Pavement



Permeable Pavement

Permeable Pavers

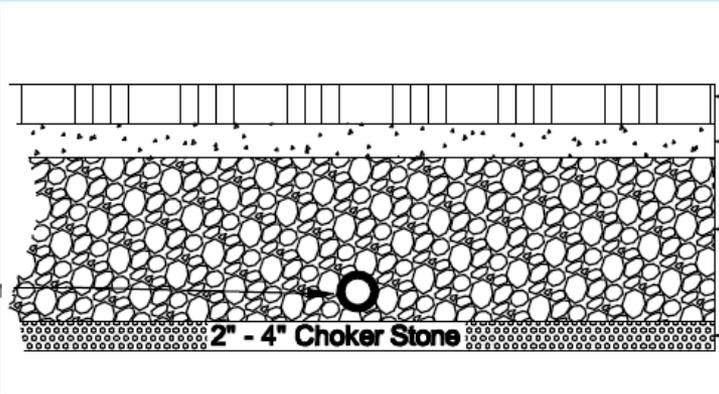


Pervious Concrete



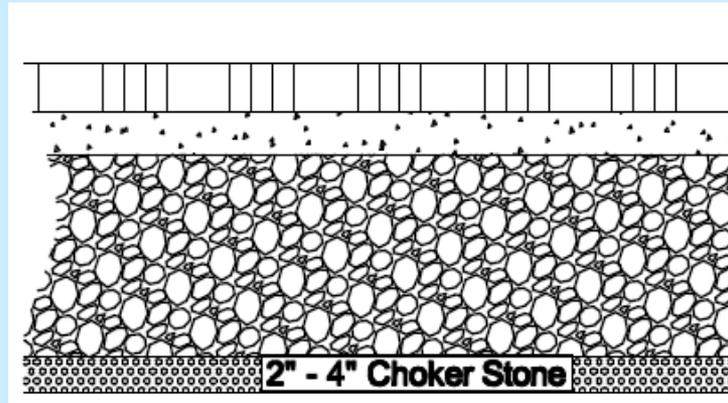
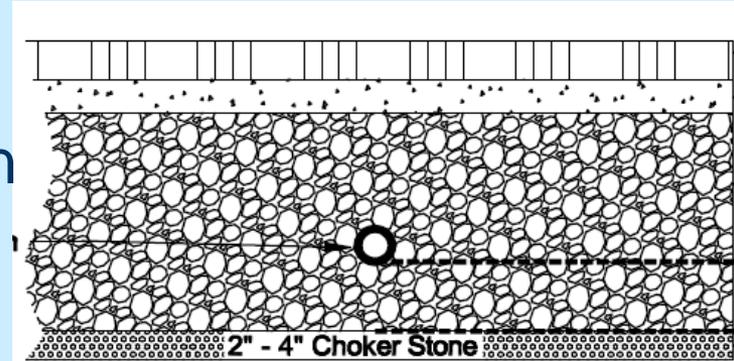
Porous Asphalt

Permeable Pavement Versions



Standard (50% Credit)

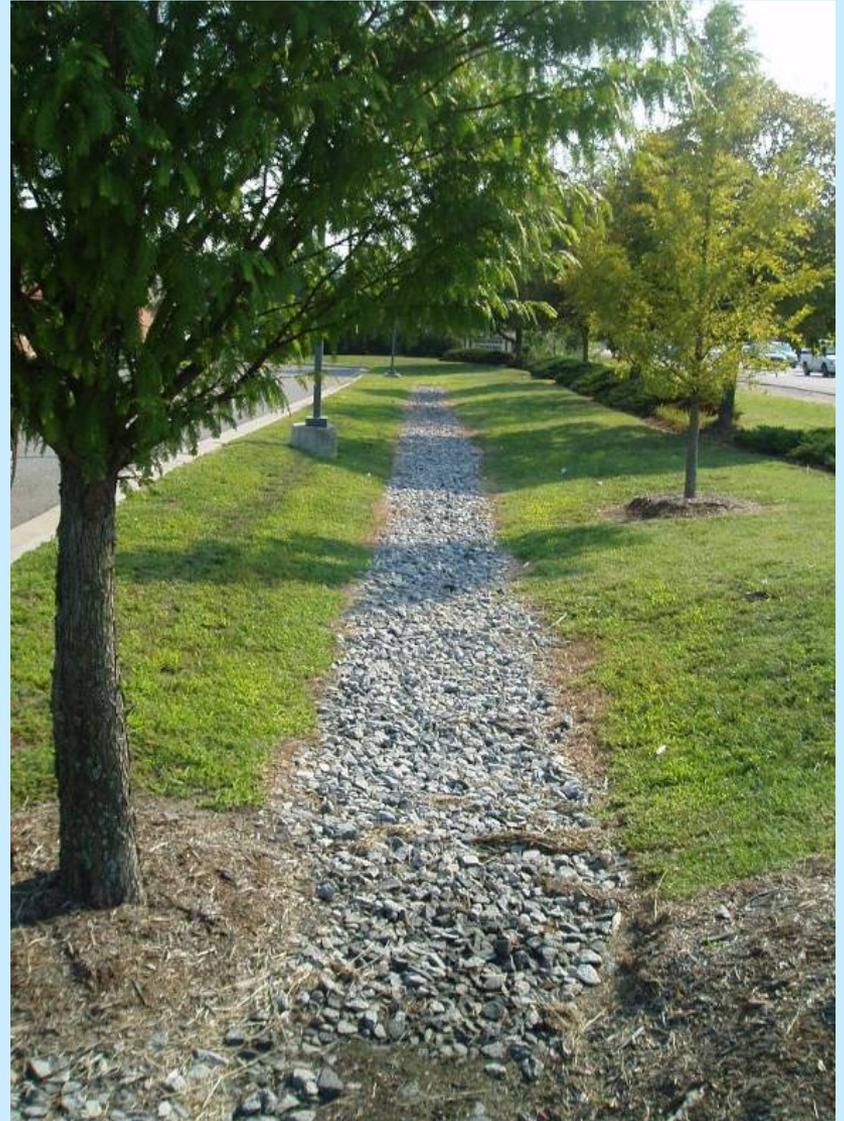
Enhanced with Underdrain
(Variable Credit)



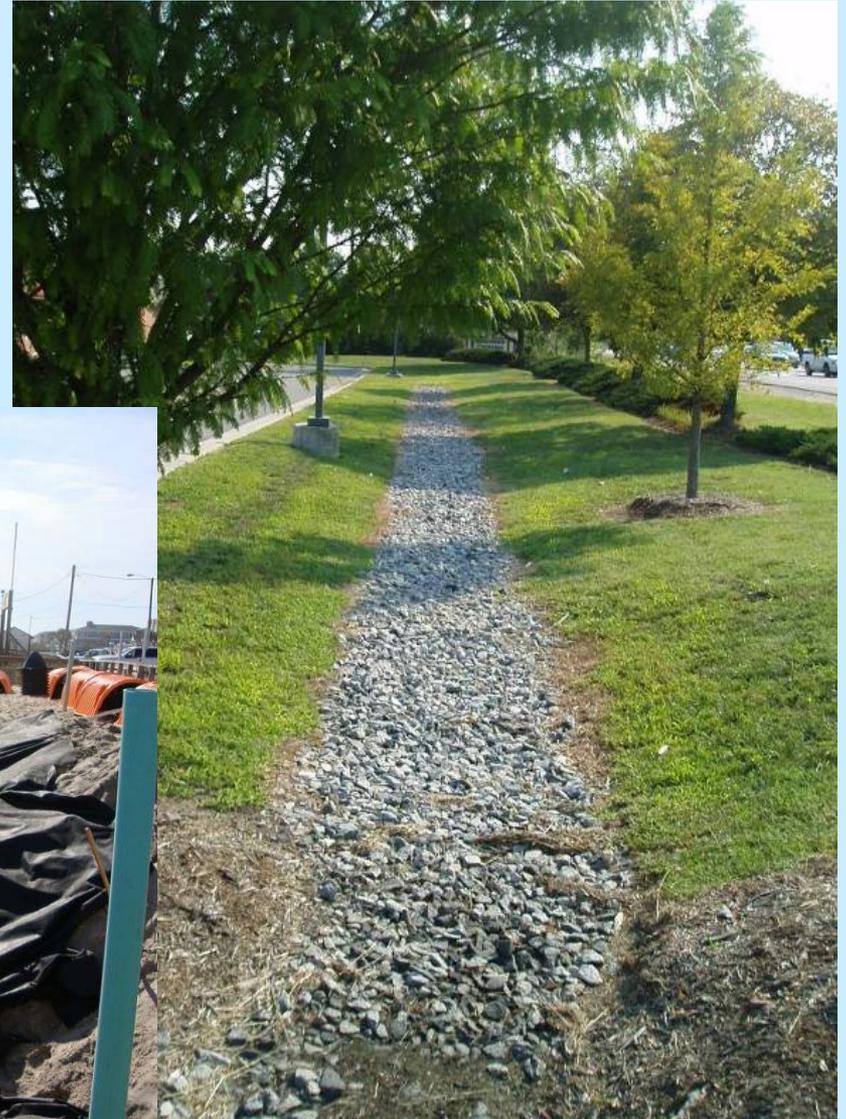
Enhanced without Underdrain
(100% Credit)

4.4 Stormwater Infiltration

- 100% credit for water that infiltrates in 72 hours
- $\frac{1}{2}$ measured infiltration rate used as safety factor



Infiltration Options



4.5 Green Roofs



<http://www.greenroofs.com/blog/2010/10/27/the-roots-of-washington-dc%E2%80%99s-green-roof-boom/>

Green Roofs

- Extensive or Intensive
- Structural design considerations
- High installation cost
- Increased roof longevity
- Additional urban environmental benefits
- Major element of compliance at urban development sites



Intensive



Extensive



Small-Scale



Green Roof Design Criteria

Sizing Equation

$$S_v = \frac{SA \times [(d \times \eta_1) + (DL \times \eta_2)]}{12}$$

S_v = storage volume (ft³)

SA = green roof area (ft²)

d = media depth (in.) (minimum 3 in.)

η_1 = verified media maximum water retention (use 0.15 as a baseline default in the absence of verification data)

DL = drainage layer depth (in.)

η_2 = verified drainage layer maximum water retention (use 0.15 as a baseline default in the absence of verification data)

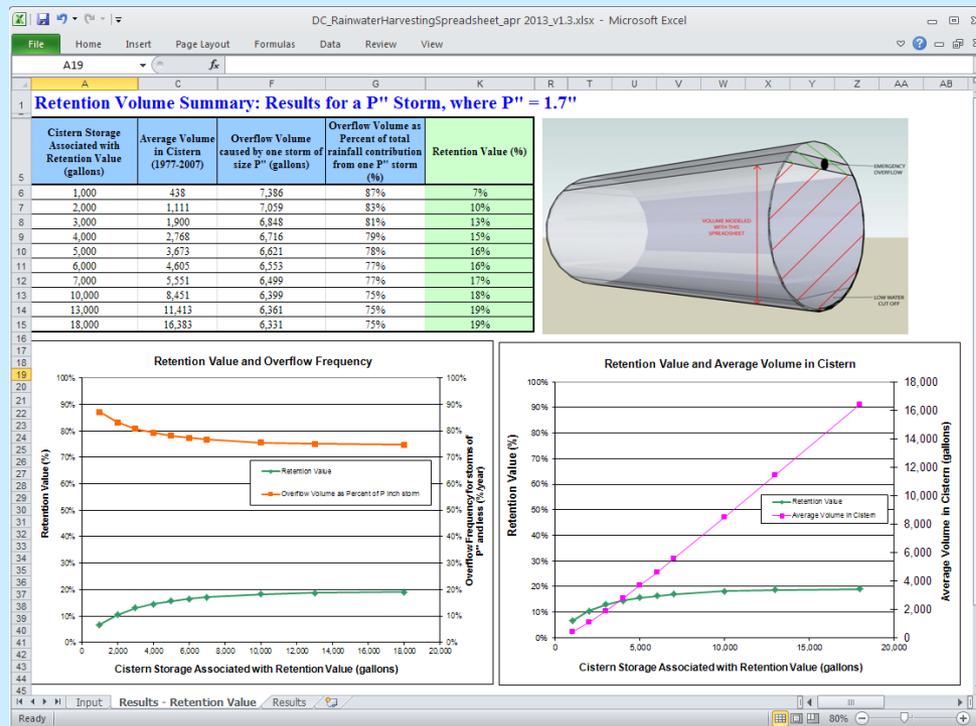
- 100% credit for water stored in Media and Drainage Layer

4.6 Rainwater Harvesting



Rainwater Harvesting Design Criteria

- Sizing of tank should be based on consistent demand.
- Large tank + large demand = large credit.

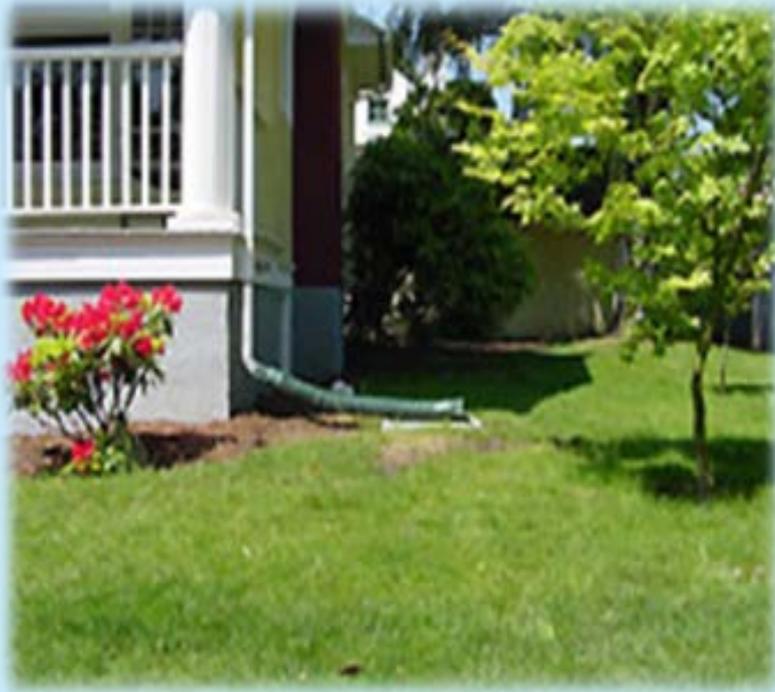


4.7 Impervious Surface Disconnection

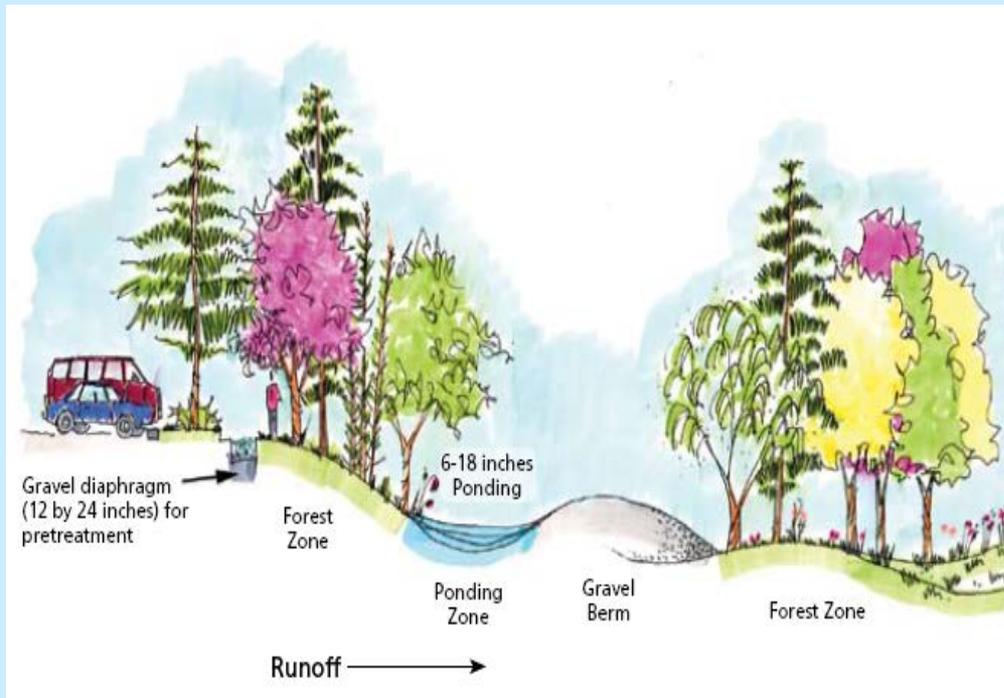


Disconnection to Managed Turf

(50%/25% Credit)



Disconnection to Forest Cover or Preserved Open Space (75% Credit)



Disconnection to Compost Amended Filter Path (50% Credit)

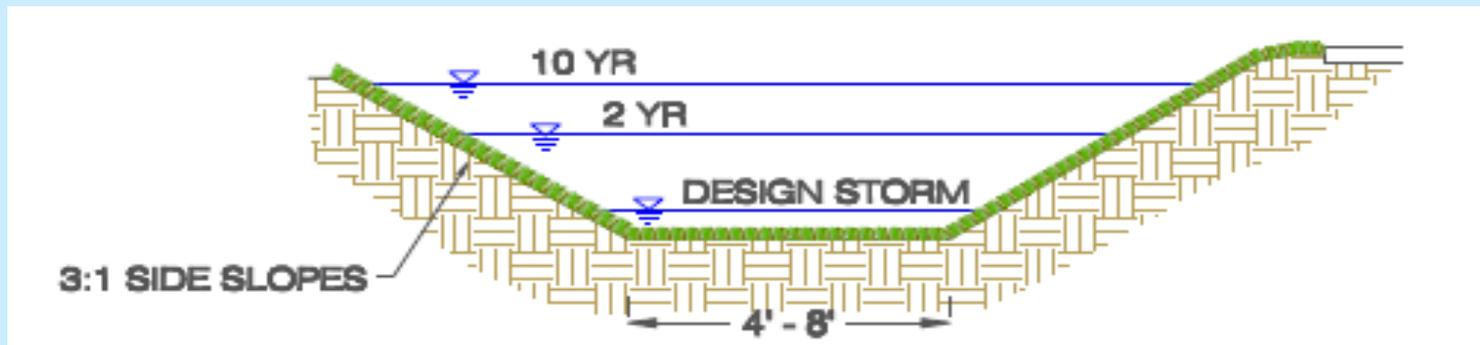


4.8 Open Channels



Grass Channel

- Flow depth for peak flow of water quality volume must be 4" or less.
- Residence time for water quality volume must be at least 9 minutes.
- A/B soils or compost amended: 20% credit
- C/D soils: 10% credit



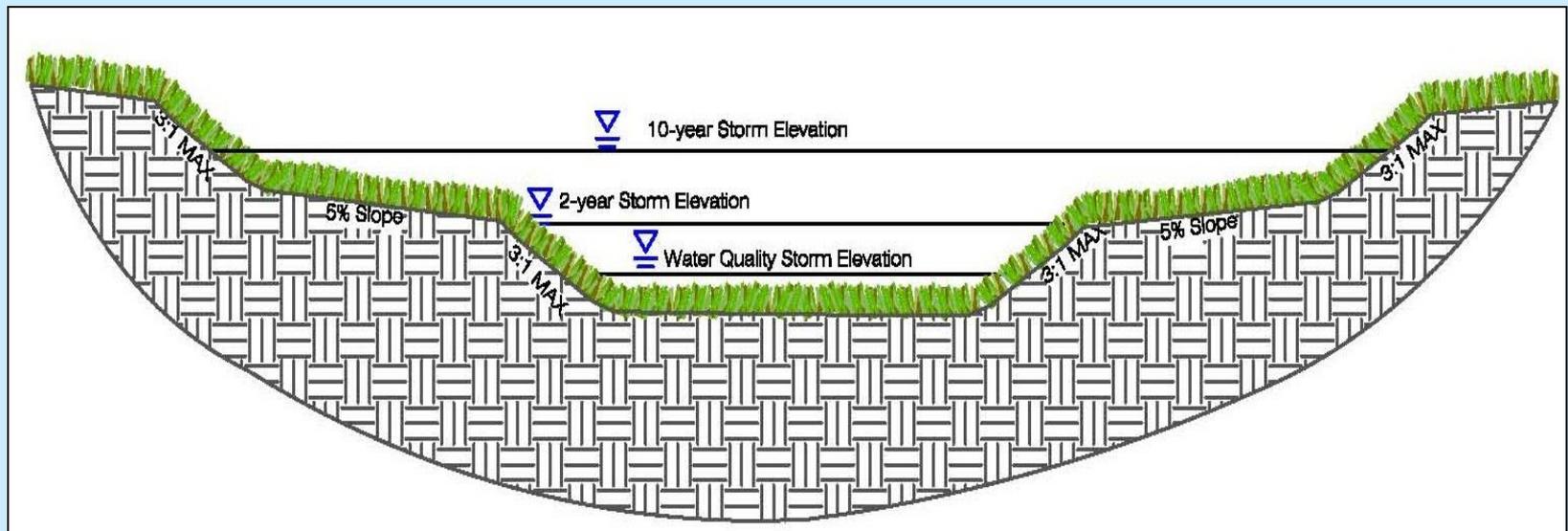
Dry Swales and Wet Swales

- Dry Swale = Linear Bioretention Area
- Wet Swale = Linear Wetland / Wet Pond



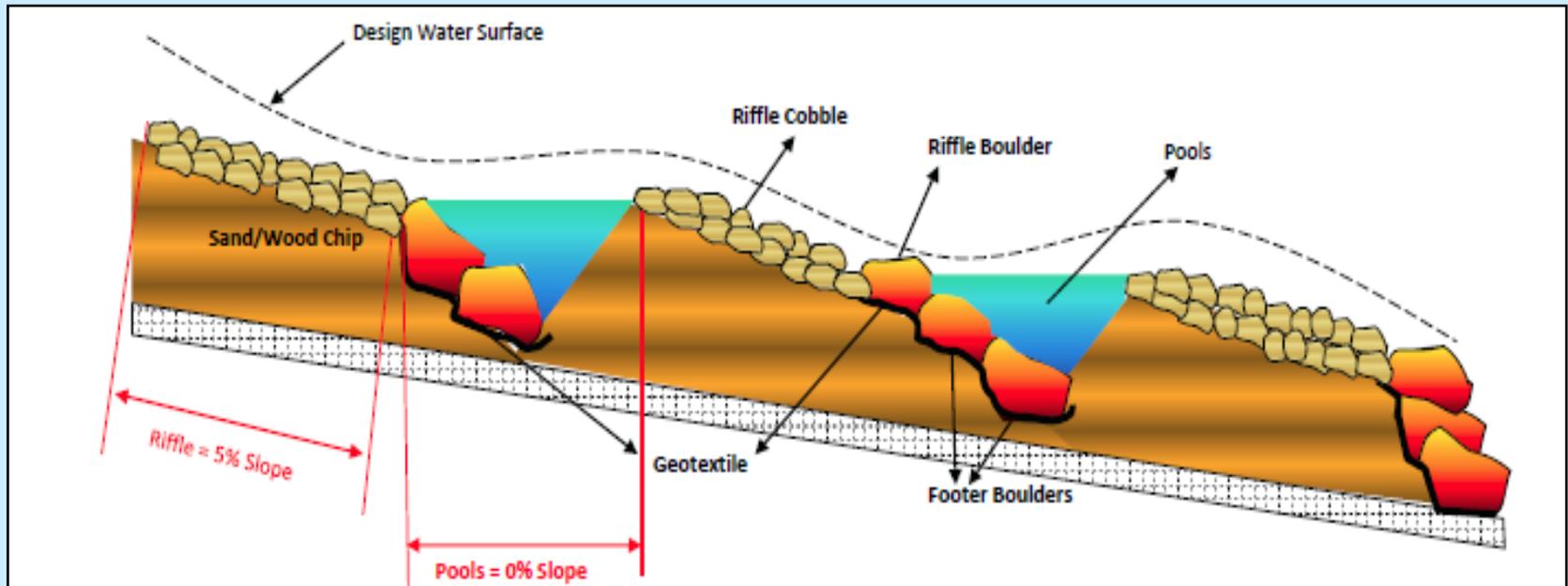
Two-Stage Ditch

- Not included for water quality credit beyond grass channel, as they are more applicable to larger storm events.
- Can improve channel stability.



Regenerative Stormwater Conveyance

- Takes advantage of existing slopes.
- Greater flows and depth = more detailed specifications
- 100% volume credit



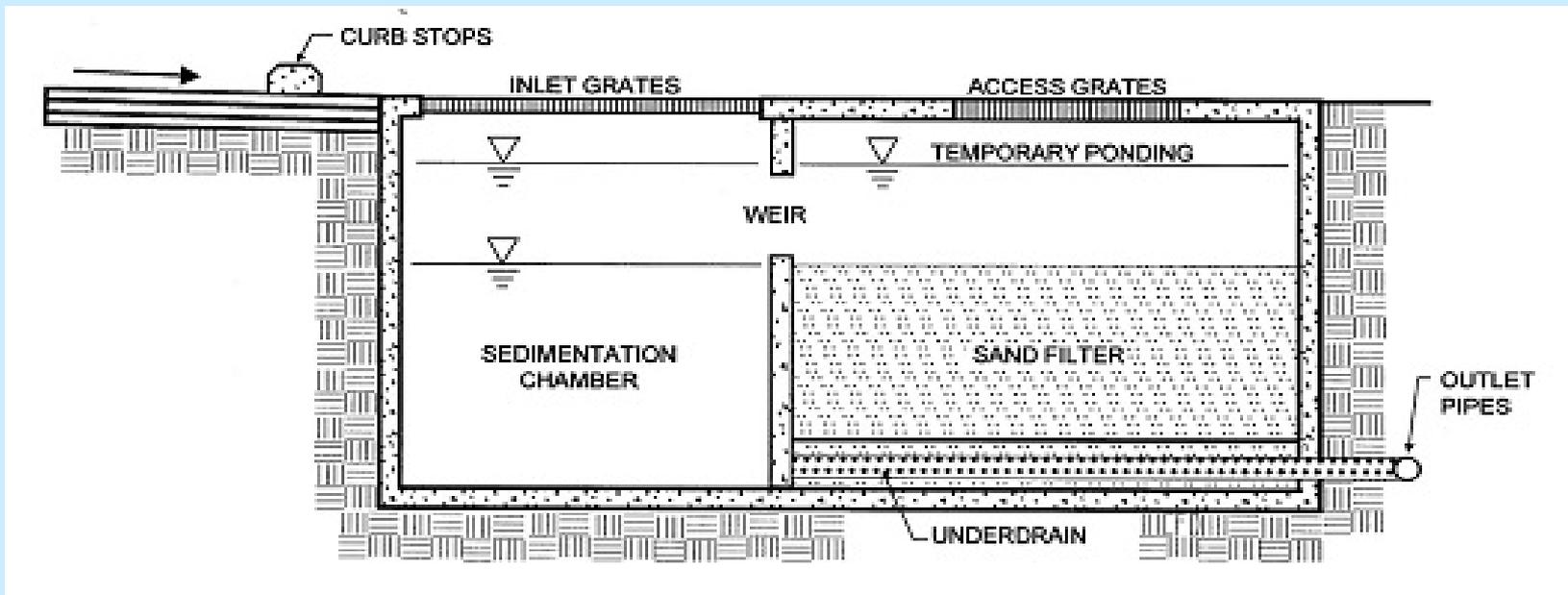
4.9 Stormwater Filtering Systems



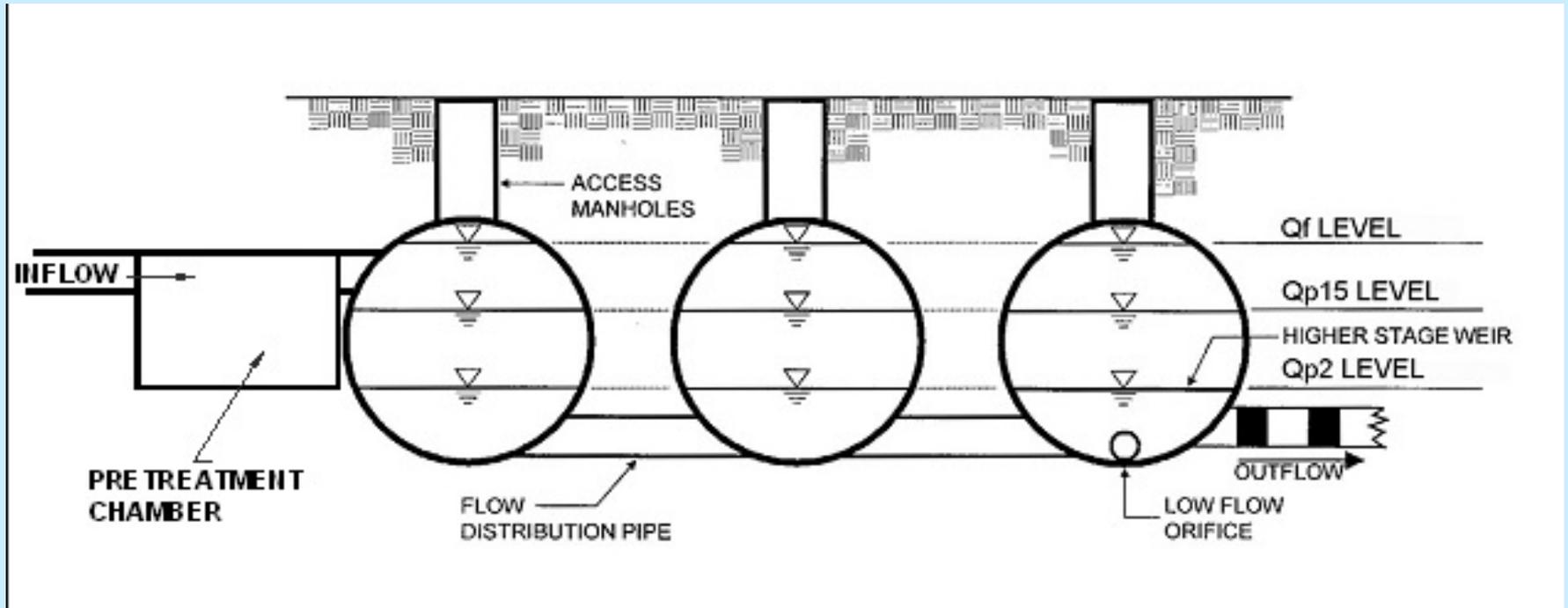
Image: Albemarle County

Stormwater Filtering Systems

- Must drain within 72 hours.
- Included in dry pond category???
- Must treat 1 inch over entire drainage area.



4.10 Dry Detention Practices



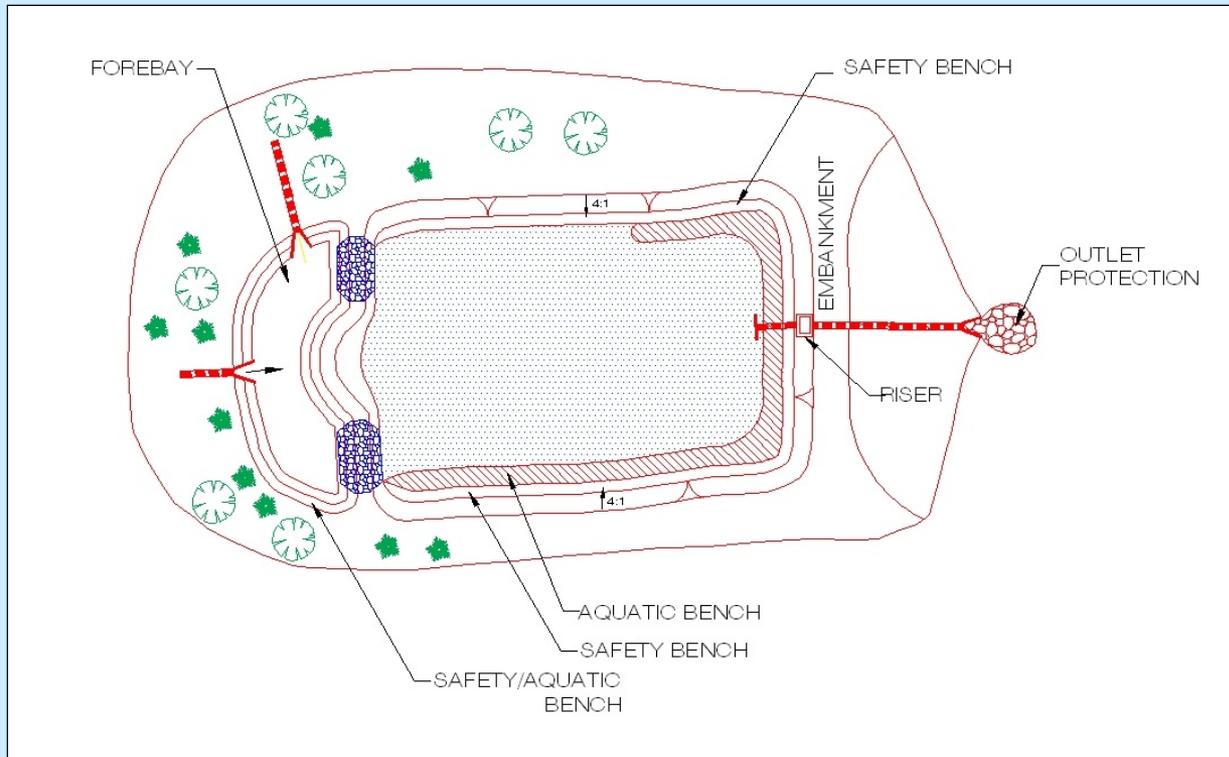
Must store and release 1 inch of runoff from entire drainage area over 24 hours.

Dry Detention Design Details

- Forebays and stabilized inlets recommended
- Pilot channels prohibited.
- Long flow paths preferred.
- Use of anti-clogging devices recommended.



4.11 Wet Detention Ponds



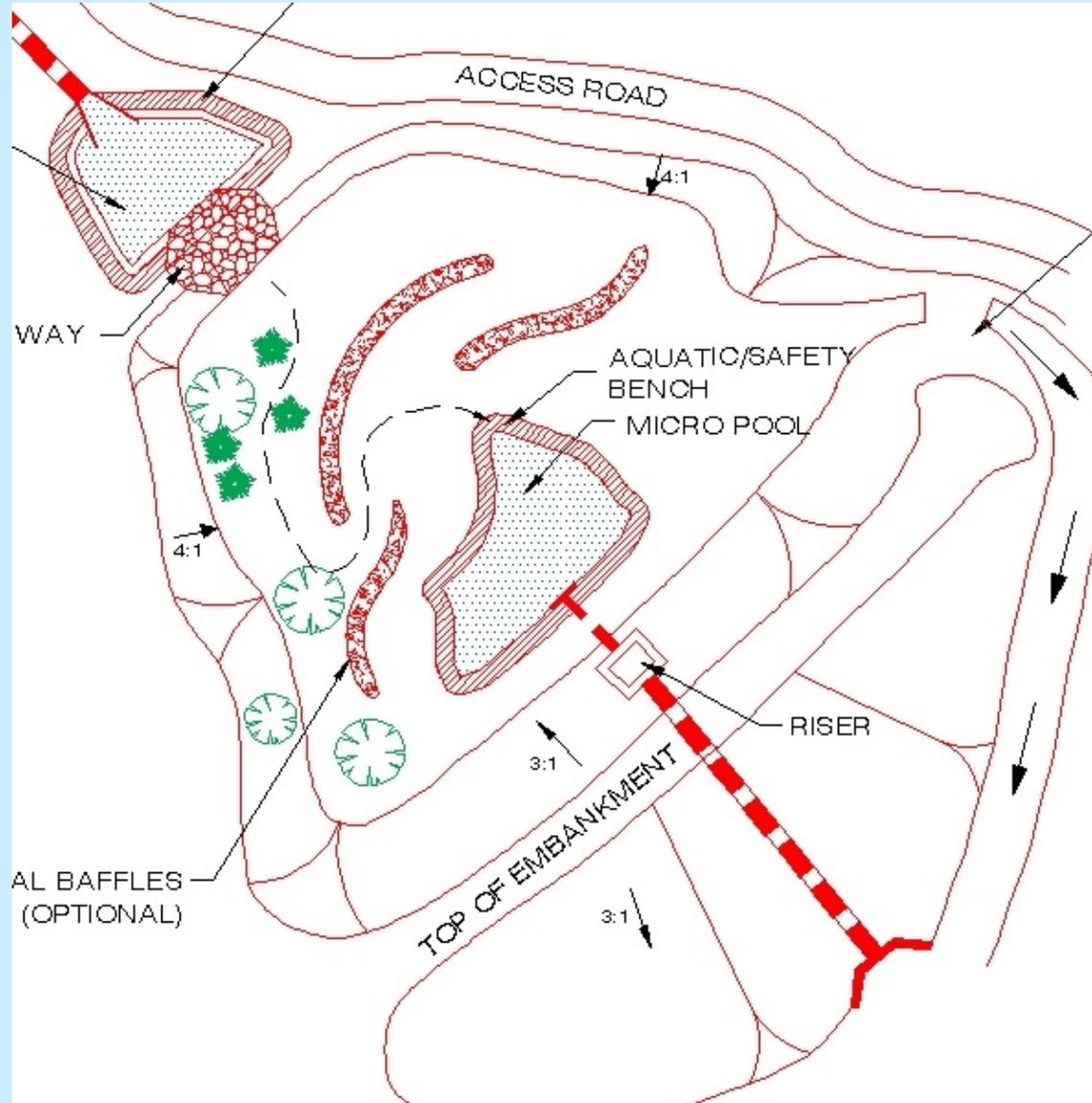
Must store and release 1/2 inch of runoff from entire drainage area over 24 hours.

Wet Detention Design Details

- Adequate water balance required.
- 0.5 inches of permanent pool storage is recommended.
- Safety bench and aquatic bench recommended.



4.12 Stormwater Wetlands



4.12 Stormwater Wetlands

- Multiple depth zones recommended, varying between 6" and 48" deep.
- Flow path to width ratio should be at least 2:1.



Questions?



<http://www.connectionnewspapers.com/news/2012/may/23/street-runs-through-it/>



<http://www.vaasphalt.org/>

Appendix A

Indicate Pre-Development Land Cover and Runoff Curve Numbers

Cover Type	Area (acres)								Total	% Cover	Rv
	Soil Type A	CN	Soil Type B	CN	Soil Type C	CN	Soil Type D	CN			
Forest Cover/Open Space		30		55		70		77	0.00	0%	0
Turf Cover		39		61		74		80	0.00	0%	0
Impervious Cover		98		98		98		98	0.00	0%	0
Total	0.00		0.00		0.00		0.00		0.00	0%	0.00

Indicate Post-Development Land Cover

Cover Type	Area (acres)								Total	% Cover	Rv
	Soil Type A	CN	Soil Type B	CN	Soil Type C	CN	Soil Type D	CN			
Forest Cover/Open Space		30		55		70		77	0.00	0%	0
Turf Cover		39		61		74		80	0.00	0%	0
Impervious Cover		98		98		98		98	0.00	0%	0
Total	0.00		0.00		0.00		0.00		0.00	0%	0.00

Is Site Located Within 1/2 Mile of Receiving Water Body?	No
Is Site Located Within 1,000 sf of a Shellfish Bed?	No

Water Quality Volume		Corresponding Rainfall (in)
Receiving Water Body Storage Volume (cf)	0	0.00
Shellfish Bed Storage Volume (cf)	0	0.00
LID Practices (cf)	0	0.00
Ponds With Permanent Pool (cf)	0	0.00
Ponds Without Permanent Pool (cf)	0	0.00

Appendix B

Infiltration Testing

- Need a verified infiltration rate to utilize infiltration testing:
 - Well Permeameter Method (USBR 7300-89)
 - Double-Ring Infiltrometer (ASTM D 3385);
- Falling Head (single ring) test currently not recommended.

Appendix C

Soil Amendments

- Specifications for Compost



Appendix D

Peak Flow Calculations

- Recommended method for determining peak flow from a small storm event (0.5 inch, 1 inch, etc).