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Stormwater Management Plan Review Course



Module 4

Runoff Reduction and Water Quality



Module 4 Content

4a: Overview of the Runoff Reduction Method

4b: Land Cover & Volumetric Runoff Coefficients

4c: The Simple Method

4d: Virginia Water Quality Requirements

4e: Introduction to Stormwater Runoff
Reduction Practices

4f: VRRM Compliance Spreadsheet Example

Virginia Runoff Reduction Spreadsheet

Virginia Runoff Reduction Method New Development Worksheet -- v2.7 Revised Feb 2014

Site Data

Project Name:

Date:

7 data input cells
8 calculation cells
9 constant values

1. Post-Development Project & Land Cover Information

Constants

Annual Rainfall (inches)	43		
Target Rainfall Event (inches)	1.00		
Phosphorus EMC (mg/L)	0.26	Nitrogen EMC (mg/L)	1.86
Target Phosphorus Target Load (lb/acre/yr)	0.41		
Pj	0.90		

Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00		0.00	0.00	0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00		0.00	0.00	0.00
Impervious Cover (acres)	0.00		0.00	0.00	0.00
	Total				0.00

Rv Coefficients

	A soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Land Cover Summary

Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.00

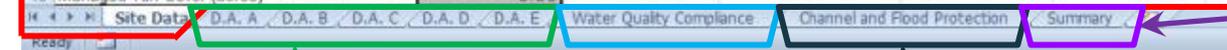
Site Data Input

Summary Print-out

Drainage Area Inputs

Water Quality Check

Channel/Flood Protection Info



Virginia Runoff Reduction Spreadsheet

	A	B	C	D	E	F
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40	Managed Turf Cover (acres)	0.00				

Land Cover (acres) by HSG

Constants & Volumetric Runoff Coefficients

Calculated Results:
 Composite Rv
 Pollutant Load
 Load Reduction
 Treatment Volume

Site Data Input

4a. Overview of the Virginia Runoff Reduction Method (VRRM)

- **Environmental Site Design**
- **Land cover type** in pollutant and hydrologic loading factors
- New treatment options with performance credit breakouts
(RR and EMC → Mass Load)
- Step-wise (iterative) compliance process



4a. Overview of the VRRM

- CWP Technical Memorandum:
Runoff Reduction Method (April, 2008)
- VRRM Instructions &
Documentation (March, 2011)

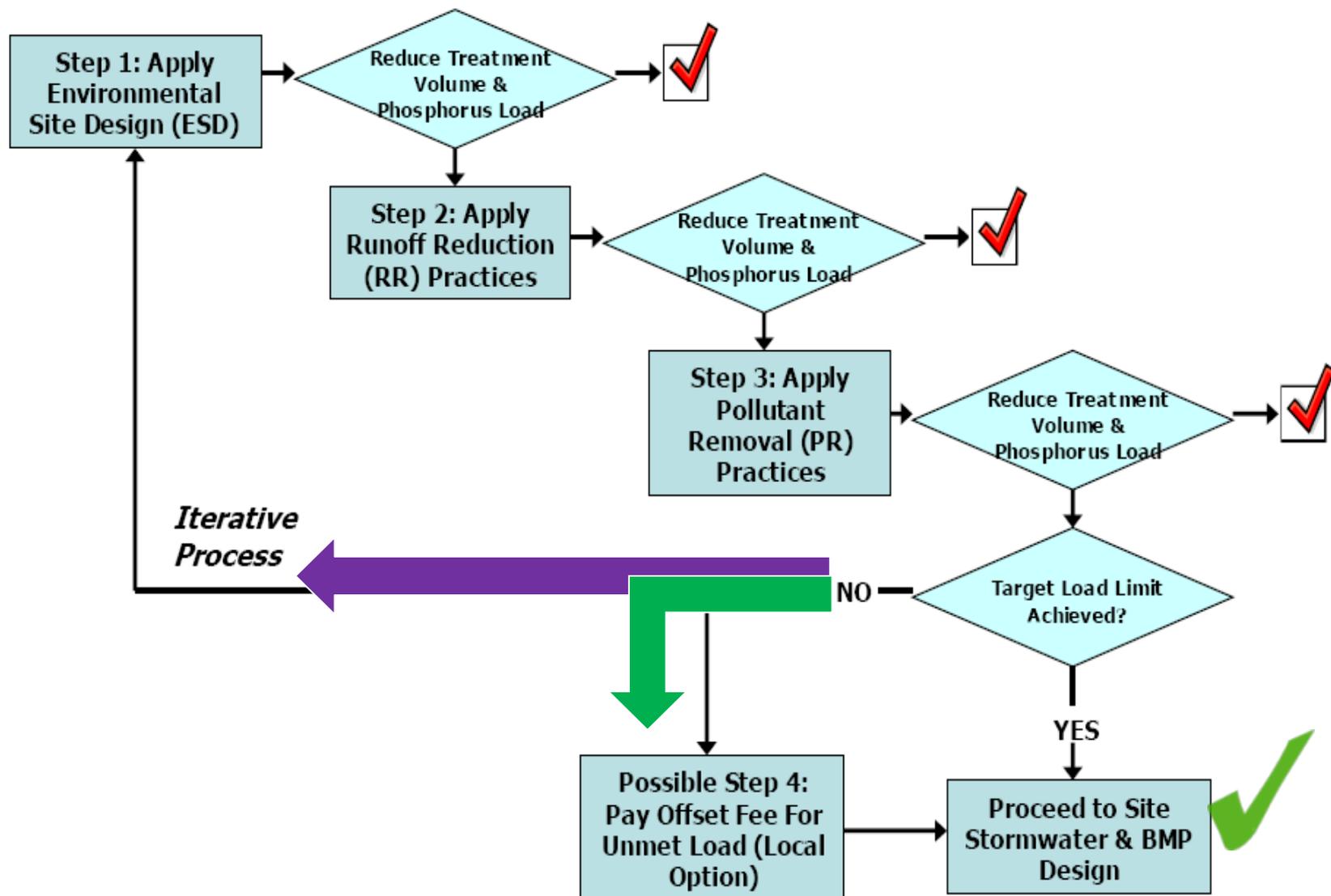
[www.deq.virginia.gov/Programs/Water/
Laws,Regulations,Guidance/Guidance/
StormwaterManagementGuidance.aspx](http://www.deq.virginia.gov/Programs/Water/Laws,Regulations,Guidance/Guidance/StormwaterManagementGuidance.aspx)



4a. Overview of the VRRM

- Key Terminology Review
 - Runoff Reduction (RR)
 - Pollutant Removal (PR)
 - Total Performance
 - VRRM Compliance Spreadsheet

4a. Overview of the VRRM





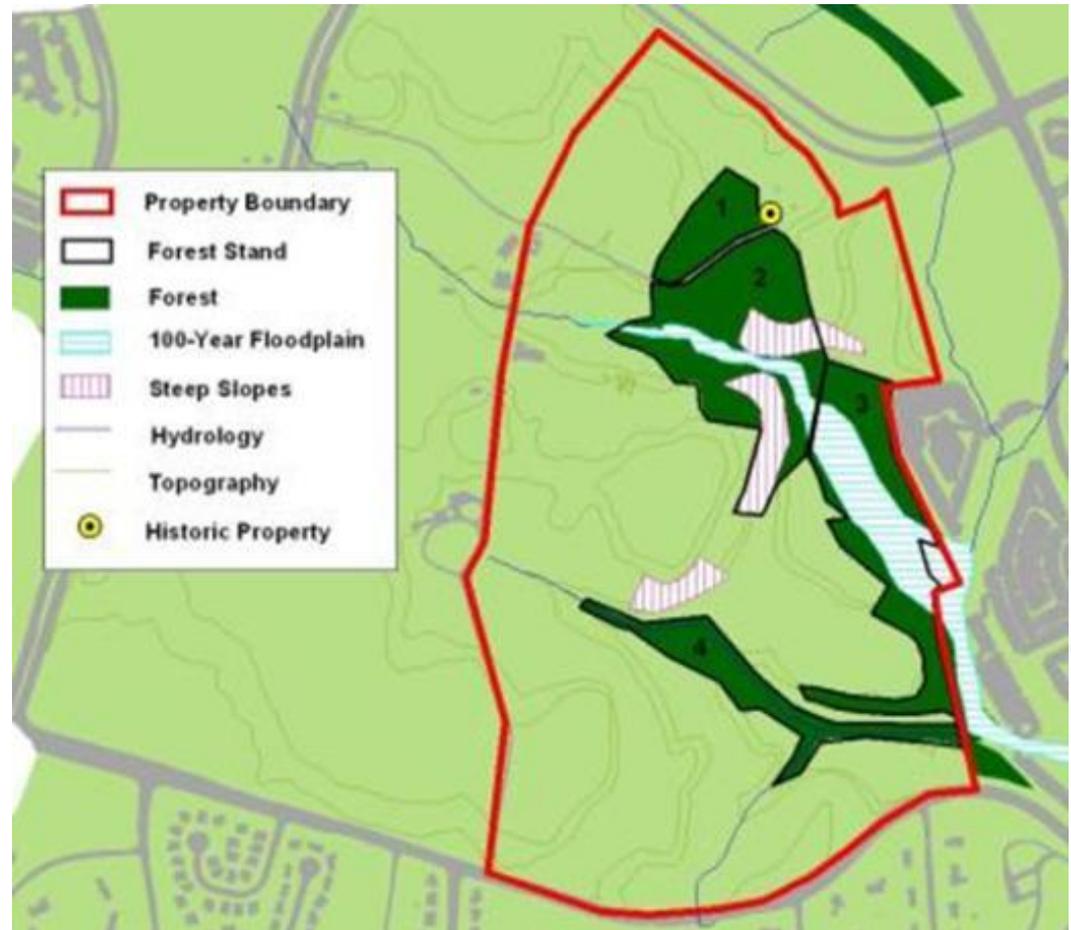
4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- **Codifies & incentivizes minimization and avoidance**
- Beyond impervious cover
- Latest BMP research (Total Mass Load Removal)
- Credits total BMP performance

4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Environmental Site Design

site inventory &
assessment



4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

Impacts from soil grading/ compaction



Volumetric Runoff Coefficients in VRRM



Undisturbed pervious areas



Impacted soils & managed turf

4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

Impacts from turf management activities



4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

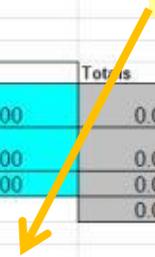
- Treatment Volume:
Site Runoff Coefficients (Rv)

Cover	HSG A	HSG B	HSG C	HSG D
Forest/Open	0.02	0.03	0.04	0.05
Managed Turf / Disturbed Soil	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Virginia Runoff Reduction Spreadsheet

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13	Constants					
15	Annual Rainfall (inches)	43				
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17	Phosphorus EMC (mg/L)	0.26	Nitrogen EMC (mg/L)	1.86		
18	Target Phosphorus Target Load (lb/acre/yr)	0.41				
19	Pj	0.90				
21	Land Cover (acres)					
22		A soils	B Soils	C Soils	D Soils	Totals
23	Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00		0.00	0.00	0.00
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25	Impervious Cover (acres)	0.00		0.00	0.00	0.00
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39	% Forest	0%				
40	Managed Turf Cover (acres)	0.00				

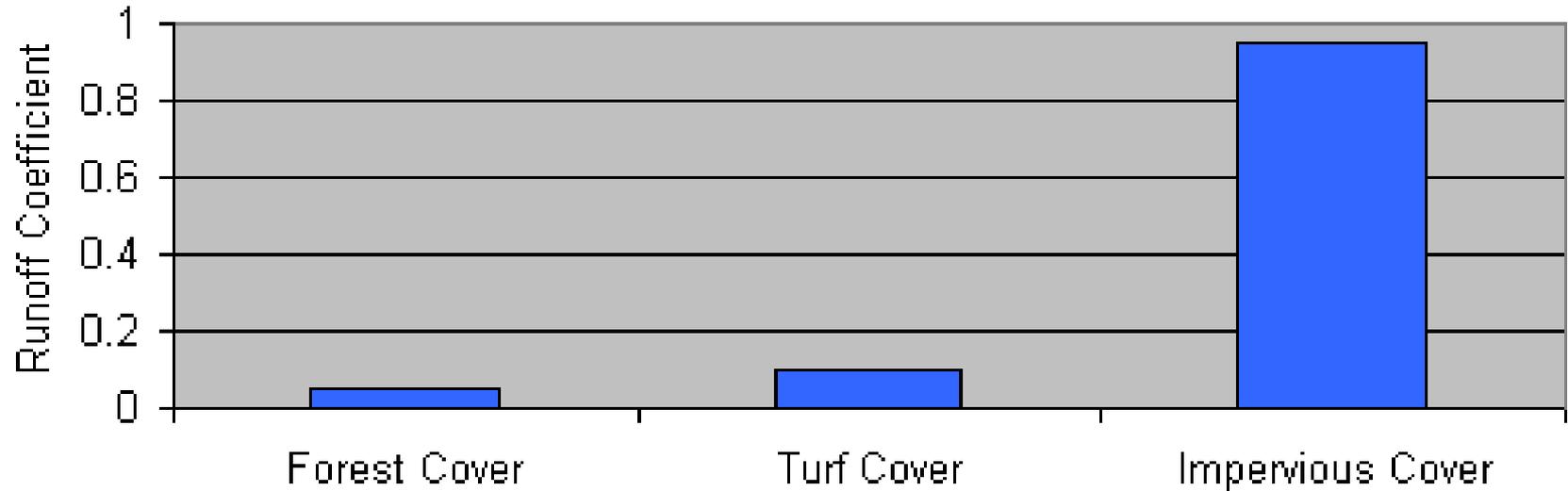
Volumetric Runoff Coefficients



Site Data Input

4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Runoff Coefficients



4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Forest and Open Space

Portions of residential lots **not** disturbed during construction

Portions of road rights-of-way used as:
filter strips, grass channels, stormwater treatment areas

Community open space areas **not** mowed routinely



4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Forest and Open Space

Utility rights-of-way left in natural vegetated state

4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Forest and Open Space

Surface area of stormwater BMPs:

NOT wet ponds

Some type of vegetative cover

Do NOT replace otherwise impervious surface

4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Forest and Open Space

Other areas of existing forest/open space:

Protected during construction

Remain undisturbed

Includes wetlands



4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Forest and Open Space Op & Management

Undisturbed portions of yards, community open space, and other areas:

Must show outside **LOD** on approved ESC plans

Demarcated in field (e.g., fencing) prior to commencement of construction

4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Forest and Open Space Op & Management

Roadway rights-of-way that will count as
forest/open space:

Assumed to be disturbed during construction

Current soil restoration/site reforestation design specs

Other relevant specs if area will be **used as BMP**



4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Forest and Open Space Op & Management

Documentation for area remaining in
natural, vegetated state*

**only approved management activities*

4b. Land Cover and Volumetric Runoff Coefficients in the VRRM

- Land Cover Definitions

Managed Turf

Areas intended to be mowed and maintained as turf within:

Residential

Industrial

Commercial

Institutional
settings

Virginia Runoff Reduction Spreadsheet

Virginia Runoff Reduction Method New Development Worksheet -- v2.7 Revised Feb 2014

Site Data

Project Name:

Date:

7 data input cells
8 calculation cells
9 constant values

1. Post-Development Project & Land Cover Information

Constants

Annual Rainfall (inches)	43			
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Phosphorus EMC (mg/L)	0.26	Nitrogen EMC (mg/L)	1.86	
Target Phosphorus Target Load (lb/acre/yr)	0.41			
Pj	0.00			

Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00		0.00	0.00	0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00		0.00	0.00	0.00
Impervious Cover (acres)	0.00		0.00	0.00	0.00
	Total				0.00

Rv Coefficients

	A soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Land Cover Summary

Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.00

Ready

Areas by:
Land Cover Type
and
HSG

Site Data Input



4c. The Simple Method

$$L = P \times P_j \times R_v \times C \times A \times \frac{2.72}{12}$$

- Estimates annual pollutant load exported in stormwater runoff from small urban catchments

4c. The Simple Method

$$L = P \times P_j \times R_v \times C \times A \times \frac{2.72}{12}$$

L (lbs/yr) = total post-dev. pollutant load

P (in) = average annual rainfall depth
= 43 in. (VA)

P_j = fraction of rainfall events
producing runoff
= 0.9

4c. The Simple Method

$$L = P \times P_j \times \underline{Rv} \times \underline{C} \times \underline{A} \times \frac{2.72}{12}$$

Rv = volumetric runoff coefficient

C (mg/L) = flow-weighted event mean concentration (EMC) of TP

= 0.26

A (acres) = area of development site

4c. The Simple Method

$$L = P \times Pj \times Rv \times C \times A \times \frac{2.72}{12}$$

2.72 = unit conversion factor:

(L to ft³, mg to lb, acres to ft²)

12 = unit conversion factor
(rainfall in. to ft.)

$$L = P \times P_j \times R_v \times C \times A \times \frac{2.72}{12}$$

Virginia Runoff Reduction Method New Development Worksheet -- v2.7 Revised Feb 2014

Site Data

Project Name:

Date:

1. Post-Development Project & Land Cover Information

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Phosphorus EMC (mg/L)	0.26
Target Phosphorus Target Load (lb/acre/yr)	0.41
P _j	0.90

Nitrogen EMC (mg/L)

Land Cover (acres)	A soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00		0.00	0.00	0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00		0.00	0.00	0.00
Impervious Cover (acres)	0.00		0.00	0.00	0.00
				Total	0.00

Rv Coefficients	A soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Land Cover Summary

Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.00

Constants:

$C_{(\text{phosphorus})} = 0.26 \text{ mg/L}$
 $P_{(\text{VA annual})} = 43 \text{ in}$
 $P_j = 0.9$

$R_{v(\text{SITE})}$

Calculated Results:
Pollutant Loads (L)

Site Data Input

4c. The Simple Method

Old Rules
(Part IIC)

$$L = P \times P_j \times \underline{R_v} \times C \times A \times \frac{2.72}{12}$$

R_v based on 16% impervious cover

$C = 0.26$ mg/L

Load Limit (L) = 0.45 lb/ac/yr

4c. The Simple Method

$$L = P \times P_j \times RV_{composite} \times C \times A \times \frac{2.72}{12}$$

- $C = 0.26 \text{ mg/l}$

*New Rules
(Part IIB)*

*Runoff Reduction
Method Technical
Memorandum, April
2008*

Parameter	Median EMC (mg/L)
Total Nitrogen	
National	1.9
Virginia	1.86
<i>Residential</i>	2.67
<i>Non-Residential</i>	1.12
Virginia Coastal Plain	2.13
<i>Residential</i>	2.96
<i>Non-Residential</i>	1.08
Virginia Piedmont	1.70
<i>Residential</i>	1.87
<i>Non-Residential</i>	1.30
Total Phosphorus	
National	0.27
Virginia	0.26
<i>Residential</i>	0.28
<i>Non-Residential</i>	0.23
Virginia Coastal Plain	0.27
Virginia Piedmont	0.22
Total Suspended Solids	
National	62
Virginia	40

4c. The Simple Method

$$L = P \times P_j \times Rv_{composite} \times C \times A \times \frac{2.72}{12}$$

New Rules:

$Rv_{composite}$ = Composite or weighted runoff coefficient

$$Rv_{composite} = (Rv_I \times \%I) + (Rv_T \times \%T) + (Rv_F \times \%F)$$

Where:

Rv_I = Runoff coefficient for Impervious cover (0.95)

Rv_T = for Managed Turf/Disturbed soils (Table 4-1)

Rv_F = for Forest/Open Space (Table 4-1)

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25	Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00
26		Total				0.00
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41	Weighted Rv(turf)	0.00				
42	% Managed Turf	0%				
43	Impervious Cover (acres)	0.00				
44	Rv(impervious)	0.95				
45	% Impervious	0%				
46	Total Site Area (acres)	0.00				
47	Site Rv	0.00				
48						
49	Post-Development Treatment Volume (acre-ft)	0.00				
50	Post-Development Treatment Volume (cubic feet)	0				
51	Post_Development Load (TP) (lb/yr)	0.00	Post_Development Load (TN) (lb/yr)			0.00
52	Total Load (TP) Reduction Required (lb/yr)	0.00				

What about site load limit?
0.41 lb/acre/yr

Weighted (by HSG) Rv for Forest, Turf, & Imp

Composite Site Rv

4c. The Simple Method

$$Rv_{composite} = (Rv_I \times \%I) + (Rv_T \times \%T) + (Rv_F \times \%F)$$

New Development Water Quality Requirements:

- **Old Requirement:** 0.45 lb/ac/yr TP
- **New Proposal:** 0.28 lb/ac/yr TP
- **Final Adopted:** **0.41 lb/ac/yr TP**
(annual load limit)

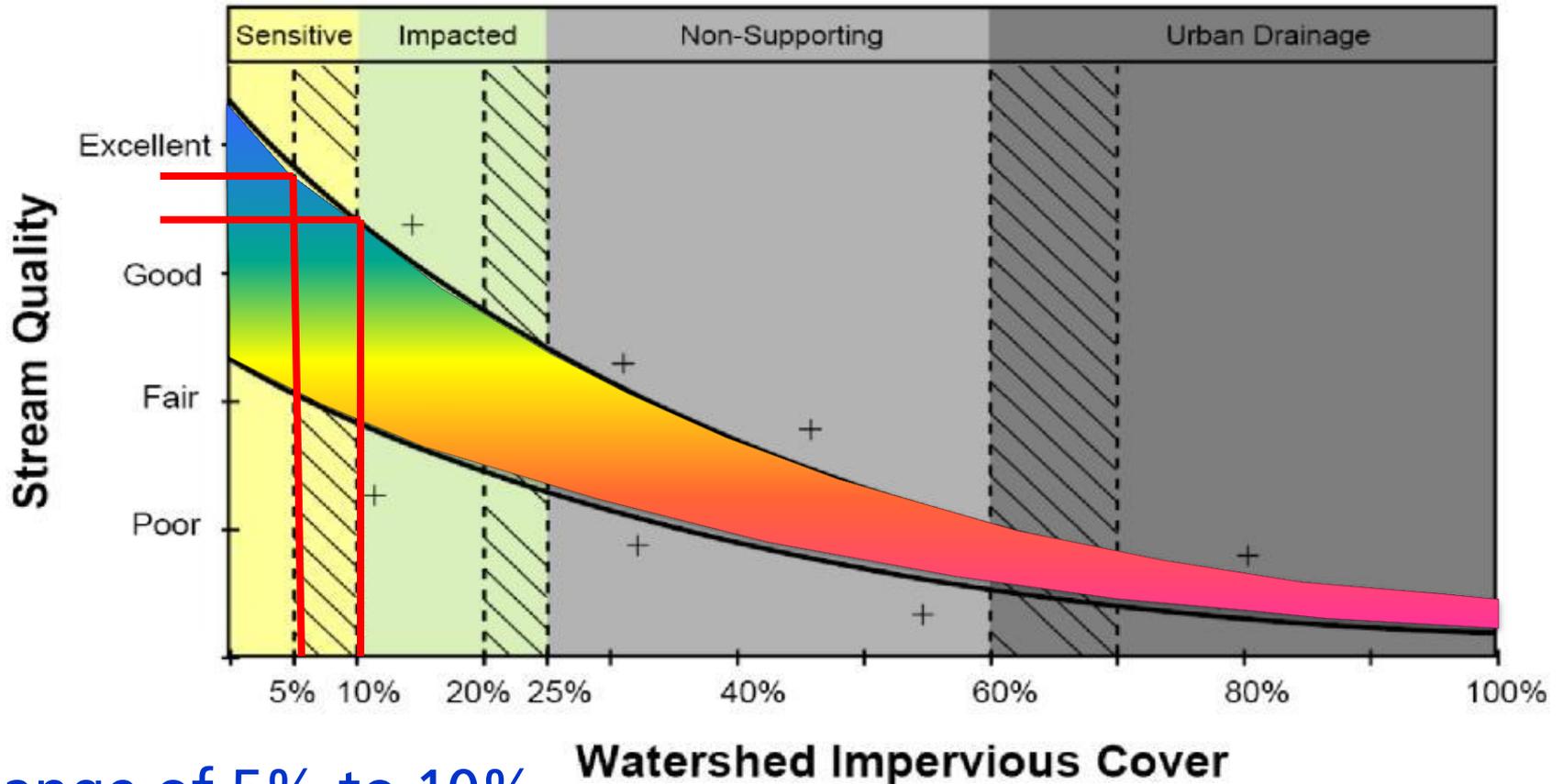
Where did I get that number?

Over 10% impervious cover:

- Streams visibly impacted
- Stream channel widened and/or deepened
- Tree roots exposed
- Pool and riffle structure compromised



Impervious Cover Model Revisited



Range of 5% to 10%
Impervious Cover

Watershed-Based Site Load Limit

$$L = P \times P_j \times R_v \times C \times A \times 2.72/12$$

$$= 0.41 \text{ lb/acre/yr}$$

Composite R_v^2 calculated using:

10% impervious cover

60% forest

30% managed turf

Treatment Volume & BMP Sizing

$$Tv_{BMP} = \frac{(P \times Rv_{composite} \times A)}{12}$$

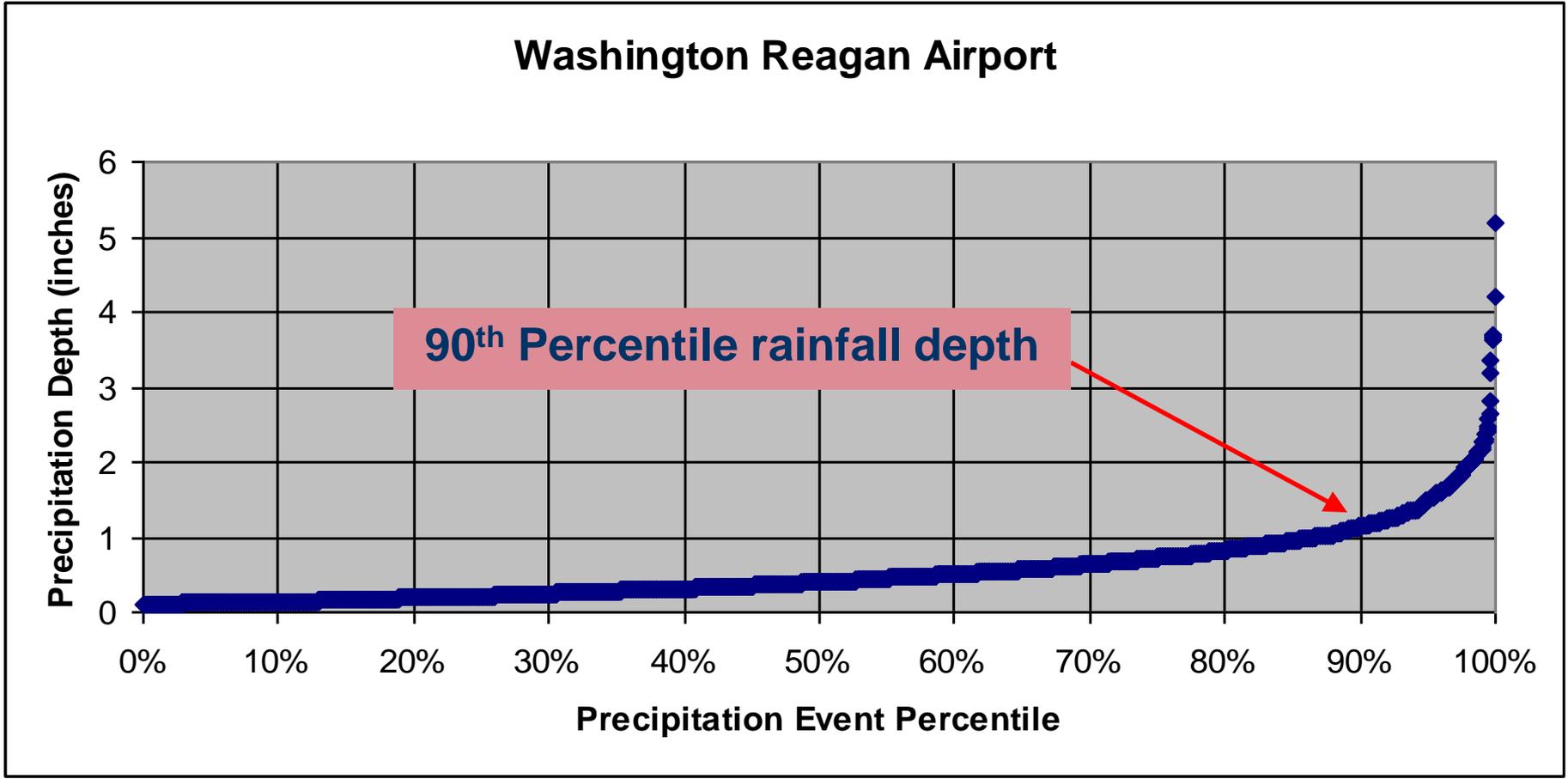
Tv_{BMP} = Treatment Volume from contributing drainage area to BMP + remaining runoff from upstream practices

P = 90th Percentile rainfall depth = 1"

$Rv_{composite}$ = Composite runoff coefficient

A = Contributing drainage area to BMP

Design Rainfall = 90th percentile rainfall depth = 1”



1" annual average: Washington Reagan Airport, Richmond Airport, Harrisonburg, Lynchburg, Bristol

90th percentile rainfall depth of 1”

Using the 90th percentile rainfall depth translates to an annual average reduction

- Represents average over all storms and not individual single-event modeled storms
- Oversizing practice - no credit
- Level 2 – allows for > 90th percentile rainfall

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41	Weighted Rv(turf)	0.00				
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43	Impervious Cover (acres)	0.00				
44	Rv(impervious)	0.95				
45	% Impervious	0%				
46	Total Site Area (acres)	0.00				
47	Site Rv	0.00				
48						
49	Post-Development Treatment Volume (acre-ft)	0.00				
50	Post-Development Treatment Volume (cubic feet)	0				
51		0.00				
52	Total Load (TP) Reduction Required (lb/yr)	0.00				
53			Post_Development Load (TN) (lb/yr)		0.00	

Weighted (by HSG) Rv for Forest, Turf, & Imp

Composite Site Rv

Post-Dev Tv

Pollutant Load (TP & TN)

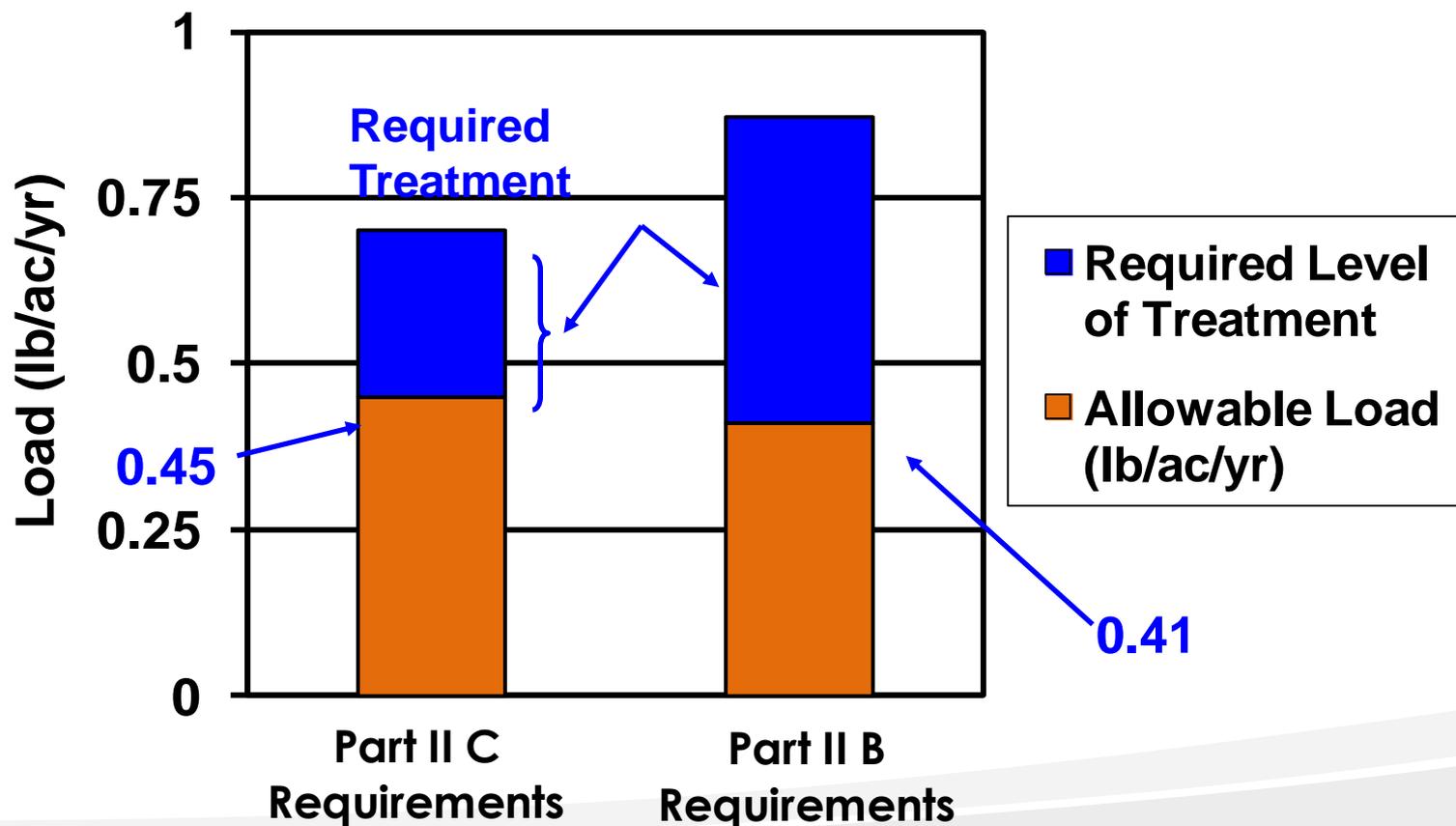
Total Load Reduction Req'd.



4d. Water Quality Requirements

- **New Development:**
 - 0.41 lb/ac/yr TP
- **Re-Development:**
 - LDA \geq 1 acre: 20% reduction in exist annual TP load
 - LDA $<$ 1 acre: 10% reduction in exist annual TP load

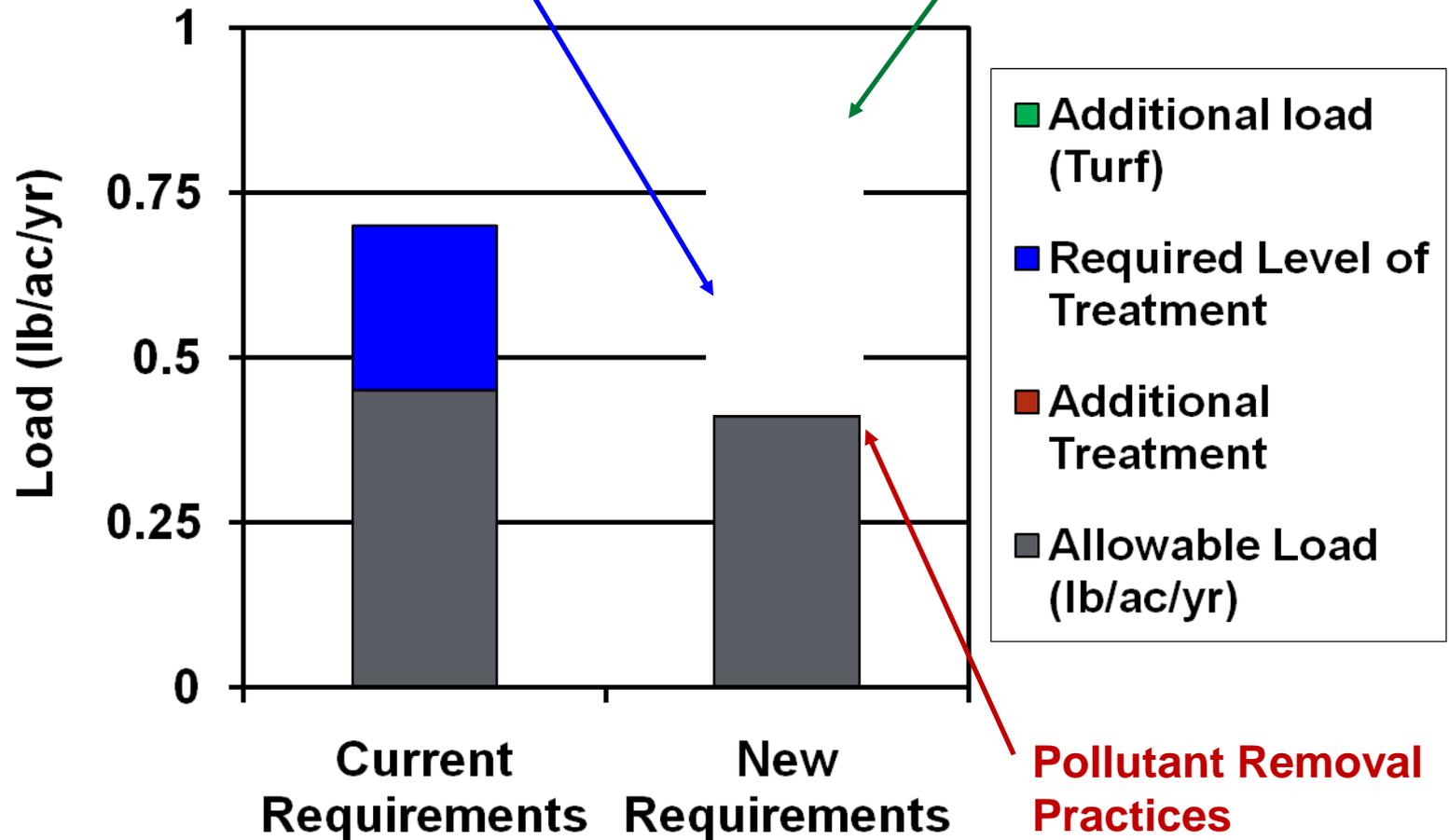
4d. Water Quality Requirements



Treatment Options Made Simple

Runoff Reduction Practices

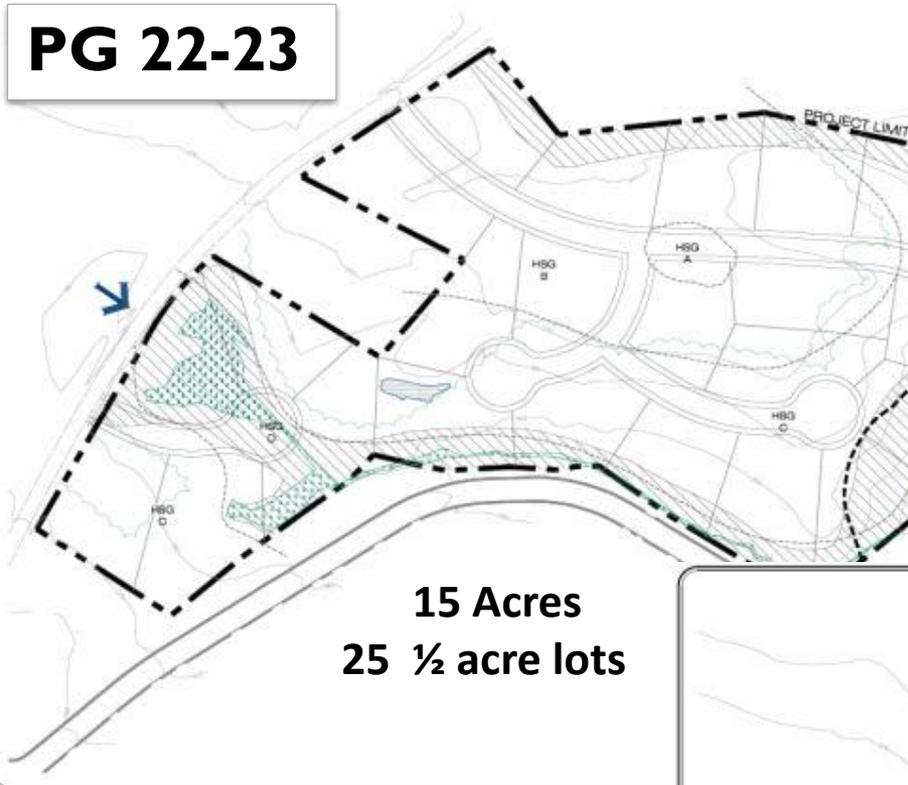
Minimization/ESD



How can ESD apply?

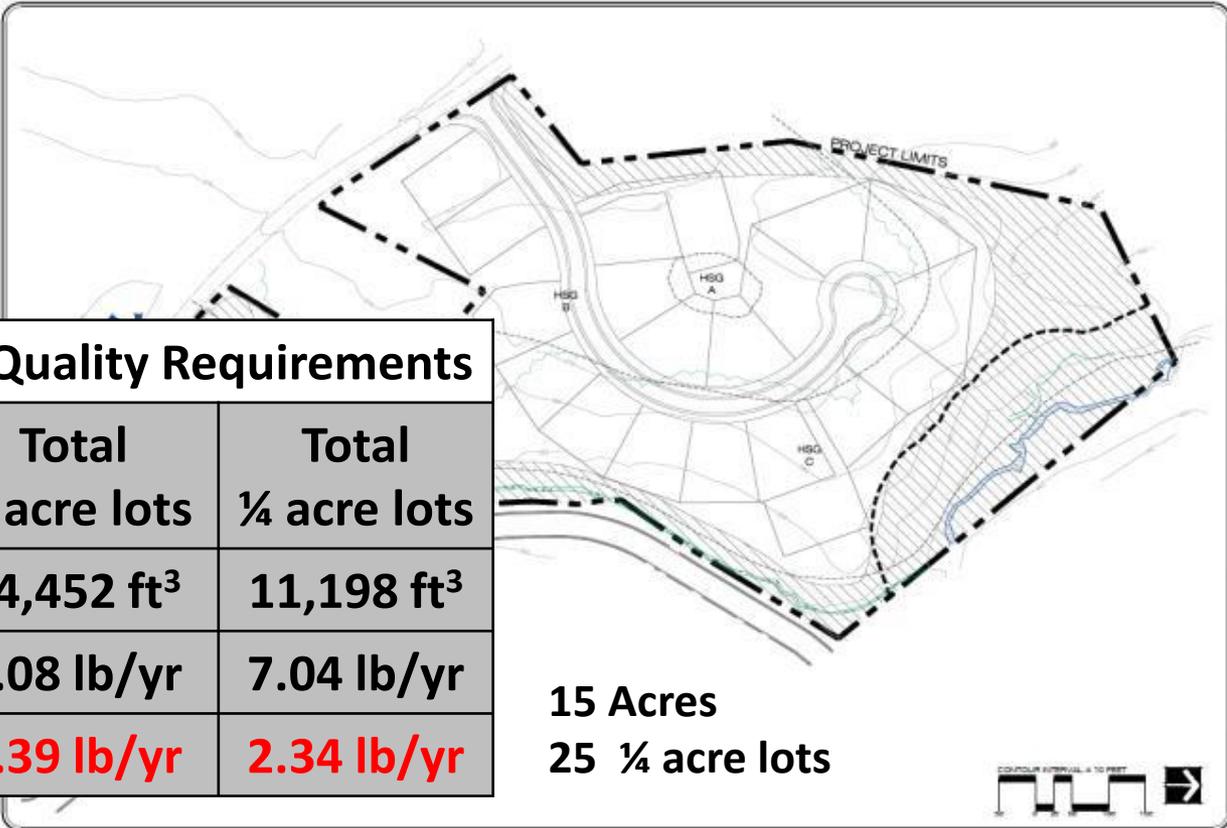


PG 22-23



15 Acres
25 ½ acre lots

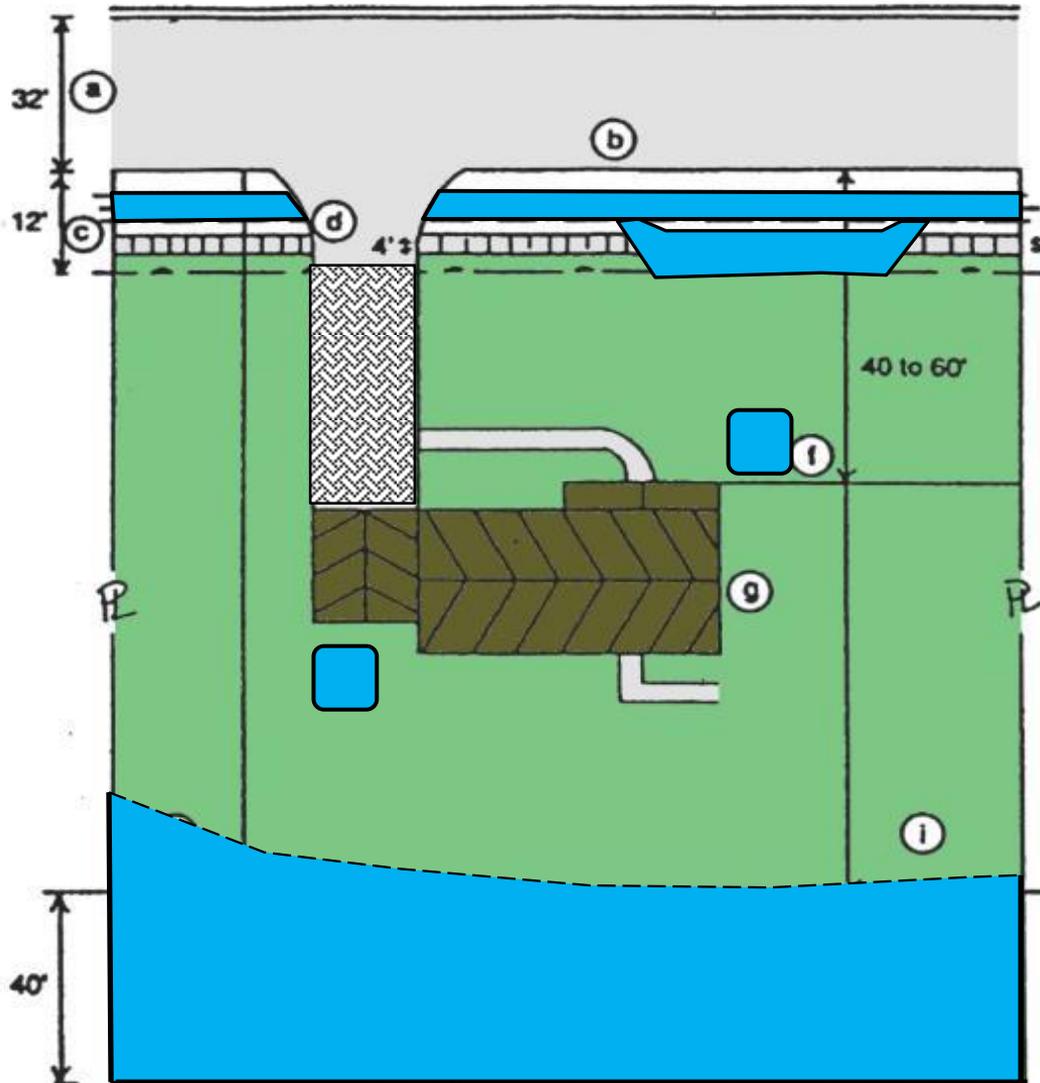
Drainage Area Land Cover (Acres)		
Land Cover	Total ½ acre lots	Total ¼ acre lots
Forest	0.87	4.31
Turf	8.32	5.26
Impervious	2.26	1.88



15 Acres
25 ¼ acre lots

Drainage Area Water Quality Requirements		
	Total ½ acre lots	Total ¼ acre lots
Post-Dev Treatment Vol	14,452 ft ³	11,198 ft ³
Post-Dev TP Load	9.08 lb/yr	7.04 lb/yr
Pollutant Removal Req'd.	4.39 lb/yr	2.34 lb/yr

Site Design: Decentralized Treatment



Right-of-way

Treatment

Grass Channels

Bioretention

On-Lot Treatment

Simple Disconnection

Alternative Practice

Disconnection

- Raingardens

- Drywells

- Cisterns

Permeable Pavement

Driveways

Soil Restoration

When soil disturbance unavoidable:

BMP Design Specification No. 4



Soil Restoration

*Photo Credit: Richard McLaughlin, Ph.D.,
North Carolina State University*



Soil Testing

*Stu Schwartz, Center for Urban Environmental Research and
Education, University of Maryland Baltimore Co.*

Recognized non-
structural RR
stormwater practice



4e. Introduction to Stormwater Runoff Reduction BMPs

- Codifies & incentivizes minimization and avoidance
- Goes beyond impervious cover as a water quality indicator
- **Utilizes latest BMP research for Total Performance**
- **Credits total BMP performance**

(New Specifications with Level 1 and Level 2)

Latest Science and Research

Total BMP Performance:

Runoff Reduction Reported Performance

Runoff Vol_{IN} vs Runoff Vol_{OUT}



Pollutant Removal Reported Performance:

EMC_{IN} vs EMC_{OUT}



Total BMP Performance (Reported as Load Reduction):

(Vol_{IN}) x (EMC_{IN}) vs (Vol_{OUT})(EMC_{OUT})

Total BMP Performance

Runoff Reduction (RR) and pollutant removal (PR):

- Reductions by reducing volume
- Beyond irreducible concentrations

Total BMP Performance

Runoff Reduction (RR) and pollutant removal (PR):

- Maximum performance through “Treatment Train” approach:
 - Pollutant Reduction (site-generated) using non-structural site design practices
 - Volume reduction using one or multiple **runoff reduction (RR) practices**
 - Pollutant removal by runoff reduction practices and additional **pollutant removal (PR) practices** as needed

Multi-Function Practices

	Site Design	Runoff Reduction	Pollutant Removal
1. Rooftop Disconnection	✓	✓	
2. Filter Strip	✓	✓	
3. Grass Channel		✓	✓
4. Soil Amendments	✓*	✓	
5. Green Roof		✓	
6. Rain Tanks & Cisterns		✓	
7. Permeable Pavement		✓	✓
8. Infiltration		✓	✓
9. Bioretention		✓	✓
10. Dry Swales		✓	✓
12. Filtering Practices			✓
13. Constructed Wetlands			✓
14. Wet Ponds			✓
15. ED Ponds		✓	✓

Stormwater Practices Differ Sharply in Ability to Reduce Runoff Volume



Wet Ponds, ED Ponds,
Constructed Wetlands,
Filters:

**= 0 to 10% Runoff Volume
Reduction**



Bioretention, Infiltration, Dry
Swales, Soil Amendments,
disconnection, Related
Practices Reduce:

**= 50 to 90% Runoff Volume
Reduction**

VRRM Spreadsheet DA Tabs

Drainage Area A															
Drainage Area & Land Cover (acres)															
	A Soils	B Soils	C Soils	D Soils	Total	Land Cover %s									
1	Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
2	Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
3	Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
Total					0.00	First Development Treatment Volume (cft)									
11 Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A															
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Upstream RR Practice (C)	Runoff Reduction (C)	Remaining Runoff Volume (C)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Phosphorus Load from Practice (lbs)	Phosphorus Removed by Practice (lbs)	Remaining Phosphorus Load (lbs)	Downstream Treatment to be Employed		
12. Vegetated Roof															
12.a	Vegetated Roof #1 (Spec #5)	area of green roof	40% runoff volume reduction	0.45	0.00	0	0	0	0.00	0.00	0.00	0.00			
12.b	Vegetated Roof #2 (Spec #6)	area of green roof	60% runoff volume reduction	0.60	0.00	0	0	0	0.00	0.00	0.00	0.00			
13. Rooftop Disconnection															
13.a	Simple Disconnection to AD (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00			
13.b	Simple Disconnection to CD (Spec #1)	impervious acres disconnected	20% runoff volume reduction for treated area	0.25	0.00	0	0	0	0.00	0.00	0.00	0.00			
13.c	To The Street (Dry Puff) as per specifications (existing C/O)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00	None		
13.d	To Dry Well or French Drain #1 (Microfiltration #1) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	25	0.00	0.00	0.00	0.00			
13.e	To Dry Well or French Drain #2 (Microfiltration #2) (Spec #1)	impervious acres disconnected	80% runoff volume reduction for treated area	0.00	0.00	0	0	25	0.00	0.00	0.00	0.00			
13.f	To Rain Garden #1 (Microfiltration #1) (Spec #1)	impervious acres disconnected	40% if volume captured	0.40	0.00	0	0	25	0.00	0.00	0.00	0.00			
13.g	To Rain Garden #2 (Microfiltration #2) (Spec #1)	impervious acres disconnected	80% runoff volume reduction for treated area based on base size and design spreadsheet (See Spec #1)	0.00	0.00	0	0	50	0.00	0.00	0.00	0.00			
13.h	To Rainwater Harvesting (Spec #1)	impervious acres captured	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00			
13.i	To Stormwater Ponds (Urban Wetland) (Spec #1) (Spec #1)	impervious acres disconnected	40% runoff volume reduction for treated area	0.40	0.00	0	0	25	0.00	0.00	0.00	0.00			
TOTAL IMPERVIOUS COVER TREATED (ac)				0.00	TOTAL TRMP AREA TREATED (ac)					0.00					
AREA CHECK OK															
TOTAL PHOSPHORUS REMOVAL REQUIRED OR SITE (lbs/c)				0.00	TOTAL RUNOFF REDUCTION IN D.A. A (cft)									0	
PHOSPHORUS REMOVAL FROM RUNOFF REDUCTION PRACTICES IN D.A. A (lbs/c)				0.00	NITROGEN										
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS															
14 Apply Practices that Remove Pollutants but Do Not Reduce Runoff Volume															
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Practice (cft)	Runoff Reduction (C)	Remaining Runoff Volume (cft)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Phosphorus Load from Practice (lbs)	Phosphorus Removed by Practice (lbs)	Remaining Phosphorus Load (lbs)	Downstream Treatment to be Employed		
15. Wet Swale (Coastal Plain)															
15.a	Wet Swale #1 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00			
15.b	Wet Swale #2 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00			
15.c	Wet Swale #3 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	40	0.00	0.00	0.00			
15.d	Wet Swale #4 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	40	0.00	0.00	0.00			
16. Manufactured BMP															
16.a	Manufactured BMP #1 (Spec #1)	impervious acres draining to device	5% runoff volume reduction	0.00	0.00	0	0	0	0	0.00	0.00	0.00			
16.b	Manufactured BMP #2 (Spec #1)	impervious acres draining to device	5% runoff volume reduction	0.00	0.00	0	0	0	0	0.00	0.00	0.00			
TOTAL IMPERVIOUS COVER TREATED (ac)				0.00	TOTAL TRMP AREA TREATED (ac)					0.00					
AREA CHECK OK															
TOTAL PHOSPHORUS REMOVAL REQUIRED OR SITE (lbs/c)				0.00	TOTAL RUNOFF REDUCTION IN D.A. A (cft)									0	
PHOSPHORUS REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A (lbs/c)				0.00	NITROGEN REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A (lbs/c)									0.00	
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS															

Upper half:
Runoff Reduction
Practices

Lower half:
Pollutant Removal
Practices

BMP Performance - Level 1 and Level 2

Level 1 standard features:

- Function
- Safety
- Appearance
- Safe conveyance
- Performance longevity
- Maintenance



BMP Performance - Level 1 and Level 2

Level 2 design enhancements

Increased RR, PR or both:

- Increased Tv sizing (x 1.1, 1.25 or 1.5 times Tv)
- Enhanced design geometry
- Vegetative condition
- Multiple cells
- Multiple treatment pathways
- Other bells and whistles
(increased pretreatment/media depth, etc.)

VRRM Spreadsheet DA Tabs

Drainage Area A

Drainage Area A Land Cover (acres)	A soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Impervious Acres (acres)	0.00	0.00	0.00	0.00	0.00	0.00
					0.00	

Credit Area (acres) to the Practice

Pollutant Reduction Credit

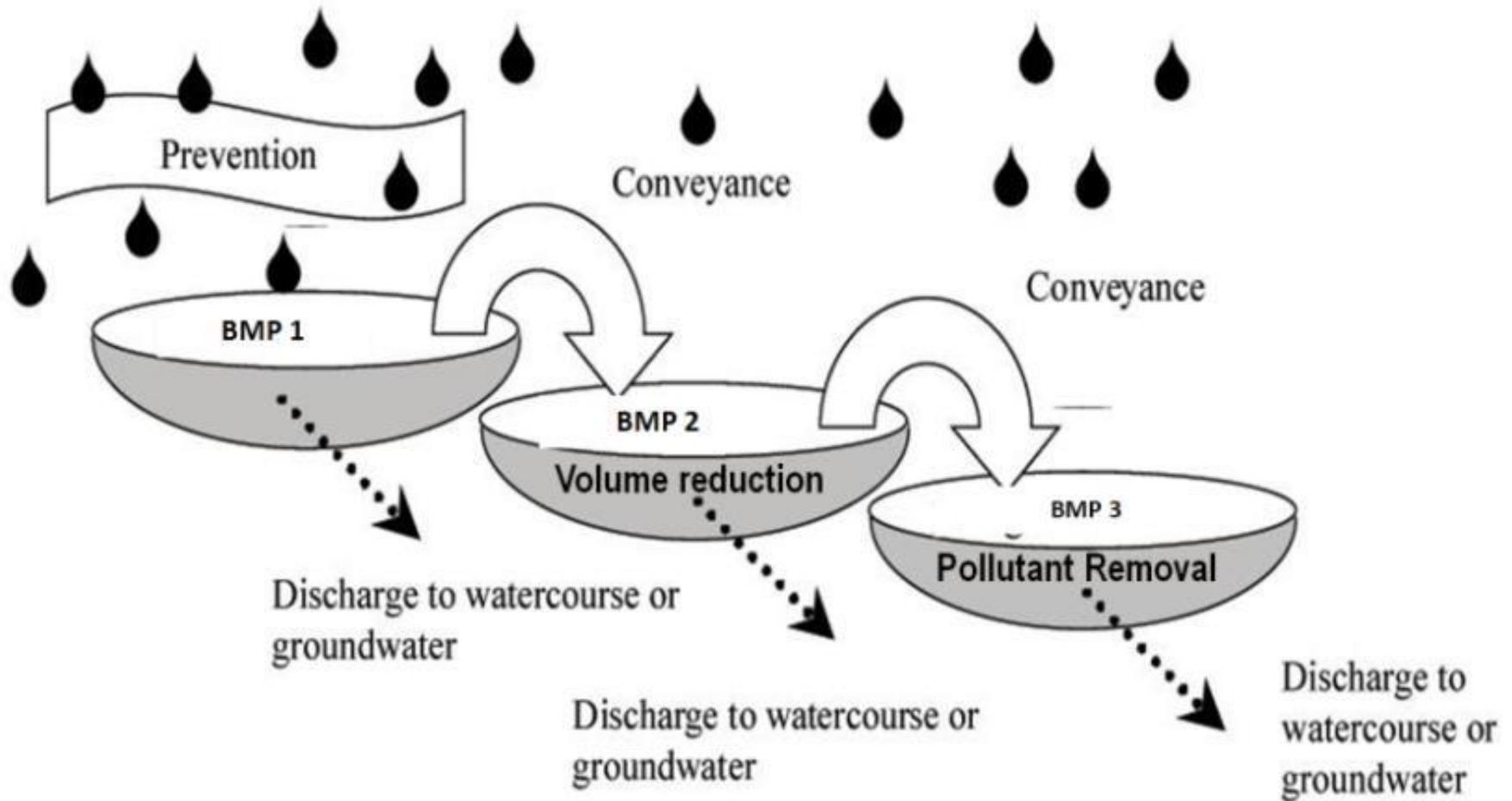
Volumetric Reduction Credit

Post Development Treatment Volume (cf) 0

Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A

Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Untreated Phosphorus Load to Practice (lbs.)	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)
6. Bioretention												
6.a. Bioretention #1 or Urban Bioretention (Spec #9)	L1	impervious acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00
		turf acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00
6.b. Bioretention #2 (Spec #9)	L2	impervious acres draining to bioretention	60% runoff volume reduction	0.80	0.00	0	0	0	50	0.00	0.00	0.00
		turf acres draining to bioretention	80% runoff volume reduction	0.80	0.00	0	0	0	50	0.00	0.00	0.00
7. Infiltration												
7.a. Infiltration #1 (Spec #8)		impervious acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00
		turf acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00
		impervious acres draining to infiltration	90% runoff volume reduction	0.90	0.00	0	0	0	25	0.00	0.00	0.00

BMP Treatment Train



BMP Treatment Trains

- High density sites (*high removal requirements*)
- Flexibility on tight sites - multiple smaller BMPs treat stormwater near source
- Runoff reduction and TV_{BMP} :
 - Incrementally **increases** (with each RR practice)

Level 1 and Level 2

&

BMP Treatment Trains

Tv_{BMP} - direct contributing drainage area + any remaining runoff from upstream RR practices

Design Summary Table BMP Design Spec.
No. 9: Bioretention

Level 1 (RR 40 TP: 25)	Level 2 (RR: 80 TP: 50)
<p><u>Sizing (Section 6.1):</u> $Tv_{BMP} = [(1)(Rv)(A) / 12] + \text{any remaining volume from upstream BMP}$</p>	<p><u>Sizing (Section 6.1):</u> $Tv_{BMP} = [(1.25)(Rv)(A) / 12] + \text{any remaining volume from upstream BMP}$</p>

BMP Treatment Train

VRRM_NewDev_Compliance Spreadsheet_v2.8_2011.xlsm - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Developer Nuance PDF

Clipboard Font Alignment Number Styles Cells Editing

P46

Drainage Area A	B	C	D	E	F	G	H	I	J	K	L	M	
Drainage Area A Land Cover (acres)													
	A soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv							
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00							
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0.00							
Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0.00							
			Total		0.00								
												Post Development Treatment Volume (cf) 0	
Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A													
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices	Untreated Phosphorus Load to Practice	Phosphorus Removed By Practice	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed
6. Bioretention													
6.a. Bioretention #1 or Urban Bioretention (Spec #9)	impervious acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
	turf acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 (Spec #9)	impervious acres draining to bioretention	80% runoff volume reduction	0.80	0.00	0	0	0	50	0.00	0.00	0.00	0.00	
	turf acres draining to bioretention	80% runoff volume reduction	0.80	0.00	0	0	0	50	0.00	0.00	0.00	0.00	
7. Infiltration													
7.a. Infiltration #1 (Spec #8)	impervious acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
	turf acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	impervious acres draining to infiltration	90% runoff volume reduction	0.90	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
	turf acres draining to infiltration	90% runoff volume reduction	0.90	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond													

Ready | Site Data | D.A. A | D.A. B | D.A. C | D.A. D | D.A. E | Water Quality Compliance | Channel and Flood Protection | Summary | Notes

Downstream practice(s)

Scroll to the right to enter downstream practice(s)

BMP Treatment Train

P46		fx		8.b. ED #2	
A		N	O	P	Q
1	Drainage Area A				
2					
3	Drainage Area A Land Cover (acres)				
4					
5	Forest/Open Space (acres)				
6	Managed Turf (acres)				
7	Impervious Cover (acres)				
8					
9					
10	Apply Runoff Reduction Prac				
11	Practice	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed	
46	6.a. Bioretention #1 or Urban Bioretention (Spec #9)	0.00	0.00	8.b. ED #2	
47		0.00	0.00	<ul style="list-style-type: none"> 8.b. ED #2 9.a. Sheetflow to Conservation Area with A/B Soils 9.b. Sheetflow to Conservation Area with C/D Soils 9.c. Sheetflow to Vegetated Filter Strip 10.a. Wet Swale #1 10.b. Wet Swale #2 11.a. Filtering Practice #1 11.b. Filtering Practice #2 	
48	6.b. Bioretention #2 (Spec #9)	0.00	0.00		
49		0.00	0.00		
50					
51	7. Infiltration				
E2		0.00	0.00		

Downstream Treatment Dropdown Selection Menu



**Comparative
BMP Level 1
& Level 2
Performance**

Practice	Design Level	Runoff Reduction	TN EMC Removal ³	TN Mass Load Removal	TP EMC Removal	TP Mass Load Removal ⁶
Rooftop Disconnect	1 ²	25 to 50 ¹	0	25 to 50 ¹	0	25 to 50 ¹
	<i>No Level 2 Design</i>					
Sheet Flow to Veg. Filter or Conserv. Open Space	1	50	0	50	0	50
	2 ⁵	50 to 75 ¹	0	50 to 75 ¹	0	50 to 75 ¹
Grass Channels	1	10 to 20 ¹	20	28 to 44 ¹	15	24 to 41 ¹
	<i>No Level 2 Design</i>					
Soil Compost Amendment	Can be used to Decrease Runoff Coefficient for Turf Cover at Site. See the design specs for Rooftop Disconnection, Sheet Flow to Vegetated Filter or Conserved Open Space, and Grass Channel					
Vegetated Roof	1	45	0	45	0	45
	2	60	0	60	0	60
Rainwater Harvesting	1	Up to 90 ^{3, 5}	0	Up to 90 ^{3, 5}	0	Up to 90 ^{3, 5}
	<i>No Level 2 Design</i>					
Permeable Pavement	1	45	25	59	25	59
	2	75	25	81	25	81
Infiltration Practices	1	50	15	57	25	63
	2	90	15	92	25	93
Bioretention Practices	1	40	40	64	25	55
	2	80	60	90	50	90
Urban Bioretention	1	40	40	64	25	55
	<i>No Level 2 Design</i>					
Dry Swales	1	40	25	55	20	52
	2	60	35	74	40	76
Wet Swales	1	0	25	25	20	20
	2	0	35	35	40	40
Filtering Practices	1	0	30	30	60	60
	2	0	45	45	65	65
Constructed Wetlands	1	0	25	25	50	50
	2	0	55	55	75	75
Wet Ponds	1	0	30 (20) ⁴	30 (20) ⁴	50 (45) ⁴	50 (45) ⁴
	2	0	40 (30) ⁴	40 (30) ⁴	75 (65) ⁴	75 (65) ⁴
Ext. Det. Ponds	1	0	10	10	15	15
	2	15	10	24	15	31



4f. VRRM Compliance Spreadsheet Example

VRRM Spreadsheet DA Tabs

Drainage Area A													
Drainage Area & Land Cover (acres)													
	A Soils	B Soils	C Soils	D Soils	Total	Land Cover %s							
1	Forest/Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
2	Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
3	Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Total					0.00								
First Development Treatment Volume (cft)													
0.00													
Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A													
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Upstream RR Practice (cft)	Runoff Reduction (cft)	Remaining Runoff Volume (cft)	Phosphorus (Efficiency %)	Phosphorus Load (lb/yr)	Phosphorus (Removal %)	Phosphorus (Removal Practice (lb/yr))	Remaining Phosphorus Load (lb/yr)	Downstream Treatment to be Employed
1. vegetated Roof													
11	1. vegetated Roof #1 (Spec #5)	area of green roof	40% runoff volume reduction	0.45	0.00	0	0	0	0.00	0.00	0.00	0.00	
12	1. vegetated Roof #2 (Spec #6)	area of green roof	60% runoff volume reduction	0.60	0.00	0	0	0	0.00	0.00	0.00	0.00	
2. Rooftop Disconnection													
13	2.a. Simple Disconnection to AD (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00	
14	2.b. Simple Disconnection to CED (Spec #1)	impervious acres disconnected	20% runoff volume reduction for treated area	0.25	0.00	0	0	0	0.00	0.00	0.00	0.00	
15	2.c. To the Nearest Flow Path as per specifications (existing C/O) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00	None
16	2.d. To Dry Well or French Drain #1 (Microfiltration #1) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	25	0.00	0.00	0.00	0.00	
17	2.e. To Dry Well or French Drain #2 (Microfiltration #2) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	25	0.00	0.00	0.00	0.00	
18	2.f. To Rain Garden #1 (Microfiltration #1) (Spec #1)	impervious acres disconnected	40% if volume captured	0.40	0.00	0	0	25	0.00	0.00	0.00	0.00	
19	2.g. To Rain Garden #2 (Microfiltration #2) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area based on base size and design spreadsheet (See Spec #1)	0.00	0.00	0	0	50	0.00	0.00	0.00	0.00	
20	2.h. To Rainwater Harvesting (Spec #1)	impervious acres captured	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
21	2.i. Stormwater Ponds (Urban Stormwater Pond #1) (Spec #1)	impervious acres disconnected	40% runoff volume reduction for treated area	0.40	0.00	0	0	25	0.00	0.00	0.00	0.00	
TOTAL IMPERVIOUS COVER TREATED (ac)				0.00									
TOTAL TRAP AREA TREATED (ac)				0.00									
AREA CHECK OK													
TOTAL PHOSPHORUS REMOVAL REQUIRED OR SITE (lb/yr)										0.00			
TOTAL RUNOFF REDUCTION IN D.A. A (cft)										0			
PHOSPHORUS REMOVAL FROM RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)										0.00			
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS										NITROGEN			
Apply Practice that Remove Pollutants but Do Not Reduce Runoff Volume													
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Practice (cft)	Runoff Reduction (cft)	Remaining Runoff Volume (cft)	Phosphorus (Efficiency %)	Phosphorus Load from Upstream RR Practices (lb/yr)	Phosphorus Removed by Practice (lb/yr)	Remaining Phosphorus Load (lb/yr)	Downstream Treatment to be Employed	
33. Wet Swale (Coastal Plain)													
33	33.a. Wet Swale #1 (Spec #11)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	20	0.00	0.00	0.00	0.00	
34	33.b. Wet Swale #2 (Spec #11)	turf areas draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	20	0.00	0.00	0.00	0.00	
35	33.c. Wet Swale #3 (Spec #11)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	40	0.00	0.00	0.00	0.00	
36	33.d. Wet Swale #4 (Spec #11)	turf areas draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	40	0.00	0.00	0.00	0.00	
34. Manufactured BMP													
37	34.a. Manufactured BMP #1 (Spec #12)	impervious acres draining to device	5% runoff volume reduction	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00	
38	34.b. Manufactured BMP #2 (Spec #12)	turf areas draining to device	5% runoff volume reduction	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00	
TOTAL IMPERVIOUS COVER TREATED (ac)				0.00									
TOTAL TRAP AREA TREATED (ac)				0.00									
AREA CHECK OK													
PHOSPHORUS REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A										0.00			
TOTAL PHOSPHORUS REMOVAL IN D.A. A (lb/yr)										0.00			
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS										NITROGEN			
PHOSPHORUS REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A										0.00			
TOTAL PHOSPHORUS REMOVAL IN D.A. A (lb/yr)										0.00			
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS										NITROGEN			
PHOSPHORUS REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A										0.00			
TOTAL PHOSPHORUS REMOVAL IN D.A. A (lb/yr)										0.00			

Upper half:
Runoff Reduction
Practices

Lower half:
Pollutant Removal
Practices

VRRM Spreadsheet DA Tabs

Drainage Area A													
Drainage Area & Land Cover (acres)													
	A Soils	B Soils	C Soils	D Soils	Total	Land Cover (%)							
Forest/Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Impervious Pavt (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Total					0.00	First Development Treatment Volume (cft)							
Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A													
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Upstream RR Practice (%)	Runoff Reduction (cft)	Remaining Runoff Volume (cft)	Phosphorus (lb/acre) (Efficiency %)	Phosphorus Load (lb) (Upstream RR Practice (lb))	Phosphorus (lb/acre) (Practice (lb))	Phosphorus Removed by Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Treatment to be Employed
1. Vegetated Roof													
1.a. Vegetated Roof #1 (Spec #5)	acres of green roof	40% runoff volume reduction	0.45	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #6)	acres of green roof	60% runoff volume reduction	0.60	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
2. Rooftop Disconnection													
2.a. Simple Disconnection to AD (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to CED (Spec #1)	impervious acres disconnected	20% runoff volume reduction for treated area	0.25	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To the Nearest Flow Path as per specifications (existing C/O) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	None
2.d. To Dry Well or French Drain #1 (Microfiltration #1) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2 (Microfiltration #2) (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.00	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1 (Spec #1)	impervious acres disconnected	40% if volume captured	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2 (Microfiltration #2) (Spec #1)	impervious acres disconnected	40% runoff volume reduction for treated area based on base size and design spreadsheet (See Spec #1)	0.00	0.00	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #1)	impervious acres captured	0.00	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Ponds (Urban Residential) (Spec #1) (Spec #1)	impervious acres disconnected	40% runoff volume reduction for treated area	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
TOTAL IMPERVIOUS COVER TREATED (ac)					0.00	TOTAL TRAP AREA TREATED (ac)				0.00			
TOTAL PHOSPHORUS REMOVAL REQUIRED OR SITE (lb/yr)					0.00								
TOTAL PHOSPHORUS REMOVAL BY PRACTICES IN D.A. A (lb/yr)					0.00								
TOTAL PHOSPHORUS REMOVAL FROM RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)					0.00								
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS													
Apply Practices that Remove Pollutants but Do Not Reduce Runoff Volume													
10. Wet Swale (Coastal Plain)													
10.a. Wet Swale #1 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00	0.00	
10.c. Wet Swale #3 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	40	0.00	0.00	0.00	0.00	
10.d. Wet Swale #4 (Spec #1)	impervious acres draining to wet swale	5% runoff volume reduction	0.00	0.00	0	0	0	40	0.00	0.00	0.00	0.00	
14. Manufactured BMP													
14.a. Manufactured BMP #1 (Spec #1)	impervious acres draining to device	5% runoff volume reduction	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
14.b. Manufactured BMP #2 (Spec #1)	impervious acres draining to device	5% runoff volume reduction	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
TOTAL IMPERVIOUS COVER TREATED (ac)					0.00	TOTAL TRAP AREA TREATED (ac)				0.00			
TOTAL PHOSPHORUS REMOVAL REQUIRED OR SITE (lb/yr)					0.00								
TOTAL PHOSPHORUS REMOVAL BY PRACTICES IN D.A. A (lb/yr)					0.00								
TOTAL PHOSPHORUS REMOVAL FROM PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A (lb/yr)					0.00								
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS													
TOTAL PHOSPHORUS REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A (lb/yr)					0.00								
TOTAL PHOSPHORUS REMOVAL IN D.A. A (lb/yr)					0.00								

Upper half:
Runoff Reduction
Practices

Drainage Area Check

Lower half:
Pollutant Removal
Practices

Drainage Area Check

VRRM Spreadsheet DA Tabs

P19															None	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Drainage Area A																
Drainage Area A Land Cover (acres)																
	A soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv										
5	Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00									
6	Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0.00									
7	Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0.00									
8		Total				0.00										
											Post Development Treatment Volume (cf)		0			
Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A																
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Untreated Phosphorus Load to Practice (lbs.)	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed			
1. Vegetated Roof																
13	1.a. Vegetated Roof #1 (Spec #5)	acres of green roof	45% runoff volume reduction	0.45	0.00	0	0	0	0	0.00	0.00	0.00				
14	1.b. Vegetated Roof #2 (Spec #5)	acres of green roof	60% runoff volume reduction	0.60	0.00	0	0	0	0	0.00	0.00	0.00				
2. Rooftop Disconnection																
17	2.a. Simple Disconnection to A/B Soils (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00				
18	2.b. Simple Disconnection to C/D Soils (Spec #1)	impervious acres disconnected	25% runoff volume reduction for treated area	0.25	0.00	0	0	0	0	0.00	0.00	0.00				
19	2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50								0.00	None			
20	2.d. To Dry Well or French Drain #1 (Microinfiltration #1) (Spec #8)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50								0.00	None			
21	2.e. To Dry Well or French Drain #2 (Micro-Infiltration #2) (Spec #8)	impervious acres disconnected	90% runoff volume reduction for treated area	0.90								0.00	None			
22	2.f. To Rain Garden #1 (Micro-Bioretenion #1) (Spec #9)	impervious acres disconnected	40% of volume captured	0.40	0.00	0	0	0	25	0.00	0.00	0.00				
23	2.g. To Rain Garden #2 (Micro-Bioretenion #2) (Spec #9)	impervious acres disconnected	80% runoff volume reduction for treated area	0.80	0.00	0	0	0	50	0.00	0.00	0.00				
24	2.h. To Rainwater Harvesting (Spec #6)	impervious acres captured	based on tank size and design spreadsheet (See Spec #6)	0.00	0.00	0	0	0	0	0.00	0.00	0.00				
25	2.i. To Stormwater Planter (Urban Bioretention) (Spec #9, Appendix A)	impervious acres disconnected	40% runoff volume reduction for treated area	0.40	0.00	0	0	0	25	0.00	0.00	0.00				
3. Permeable Pavement																
28	3.a. Permeable Pavement #1 (Spec #7)	acres of permeable pavement + acres of "external" (upgradient) impervious pavement	45% runoff volume reduction	0.45	0.00	0	0	0	25	0.00	0.00	0.00				
29	3.b. Permeable Pavement #2 (Spec #7)	acres of permeable pavement	75% runoff volume reduction	0.75	0.00	0	0	0	25	0.00	0.00	0.00				
4. Grass Channel																
32	4.a. Grass Channel A/B Soils (Spec #9)	impervious acres draining to grass channels	20% runoff volume reduction	0.20	0.00	0	0	0	15	0.00	0.00	0.00				

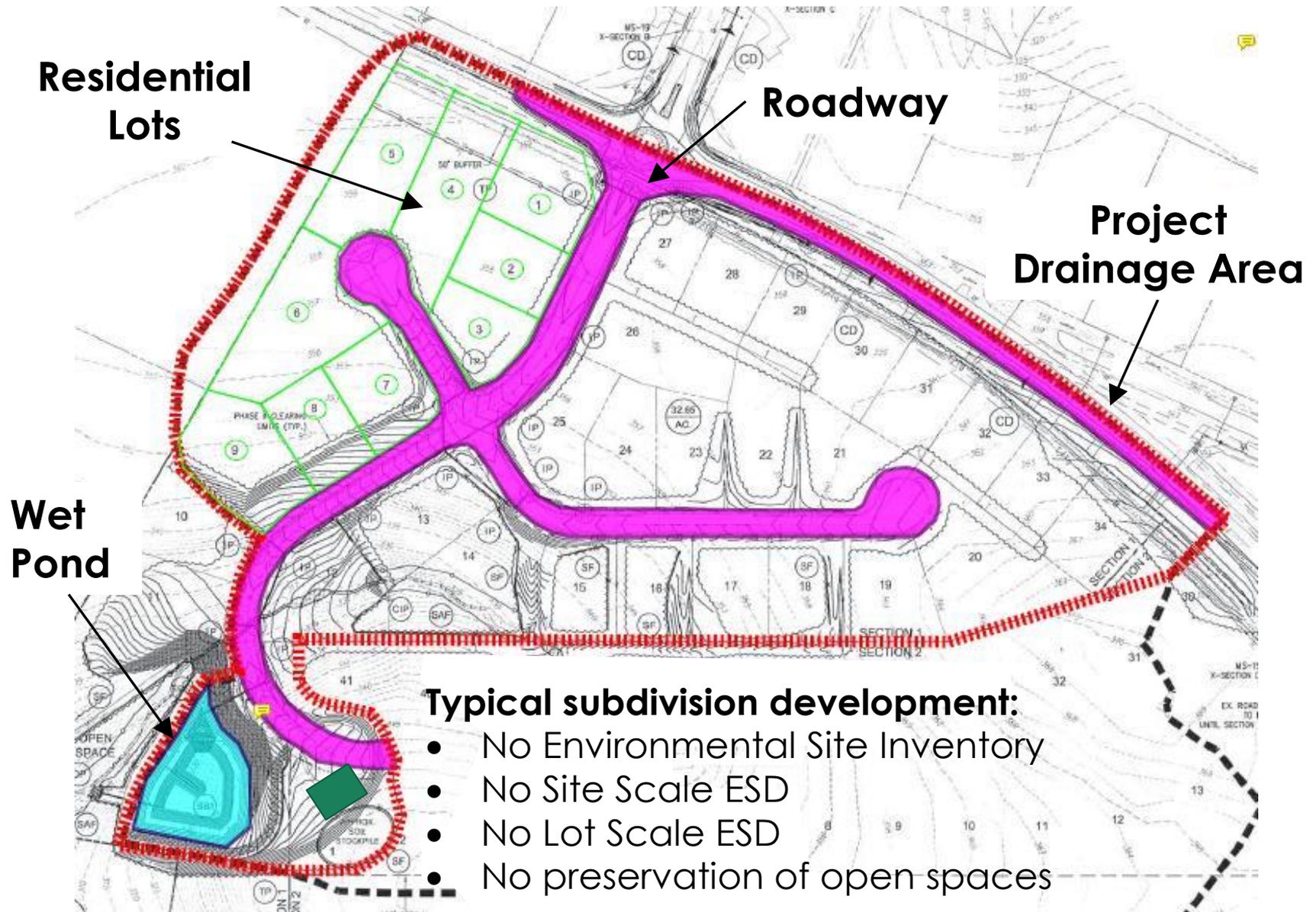
User Defined Rainwater Harvesting Credit

- None
- 4.a. Grass Channel A/B Soils
- 4.b. Grass Channel C/D Soils
- 4.c. Grass Channel Compost Amended Soils
- 5.a. Dry Swale #1
- 5.b. Dry Swale #2
- 6.a. Bioretention #1
- 6.b. Bioretention #2

Site Data | D.A. A | D.A. B | D.A. C | D.A. D | D.A. E

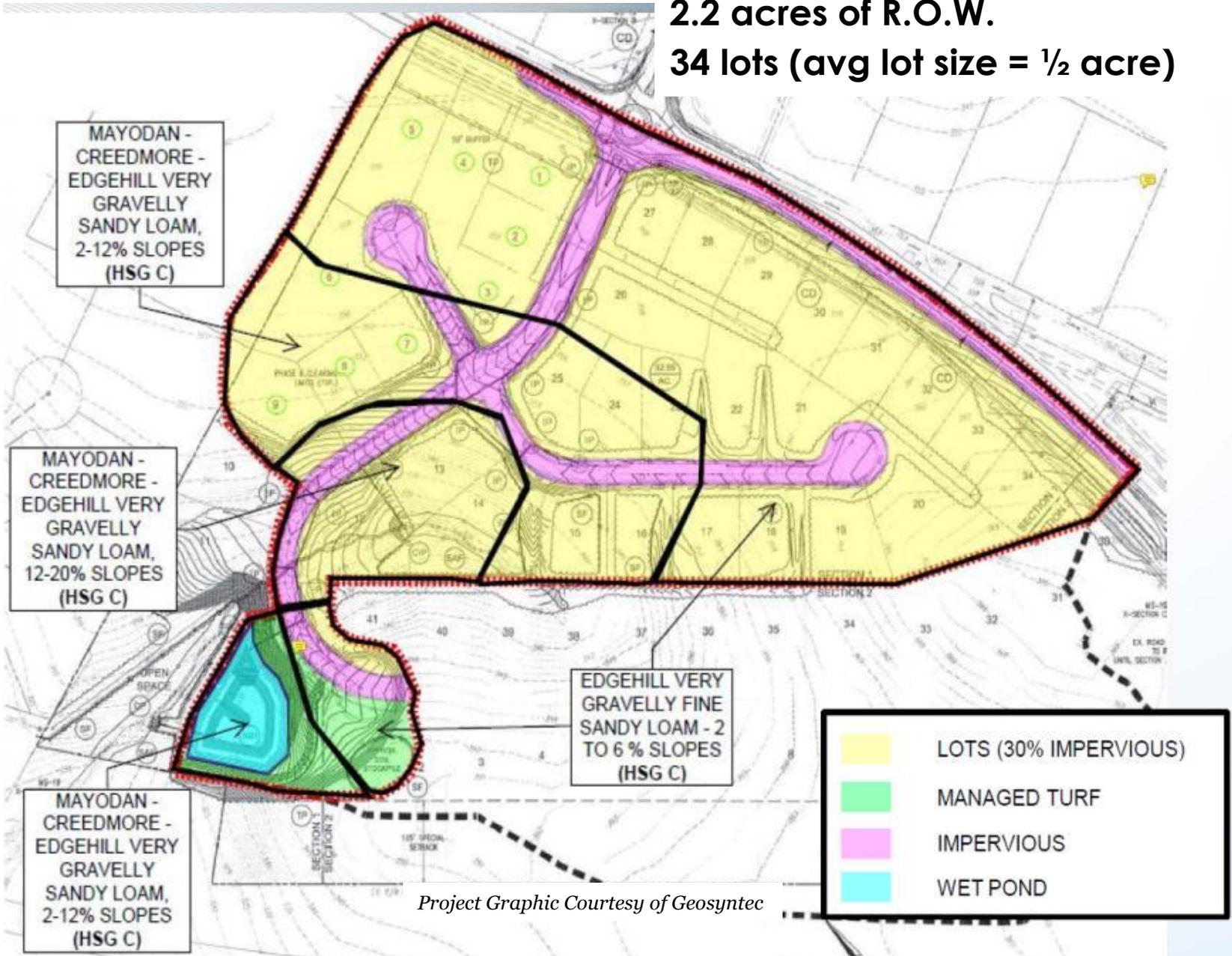
Water Quality Compliance | Channel and Flood Protection | Summary

Design Example



- Typical subdivision development:**
- No Environmental Site Inventory
 - No Site Scale ESD
 - No Lot Scale ESD
 - No preservation of open spaces

19.8 acre single Family Subdivision
2.2 acres of R.O.W.
34 lots (avg lot size = 1/2 acre)



Project Graphic Courtesy of Geosyntec

Site Data Tab

	A	B				
1	Virginia Runoff Reduction Method Nev					
2	Site Data					
3						
4	Project Name:					
5	Date:					
6						
7			data input cells			
8			calculation cells			
9			constant values			
10						
11	1. Post-Development Project & Land Cover Information					
12						
13	Constants					
14						
15	Annual Rainfall (Inches)	43				
16	Target Rainfall Event (Inches)	1.00				
17	Phosphorus EMC (mg/L)	0.26	Nitrogen EMC (mg/L) 1.86			
18	Target Phosphorus Target Load (lb/acre/yr)	0.41				
19	Pj	0.90				
20						
21	Land Cover (acres)					
22		A soils	B Soils	C Soils	D Soils	Totals
23	Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00		0.00	0.00	0.00
24	Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00		12.09	0.00	12.09
25	Impervious Cover (acres)	0.00		7.71	0.00	7.71
26					Total	19.80
27	Rv Coefficients					
28		A soils	B Soils	C Soils	D Soils	
29	Forest/Open Space	0.02	0.03	0.04	0.05	
30	Managed Turf	0.15	0.20	0.22	0.25	
31	Impervious Cover	0.95	0.95	0.95	0.95	
32						
33						
34						
35	Land Cover Summary					
36	Forest/Open Space Cover (acres)	0.00				
37	Weighted Rv(forest)	0.00				
38	% Forest	0%				
39	Managed Turf Cover (acres)	12.09				
40	Weighted Rv(turf)	0.22				
41	% Managed Turf	61%				
42	Impervious Cover (acres)	7.71				
43	Rv(impervious)	0.95				
44	% Impervious	39%				
45	Total Site Area (acres)	19.80				
46	Site Rv	0.50				
47						
48						
49	Post-Development Treatment Volume (acre-ft)	0.83				
50	Post-Development Treatment Volume (cubic feet)	36,243				
51	Post-Development Load (TP) (lb/yr)	22.77				
52	Total Load (TP) Reduction Required (lb/yr)	14.65				
53				Post-Development Load (TN) (lb/yr)	162.90	

Turf = 12.09
 Imp = 7.71
 Area Total = 19.8 acres

Site Rv = 0.50

Post Dev Tv = 0.83 ac-ft

Post Dev TP Load = 22.77 lb/yr

Load Reduction Required = 14.65 lb/yr

Drainage Area Tab

	A	B	C											
1	Drainage Area A													
2														
3	Drainage Area A Land Cover (acres)													
4	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rr								
5	Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00								
6	Managed Turf (acres)	0.00	0.00	12.09	12.09	0.22								
7	Impervious Cover (acres)	0.00	0.00	7.71	7.71	0.95								
8	Total				19.80									
9					Post Development Treatment Volume (cf)	36243								
10	Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A													
11	Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Untreated Phosphorus Load to Practice (lbs.)	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed
106	13.b. Wet Pond #1 (Coastal Plan) (Spec #14)	impervious acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	45	0.00	0.00	0.00	0.00	
107		turf acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	75	0.00	0.00	0.00	0.00	
108	13.c. Wet Pond #2 (Spec #14)	impervious acres draining to wet pond	0% runoff volume reduction	0.00	7.71	0	0	26588	75	0.00	16.69	12.8	4.17	
109		turf acres draining to wet pond	0% runoff volume reduction	0.00	12.09	0	0	9655	75	0.00	6.06	4.54	1.51	
110	13.d. Wet Pond #2 (Coastal Plan) (Spec #14)	impervious acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	65	0.00	0.00	0.00	0.00	
111		turf acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	65	0.00	0.00	0.00	0.00	
112														
113	14. Manufactured BMP													
114	14. Insert Name of Device	impervious acres draining to device	0% runoff volume reduction	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
115		turf acres draining to device	0% runoff volume reduction	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00	
116														
117	TOTAL IMPERVIOUS COVER TREATED (ac)				7.71									
118	TOTAL TURF AREA TREATED (ac)				12.09									
119														
120	AREA CHECK OK													
121														
122	PHOSPHORUS REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A													
123	TOTAL PHOSPHORUS REMOVAL IN D.A. A (lb/yr)						17.06							
124														
125	SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS													
126														
127														
128	NITROGEN REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A													
129	TOTAL NITROGEN REMOVAL IN D.A. A (lb/yr)						32.54							
130														
131														
132														
133														
134														

Credit Area (acres) to Wet Pond Level 2:
 Imp = 7.71 ac
 Turf = 12.09 ac

0 RR
 Remaining Runoff vol.
 & Remaining TP load

Area Check: **OK**

TP Removed = 17.06 lb/yr

D.A. A / D.A. B / D.A. C / D.A. D / D.A. E

Water Quality Compliance Tab

	A	B	C	D	E	F	G
1	Site Results						
2							
3		D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
4	IMPERVIOUS COVER	7.71	0.00	0.00	0.00	0.00	OK.
5	IMPERVIOUS COVER TREATED	7.71	0.00	0.00	0.00	0.00	OK.
6	TURF AREA	12.09	0.00	0.00	0.00	0.00	OK.
7	TURF AREA TREATED	12.09	0.00	0.00	0.00	0.00	OK.
8	AREA CHECK	OK.	OK.	OK.	OK.	OK.	
9							
10	Phosphorus						
11	TOTAL TREATMENT VOLUME (cf)	36,243					
12	TOTAL PHOSPHORUS LOAD REDUCTION REQUIRED (LB/YEAR)	14.65					
13							
14	RUNOFF REDUCTION (cf)	0					
15	PHOSPHORUS LOAD REDUCTION ACHIEVED (LB/YR)	17.06					
16							
17	ADJUSTED POST-DEVELOPMENT PHOSPHORUS LOAD (TP) (lb/yr)	5.71					
18							
19	REMAINING PHOSPHORUS LOAD REDUCTION (LB/YR) NEEDED	CONGRATULATIONS!! YOU EXCEEDED THE TARGET REDUCTION BY 2.4 LB/YEAR!!					
20							
21							
22							
23	Nitrogen (for information purposes)						
24	TOTAL TREATMENT VOLUME (cf)	36,243					
25							
26							
27	RUNOFF REDUCTION (cf)	0					
28	NITROGEN LOAD REDUCTION ACHIEVED (LB/YR)	32.54					
29							
30	ADJUSTED POST-DEVELOPMENT NITROGEN LOAD (TN) (lb/yr)	130.36					
31							

Area Check: OK

Runoff Reduction = 0

TP Reduction = 17.06 lb/yr

CONGRATULATIONS!! YOU EXCEEDED THE TARGET REDUCTION BY 2.4 LB/YEAR!!

Channel & Flood Protection Tab

	A	B	C	D	E	F	G	H
1				1-year storm	2-year storm	10-year storm		
2	Target Rainfall Event (in)			2.79	3.38	5.14		
4	Drainage Area A							
5	Drainage Area (acres)		19.80					
6	Runoff Reduction Volume (cf)		0					
8	Drainage Area B							
9	Drainage Area (acres)		0.00					
10	Runoff Reduction Volume (cf)		0					
12	Drainage Area C							
13	Drainage Area (acres)		0.00					
14	Runoff Reduction Volume (cf)		0					
16	Drainage Area D							
17	Drainage Area (acres)		0.00					
18	Runoff Reduction Volume (cf)		0					
20	Drainage Area E							
21	Drainage Area (acres)		0.00					
22	Runoff Reduction Volume (cf)		0					
25	Based on the use of Runoff Reduction practices in the selected drainage areas, the spreadsheet calculates an adjusted $RV_{Developed}$ and adjusted Curve Number.							
27	Drainage Area A			A soils	B Soils	C Soils	D Soils	
28	Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	0.00	
29		CN	30	55	70	77		
30	Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.00	12.09	0.00		
31		CN	39	61	74	80		
32		Area (acres)	0.00	0.00	7.71	0.00		
33	Impervious Cover	CN	98	98	98	98		
34							Weighted CN	S
35							83	2.05
36				1-year storm	2-year storm	10-year storm		
37		$RV_{Developed}$ (in) with no Runoff Reduction		1.28	1.76	3.30		
38		$RV_{Developed}$ (in) with Runoff Reduction		1.28	1.76	3.30		
39		Adjusted CN		83	83	83		

1, 2, and 10-year storm rainfall depths

No volume reduction

CN = 83
 1, 2, and 10-year volume (RV) measured in watershed inches =
 $RV_1 = 1.28$ inches
 $RV_2 = 1.76$ inches
 $RV_{10} = 3.30$ inches

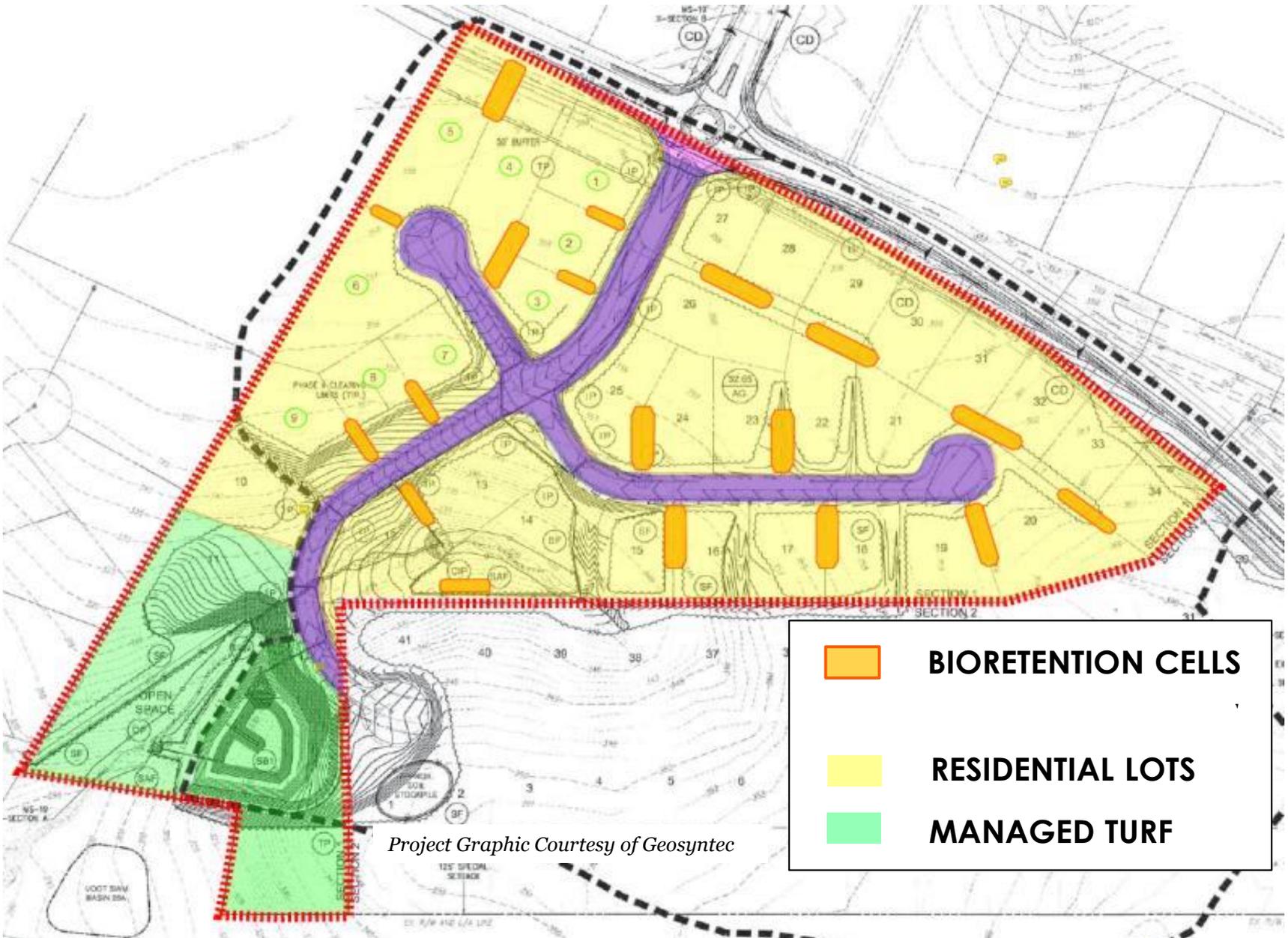
No RR
No CN Adjustment!

Alternative Design

Goal: Replace wet pond with BMPs that will reduce runoff volume (and remove pollutants):

- ***Rooftop disconnection***, downstream treatment to ***Bioretention*** to treat all impervious area on residential lots
- Remaining impervious (roads) and some pervious area on lots to ***Bioretention*** areas
- Conveyance to ***vegetated filter strip*** for downstream treatment

Additional Volume Reduction options: Permeable Pavement on roads; downstream Vegetated Filter Strips (or Conserved Open Space)



Project Graphic Courtesy of Geosyntec

	BIORETENTION CELLS
	RESIDENTIAL LOTS
	MANAGED TURF

	A	B	C	D	E	F
1	Virginia Runoff Reduction Method New Development Worksheet -- v2.7 Revised Feb 2014					
2	Site Data					
3						
4	Project Name:					
5	Date:					
6						
7	data input cells					
8	calculation cells					
9	constant values					
10						
11	1. Post-Development Project & Land Cover Information					
12	Constants					
13						
14	Annual Rainfall (inches)					
15		43				
16	Target Rainfall Event (inches)					
17		1.00				
18	Phosphorus EMC (mg/L)					
19		0.26	Nitrogen EMC (mg/L)		1.86	
20	Target Phosphorus Target Load (lb/acre/yr)					
21		0.41				
22	P _i					
23		0.90				
24	Land Cover (acres)					
25		A soils	B Soils	C Soils	D Soils	Totals
26	Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested	0.00		0.40	0.00	0.40
27	Managed Turf (acres) -- disturbed, graded for yards or other turf to be moved/managed	0.00		12.13	0.00	12.13
28	Impervious Cover (acres)	0.00		7.27	0.00	7.27
29		Total				19.80
30	Rv Coefficients					
31		A soils	B Soils	C Soils	D Soils	
32	Forest/Open Space	0.02	0.03	0.04	0.05	
33	Managed Turf	0.15	0.20	0.22	0.25	
34	Impervious Cover	0.95	0.95	0.95	0.95	
35	Land Cover Summary					
36	Forest/Open Space Cover (acres)	0.40				
37	Weighted Rv(forest)	0.04				
38	% Forest	2%				
39	Managed Turf Cover (acres)	12.13				
40	Weighted Rv(turf)	0.22				
41	% Managed Turf	61%				
42	Impervious Cover (acres)	7.27				
43	Rv(impervious)	0.95				
44	% Impervious	37%				
45	Total Site Area (acres)	19.80				
46	Site Rv	0.48				
47	Post-Development Treatment Volume (acre-foot)					
48		0.80				
49	Post-Development Treatment Volume (cubic feet)	34,816				
50	Post-Development Load (TP) (lb/yr)	21.87	Post-Development Load (TN) (lb/yr)		156.49	
51	Total Load (TP) Reduction Required (lb/yr)	13.76				
52						
53						
54						

Same as traditional scenario, but:

- **Wet Pond** area partially converted from 'Impervious Cover' to 'Managed Turf'
 - **BMP areas** converted from 'Managed Turf' to 'Forest/Open Space'
- Forest/Open = 0.4
 Managed Turf = 12.13
 Impervious = 7.27

Slight change in Tv, TP Load, and Reduction Requirement

Note: Pervious Pavement & Green Roof is inventoried as 'Impervious Cover' with an associated CN Adjustment to reflect the permeable properties.

Runoff Reduction Design

Credit Area to Simple Disconnection = 5 ac

**Runoff Reduction = 4,311 ft³
 Runoff Remaining = 12,932 ft³
 Total = Tv_{BMP} = 17,243 ft³**

Drainage Area A														
Drainage Area A Land Cover (acres)														
	A soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv								
Forest/Open Space (acres)	0.00	0.00	0.40	0.00	0.40	0.04								
Managed Turf (acres)	0.00	0.00	12.13	0.00	12.13	0.22								
Impervious Cover (acres)	0.00	0.00	7.27	0.00	7.27	0.95								
Total					19.80									
					Post Development Treatment Volume (cf)	34816								
Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A														
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream Practices (lbs)	Untreated Phosphorus Load to Practice (lbs.)	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed	
1. Vegetated Roof														
1.a. Vegetated Roof #1 (Spec #5)	acres of green roof	45% runoff volume reduction	0.45	0.00	0	0	0	0	0.00	0.00	0.00	0.00		
1.b. Vegetated Roof #2 (Spec #5)	acres of green roof	60% runoff volume reduction	0.60	0.00	0	0	0	0	0.00	0.00	0.00	0.00		
2. Rooftop Disconnection														
2.a. Simple Disconnection to A/B Soils (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00		
2.b. Simple Disconnection to C/D Soils (Spec #1)	impervious acres disconnected	25% runoff volume reduction for treated area	0.25	5.00	0	4311	12932	0	0.00	10.82	2.71	8.12	6.b. Bioretention #2	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00	None	
2.d. To Dry Well or French Drain #1 (Microinfiltration #1) (Spec #5)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00		
2.e. To Dry Well or French Drain #2		90% runoff volume	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00		

Downstream Treatment: Bioretention L2

Runoff Reduction Design

Credit Area to Bioretention Level 2:
1.89 ac additional Impervious
5.0 ac turf

Volume from upstream RR practice:
12,932 ft³

Drainage Area A													
Drainage Area A Land Cover (acres)													
	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv							
Forest/Open Space (acres)	0.00	0.00	0.40	0.00	0.40	0.04							
Managed Turf (acres)	0.00	0.00	12.13	0.00	12.13	0.22							
Impervious Cover (acres)	0.00	0.00	7.27	0.00	7.27	0.95							
	Total				19.80								
Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A													
Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Untreated Phosphorus Load to Practice (lbs.)	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed
6. Bioretention													
6.a. Bioretention #1 or Urban Bioretention (Spec #9)	impervious acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
	turf acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 (Spec #9)	impervious acres draining to bioretention	80% runoff volume reduction	0.80	1.89	12932	15560	3890	50	8.12	4.09	10.99	1.22	None
	turf acres draining to bioretention	80% runoff volume reduction	0.80	5.00	0	3194	799	50	0.00	2.51	2.26	0.25	None
7. Infiltration													
7.a. Infiltration #1 (Spec #8)	impervious acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
	turf acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	impervious acres draining to infiltration	90% runoff volume reduction	0.90	0.00	0	0	0	25	0.00	0.00	0.00	0.00	
	turf acres draining to infiltration	90% runoff volume reduction	0.15	0.00	0	0	0	15	0.00	0.00	0.00	0.00	

Runoff Reduction = 15,560 + 3,194 ft³
 + Runoff Remaining = 3,890 + 799 ft³
 = Total = Tv_{BMP} = 23,443 ft³

Water Quality Compliance Tab

Area Check - OK

A	B	C	D	E	F	G
1	Site Results					
2						
3		D.A. A	D.A. B	D.A. C	D.A. D	D.A. E
4	IMPERVIOUS COVER	7.27	0.00	0.00	0.00	0.00
5	IMPERVIOUS COVER TREATED	6.89	0.00	0.00	0.00	0.00
6	TURF AREA	12.13	0.00	0.00	0.00	0.00
7	TURF AREA TREATED	5.00	0.00	0.00	0.00	0.00
8	AREA CHECK	OK.	OK.	OK.	OK.	OK.
9						
10	Phosphorus					
11	TOTAL TREATMENT VOLUME (cf)	34,816				
12	TOTAL PHOSPHORUS LOAD REDUCTION REQUIRED (LB/YEAR)	13.76				
13						
14	RUNOFF REDUCTION (cf)	23065				
15	PHOSPHORUS LOAD REDUCTION ACHIEVED (LB/YR)	15.95				
16						
17	ADJUSTED POST-DEVELOPMENT PHOSPHORUS LOAD (TP) (lb/yr)	5.93				
18						
19	REMAINING PHOSPHORUS LOAD REDUCTION (LB/YR) NEEDED	CONGRATULATIONS!! YOU EXCEEDED THE TARGET REDUCTION BY 2.2 LB/YEAR!!				
20						
21						
22						
23	Nitrogen (for information purposes)					
24	TOTAL TREATMENT VOLUME (cf)	34,816				
25						
26						
27	RUNOFF REDUCTION (cf)	23065				
28	NITROGEN LOAD REDUCTION ACHIEVED (LB/YR)	124.60				
29						
30	ADJUSTED POST-DEVELOPMENT NITROGEN LOAD (TN) (lb/yr)	31.89				
31						

**Runoff Reduction Achieved:
23,065 ft³**

CONGRATULATIONS!! YOU EXCEEDED THE TARGET REDUCTION BY 2.2 LB/YEAR!!

Congratulations! You exceeded target reduction by 2.2 lbs/yr

Channel & Flood Protection Tab

	A	B	C	D	E	F	G	H
1				1-year storm	2-year storm	10-year storm		
2	Target Rainfall Event (in)			2.79	3.38	5.14		
3								
4	<u>Drainage Area A</u>							
5	Drainage Area (acres)		19.80					
6	Runoff Reduction Volume (cf)		23,065					
7								
8	<u>Drainage Area B</u>							
9	Drainage Area (acres)		0.00					
10	Runoff Reduction Volume (cf)		0					
11								
12	<u>Drainage Area C</u>							
13	Drainage Area (acres)		0.00					
14	Runoff Reduction Volume (cf)		0					
15								
16	<u>Drainage Area D</u>							
17	Drainage Area (acres)		0.00					
18	Runoff Reduction Volume (cf)		0					
19								
20	<u>Drainage Area E</u>							
21	Drainage Area (acres)		0.00					
22	Runoff Reduction Volume (cf)		0					
23								
24								
25	Based on the use of Runoff Reduction practices in the selected drainage areas, the spreadsheet calculates an adjusted $RV_{Developed}$ and adjusted CN							
26								
27	Drainage Area A			A soils	B Soils	C Soils	D Soils	
28	Forest/Open Space – undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.40	0.00	0.00	
29		CN	30	55	70	77	77	
30	Managed Turf – disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.00	12.13	0.00	0.00	
31		CN	39	61	74	80	80	
32	Impervious Cover	Area (acres)	0.00	0.00	7.27	0.00	0.00	
33		CN	98	98	98	98	98	
34								
35							Weighted CN	83
36								2.05
37				1-year storm	2-year storm	10-year storm		
38		$RV_{Developed}$ (in) with no Runoff Reduction		1.28	1.76	3.30		
39		$RV_{Developed}$ (in) with Runoff Reduction		0.96	1.44	2.98		
40		Adjusted CN		77	78	80		

1, 2, and 10-year storm rainfall depths

Volume Reduction = 23,065 ft³

1, 2, and 10-year volume (RV) reduction =

$RV_1 = 1.12'' \rightarrow 0.96''$

$CN_1 \ 83 \rightarrow 77$

$RV_2 = 1.54'' \rightarrow 1.44''$

$CN_2 \ 83 \rightarrow 78$

$RV_{10} = 3.30'' \rightarrow 2.98''$

$CN_{10} \ 83 \rightarrow 80$

Design Comparison

Original design:

- No Volume Reduction
- Treat 100% of site (19.8 ac) with Wet Pond Level 2
- Compliance: exceed reqmt. by 2.4 lb/yr

RR Design:

- Treat 11.9 acres
- Compliance: exceed reqmt. by 2.2 lb/yr
- No wet pond Req'd (for water quality)
- Reduce 23,065 ft³ volume (from site Tv = 34,816 ft³)
- Reduce 1-yr CN from 83 to 77

Alternative Design

Additional Volume Reduction:

Option of adding permeable pavement:

- Increases load reduction 1 pound/yr:
2.2 to 3.2 lb/yr;
- Increases volume reduction approx 8%
- Increases CN Reduction for 1-yr storm:
from 83 to 76 (versus 83 to 77)

Cost-Benefit analysis of incremental increase in performance?

Runoff Reduction Method

- Not difficult!
- Spreadsheet tracks runoff volume and pollutant load reductions by DA (Summary Tab)
- Additional tracking tools (spreadsheets or other tools can be utilized)
- Better site design, improved BMP performance, and practices designed for long term functioning

- Additional discussion on VRRM and Compliance Spreadsheet
 - Capabilities
 - Limitations



(Modules 5, 8, and 9)

Questions & Discussion

