Chesapeake Bay TMDL and Virginia Stormwater Regulations

March 2, 2011

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Agenda

Chesapeake Bay TMDL Overview

Virginia WIP

- Allocations
- Sector Requirements, Contingencies, and Concerns
  - Urban
  - Wastewater
  - On-Site Septic
  - Agriculture

Virginia Stormwater Management Regulations

- Overview
- Draft Regulations and Concerns
  - Quantity
  - Quality
  - Offsets
  - Grandfathering
  - Local Program Criteria
- Virginia Runoff Reduction Method Concerns

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What is a TMDL?

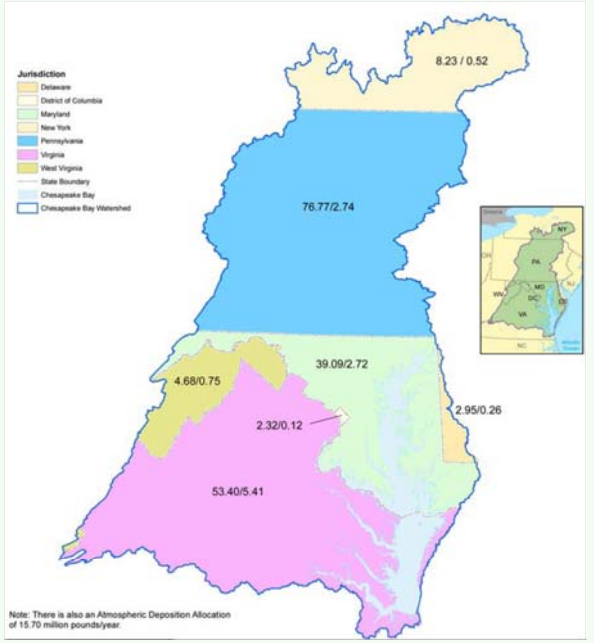
Total Maximum Daily Load (TMDL): The maximum sum of pollutants that a water body can accept and still maintain certain "designated uses" such as a fishable or swimmable condition. (Designated uses vary by location and regulatory authority.)

- Maximum sum of pollutants = Point source wasteload allocations (WLAs)
  +
  Non-point source load allocations (Las)

The Chesapeake Bay TMDL seeks to improve dissolved oxygen, water clarity, and chlorophyll *a* (a measure of algae) by 2025 by setting maximum Total Nitrogen (TN), Total Phosphorus (TP), and Sediment (TSS) allocations.

The TMDL covers parts of six states and the District of Columbia (64,000 square miles).

"Executive Order 13508: Chesapeake Bay Protection and Restoration" mandated EPA to create the TMDL.



What is a WIP?

Watershed Implementation Plan (WIP): a document published by each Bay state outlining the State's plan to meet the TMDL allocations.

- Outlines ***actions*** to reduce TN, TP, and sediment loads to meet the TMDL allocations:
  - 60% reduction by 2017; and
  - 100% reduction by 2025.

- EPA requires that WIPs provide ***"reasonable assurance"*** that each state will meet its load reductions.

- If a WIP does not show reasonable assurance, EPA will implement a **"*backstop*"** (mandated load reduction).

Phase I WIPs allocate pollutant loads by ***river basin***.
Phase II WIPs allocate pollutant loads on a local scale (***39 watershed segments*** in VA).
Phase III WIPs provide additional detail of restoration actions ***beyond 2017***.

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Chesapeake Bay TMDL Schedule

2010:

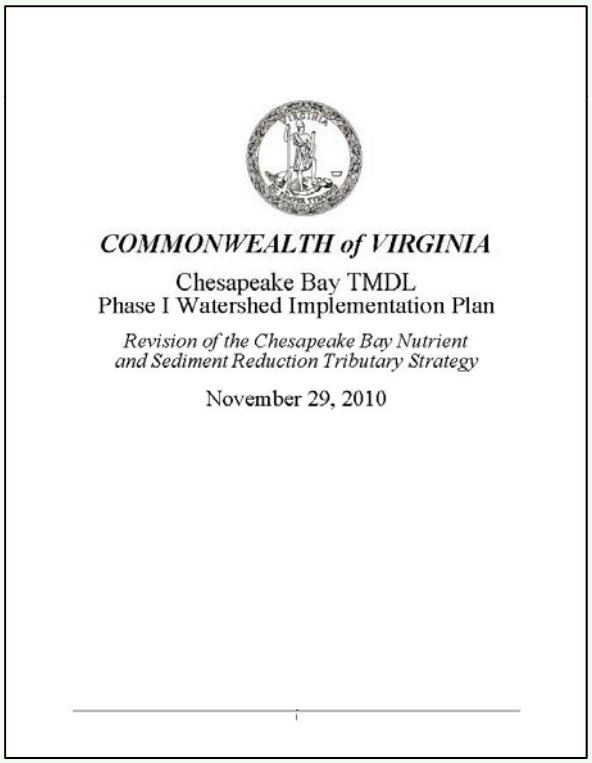
July- EPA sets allowable state/basin TP and TN loads (based on Phase 5.3 model);
August- EPA sets allowable state/basin TSS loads;
September- States publish draft Phase I Watershed Implementation Plans (WIPs);
November- States publish final Phase I WIPs;
December- Virginia revises final WIP based on recent model run showing an allocation gap in the James basin;
EPA publishes final TMDL rule

2011:

June- States complete *draft* Phase II WIPs (June 1);
November- States complete *final* Phase II WIPs (Nov. 1);
December- EPA modifies the TMDL, if necessary;
First set of 2-year milestones is completed (Dec.31)

2017:

States publish Phase III WIPs;
EPA modifies Chesapeake Bay TMDL if necessary


COMMONWEALTH of VIRGINIA

Chesapeake Bay TMDL
Phase I Watershed Implementation Plan

Revision of the Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy

November 29, 2010

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Chesapeake Bay TMDL Progress

Secretary of Natural Resources established Stakeholder Advisory Group (SAG) to assist in WIP development

- SAG's recommendation:
  - First, develop the most cost-effective method for achieving TMDL allocations
  - Then, develop a method to share costs equitably across sectors

- WSSI and others submitted letters during public comment period highlighting importance of this issue

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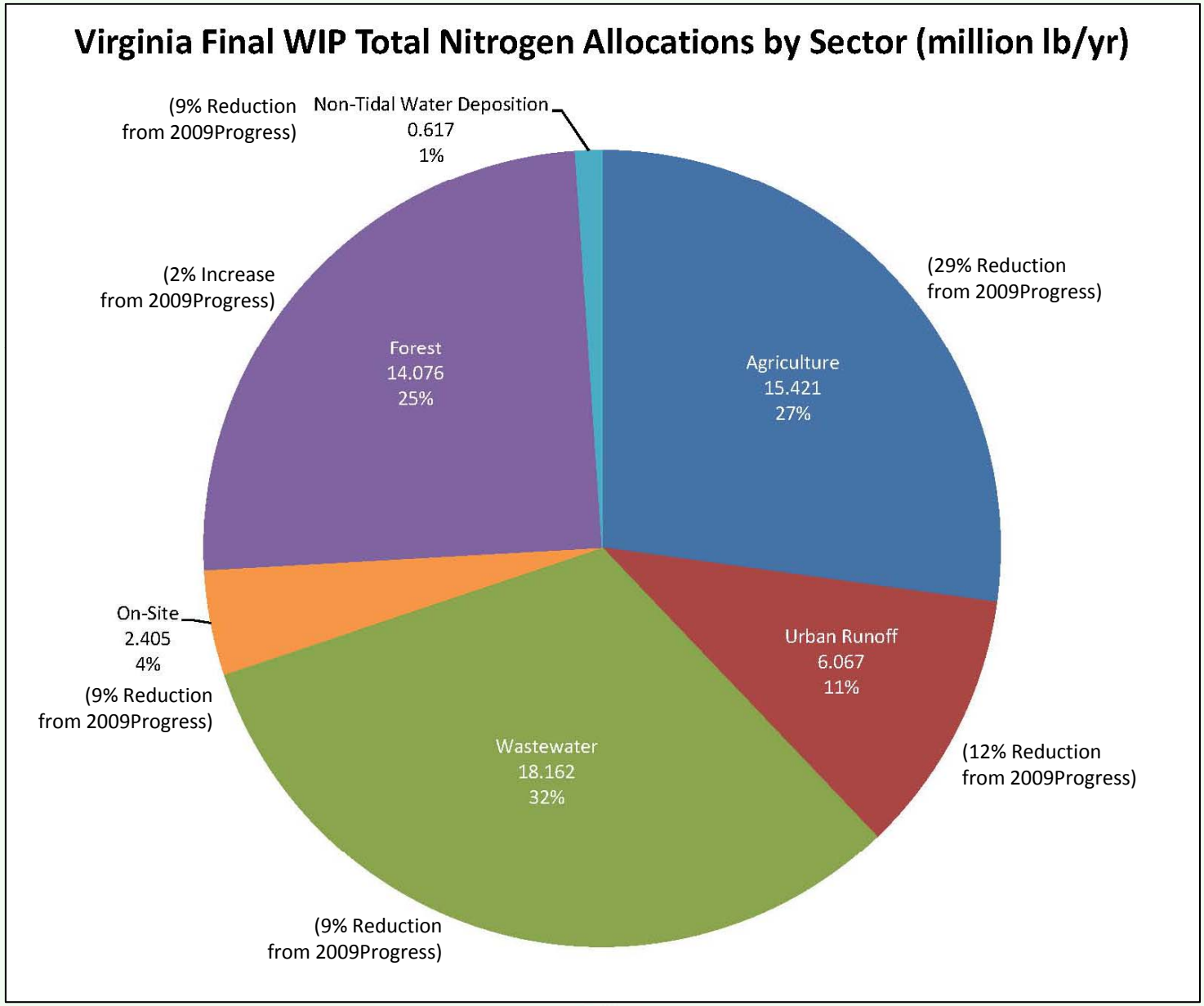
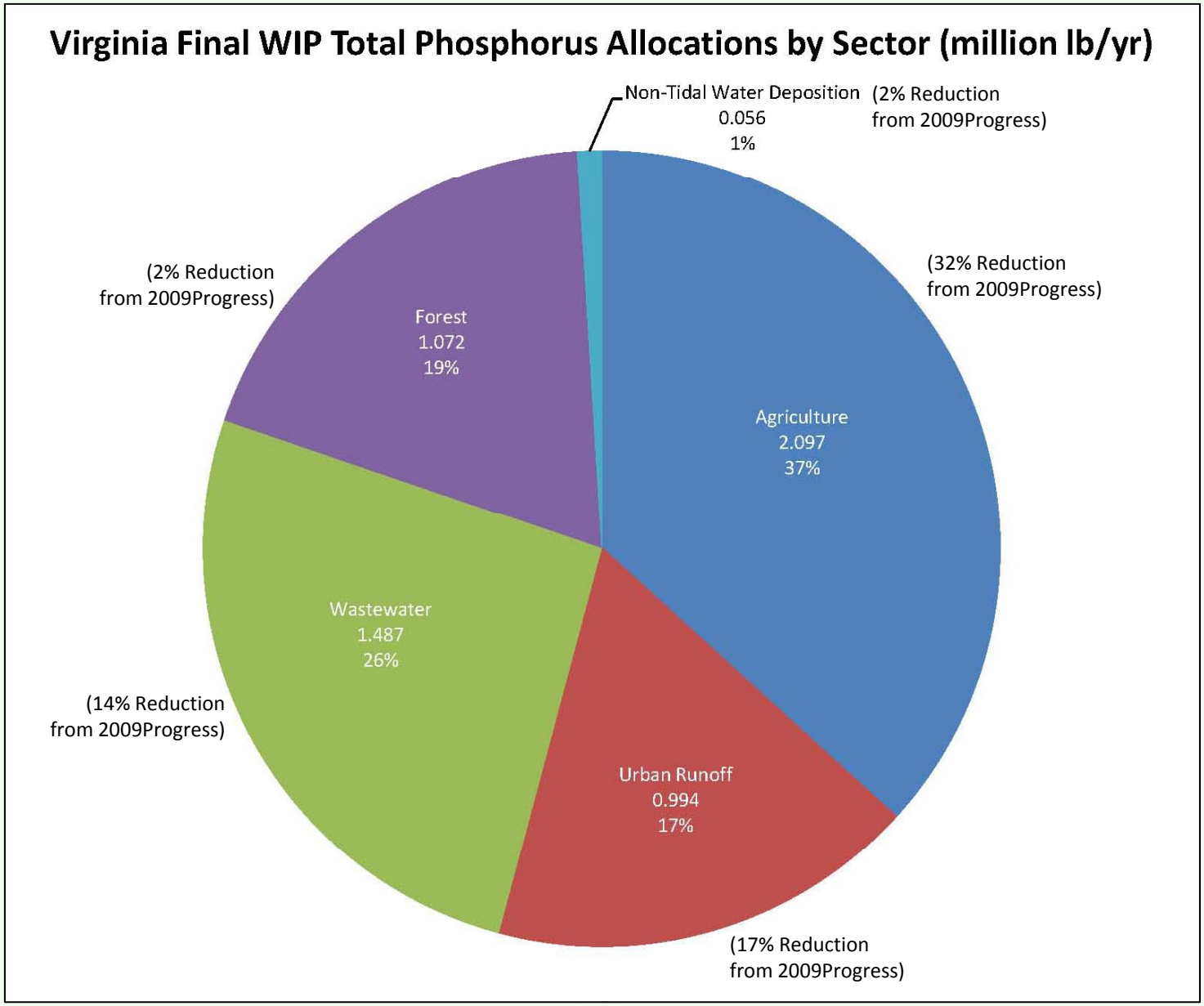
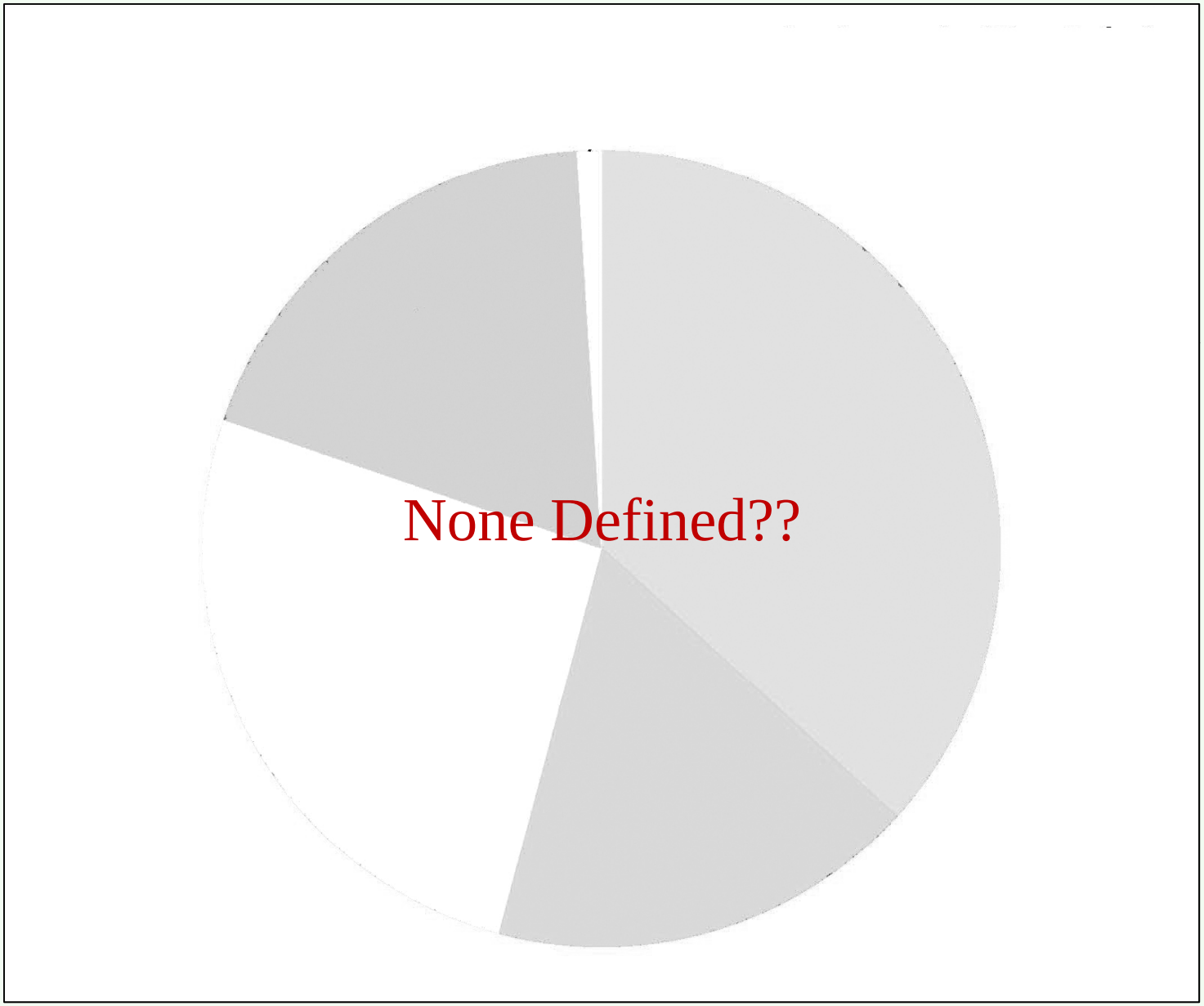
Virginia Final WIP TN Allocations



Virginia Final WIP TP Allocations

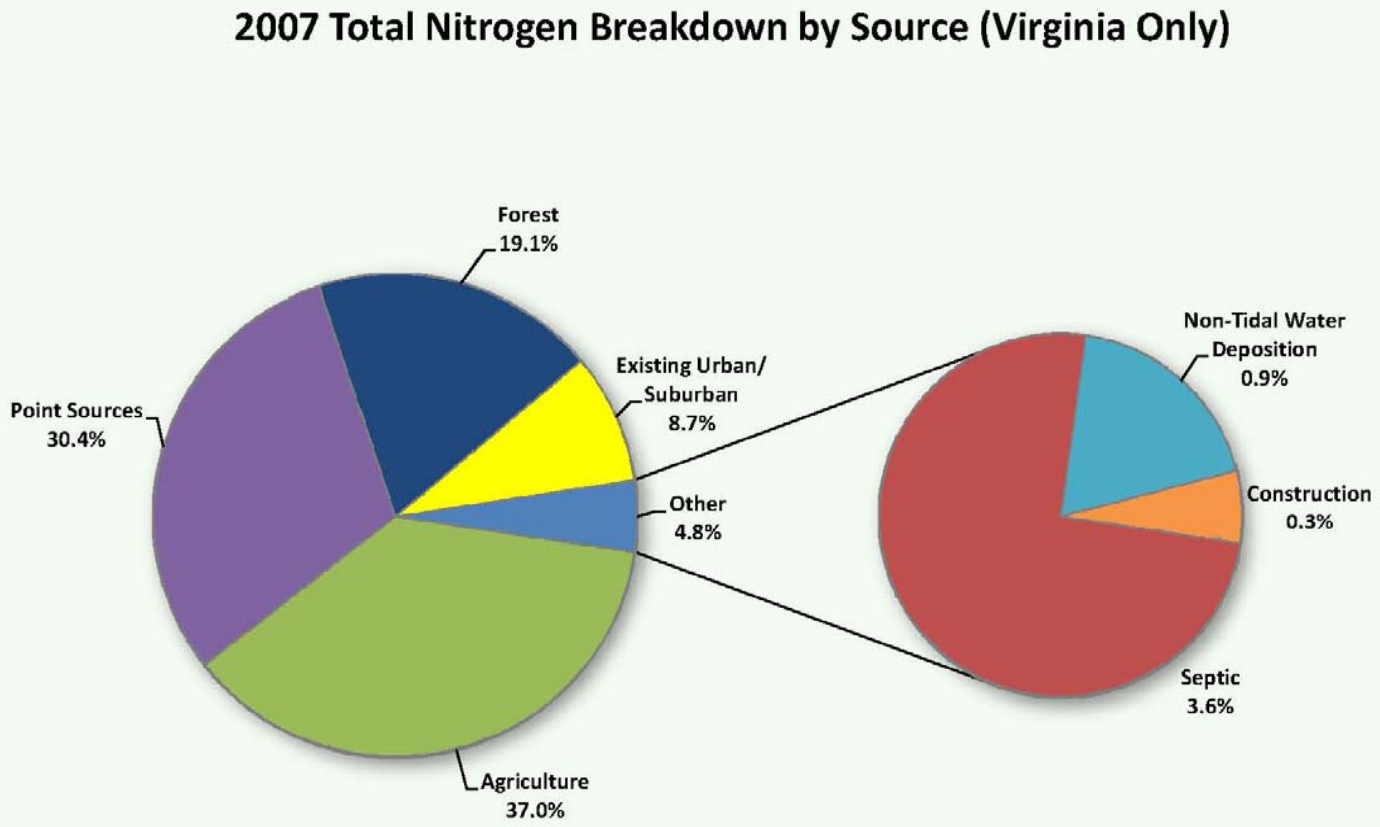


Virginia Final WIP Sediment Allocations



Chesapeake Bay Model Results for VA

Results (based on Phase 5.3 results file, 5/19/2010):



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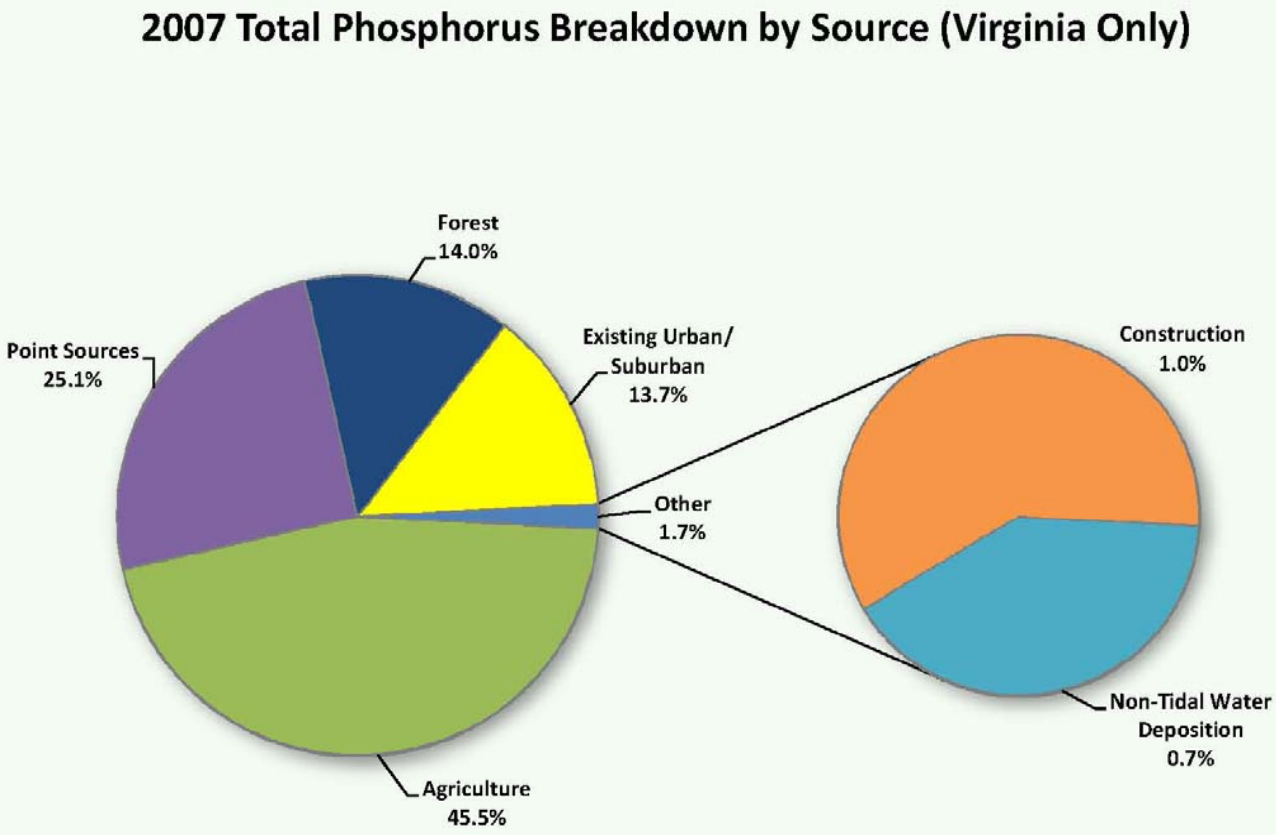

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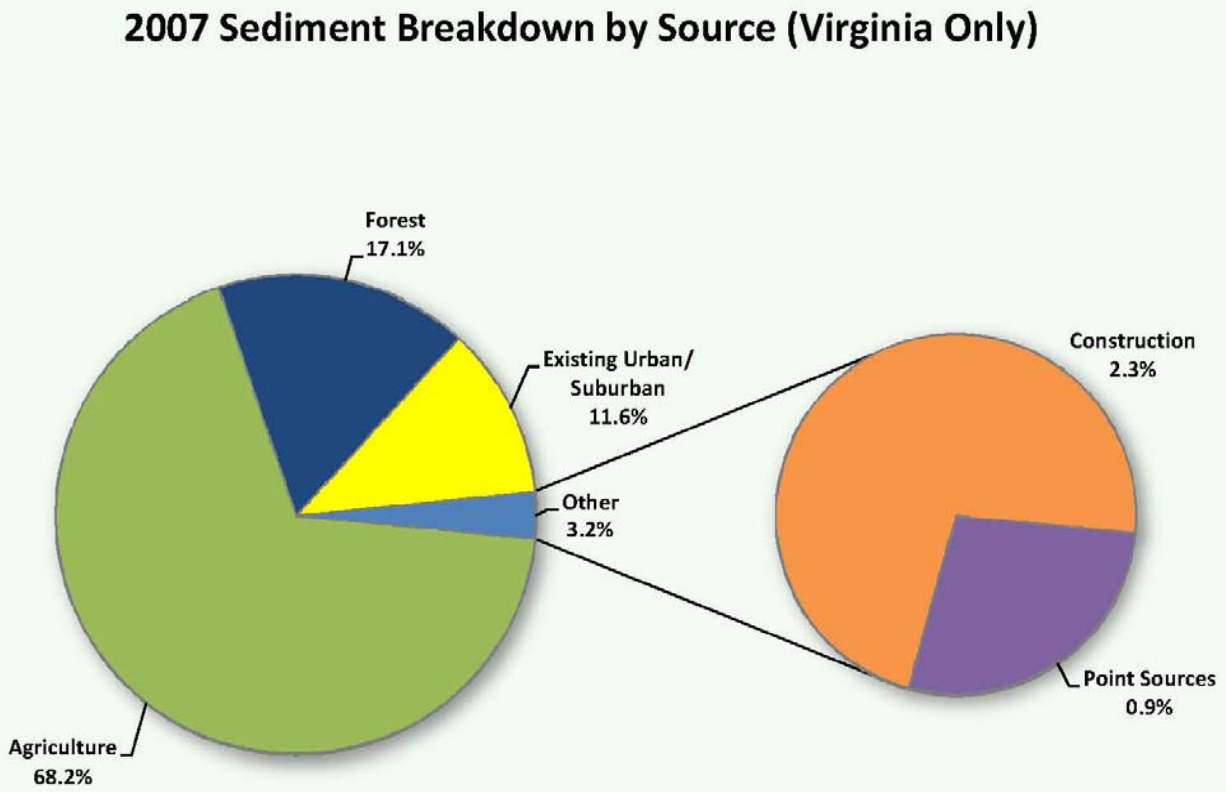

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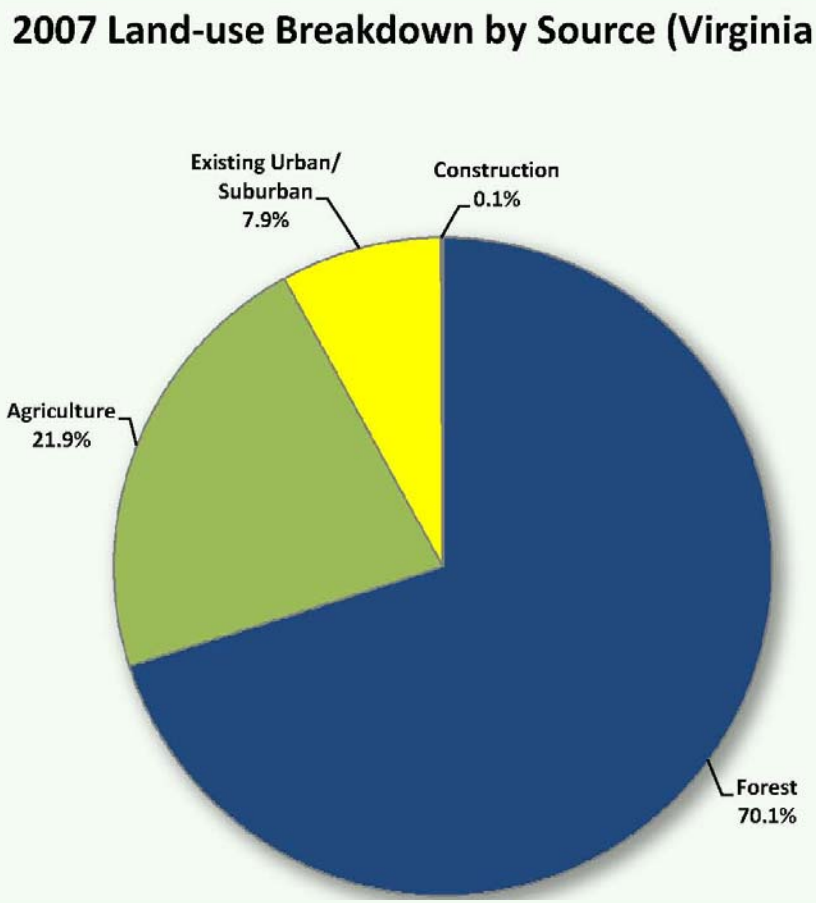

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Virginia Final WIP Allocations

Total Nitrogen TMDL Allocations (Pounds/Year)

Source Data	2009[1]	Draft WIP (Sept. 2010)[2]	SAG[3]	**Final WIP (Nov. 2010)[4]**
Agriculture	21,840,226	16,391,000	16,577,610	**15,421,000**
Urban Runoff	6,868,018	3,915,000	6,107,925	**6,067,000**
Wastewater	20,028,080	20,394,000	19,471,849	**18,162,000**
On-Site	2,631,823	1,922,000	2,673,994	**2,405,000**
Forest	13,756,189	13,939,000	13,951,338	**14,076,000**
Non-Tidal Dep.	604,005	612,000	611,967	**617,000**
Total	65,728,341	57,173,000	59,394,683	**56,748,000**
EPA Allocation				**53,420,000**

Total Phosphorous TMDL Allocations (Pounds/Year)

Source Data	2009[1]	Draft WIP (Sept. 2010)[2]	SAG[3]	**Final WIP (Nov. 2010)[4]**
Agriculture	3,065,034	2,146,000	2,200,340	**2,097,000**
Urban Runoff	1,200,194	380,000	1,038,535	**994,000**
Wastewater	1,728,923	1,832,000	1,828,174	**1,487,000**
On-Site	-	-	-	**-**
Forest	1,089,197	1,090,000	1,090,986	**1,072,000**
Non-Tidal Dep.	56,755	58,000	57,421	**56,000**
Total	7,140,103	5,506,000	6,215,456	**5,707,000**
EPA Allocation				**5,360,000**

1 SAG Handout, 6/16/2010

2 Commonwealth of Virginia Chesapeake Bay TMDL Phase I Watershed Implementation Plan ,Public Review Draft, Sept. 2010

3 SAG Handout, 8/24/2010

4 Commonwealth of Virginia Chesapeake Bay TMDL Phase I Watershed Implementation Plan, November 29, 2010

Virginia Final WIP TN Allocations

Virginia's WIP meets EPA's required TN allocation except in the James Watershed.

- The Commonwealth is conducting a special Chlorophyll-*a* study in the James

WIP Total Nitrogen Loads

Sector	Potomac	Rappahannock	York	James	Eastern Shore	VA TOTAL
Agriculture	6.359	2.515	1.404	4.253	0.890	15.421
Urban	2.635	0.403	0.445	2.534	0.050	6.067
Wastewater	3.743	0.640	1.201	**12.491**	0.087	18.162
Septic	0.597	0.322	0.487	0.923	0.076	2.405
Forest	4.197	1.886	1.782	6.048	0.162	14.076
Air	0.103	0.073	0.089	0.320	0.032	0.617
Total WIP Allocation	**17.634**	**5.839**	**5.408**	**26.569**	**1.297**	**56.748**
EPA Allocation	**17.77**	**5.84**	**5.41**	**23.09**	**1.31**	**53.42**

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Virginia Final WIP TP Allocations

Virginia's WIP meets EPA's required TP allocation except in the James Watershed.

- The Commonwealth is conducting a special Chlorophyll-*a* study in the James

WIP Total Phosphorous Loads:

Sector	Potomac	Rappahannock	York	James	Eastern Shore	VA TOTAL
Agriculture	0.674	0.533	0.157	0.622	0.111	2.097
Urban	0.273	0.094	0.090	0.528	0.009	0.994
Wastewater	0.278	0.079	0.155	**0.967**	0.008	1.487
Forest	0.205	0.183	0.126	0.543	0.015	1.072
Air	0.008	0.007	0.009	0.030	0.002	0.056
Total WIP Allocation	**1.438**	**0.896**	**0.537**	**2.690**	**0.145**	**5.707**
EPA Allocation	**1.41**	**0.90**	**0.54**	**2.37**	**0.14**	**5.36**

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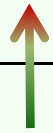
Chesapeake Bay TMDL - Equitability

VA WIP proposes most the significant reductions (as %) from Urban, On-Site Septic, and Agriculture but only proposes reductions from wastewater in the James and York watersheds.

This point is most vividly displayed in the James Watershed

- WIP proposes to take Urban allocation to costly levels (L2) but allows Wastewater to discharge effluent concentrations significantly higher in the James (TN = up to 6.0; TP = 0.4) than currently allowed in the Potomac Embayment (TN = 3.0; TP = 0.18)

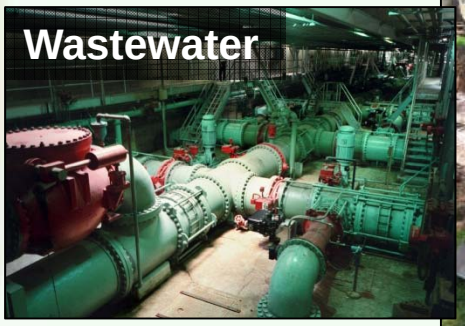
Sector	Cost-Effectiveness ($/lb of TN or TP Removed)	Ease of Installation	WIP Reduction Requirements
Urban	Low	Hard	High
On-Site Septic			
Agriculture			
Wastewater	High	Easy	Low

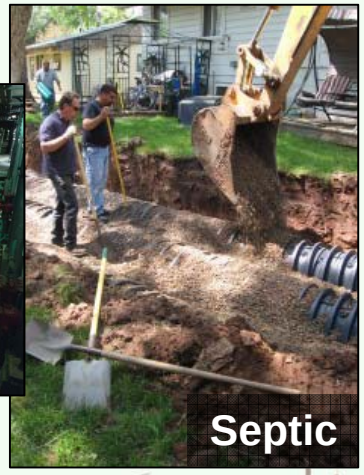
Chesapeake Bay TMDL - Equitability

Cost-Effectiveness of Nutrient Reduction by Sector

Proposed Option	Removal Cost[1] ($/lb-yr)	
	TN	TP
Wastewater	250	2,700
Urban Retrofit	6,000	33,500
Septic Field Upgrades	720	N/A
Urban Fertilizer Management	19	0
Agricultural BMP: Enhanced Nutrient Management	125	2,750

1. Urban Retrofit - 50/50 cost allocation between TN/TP
   - Total Area = 50% of high density impervious and 25% of low density impervious





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Chesapeake Bay TMDL - Equitability

Waste Loads (related to people) are un-equitably shared by basins in the WIP

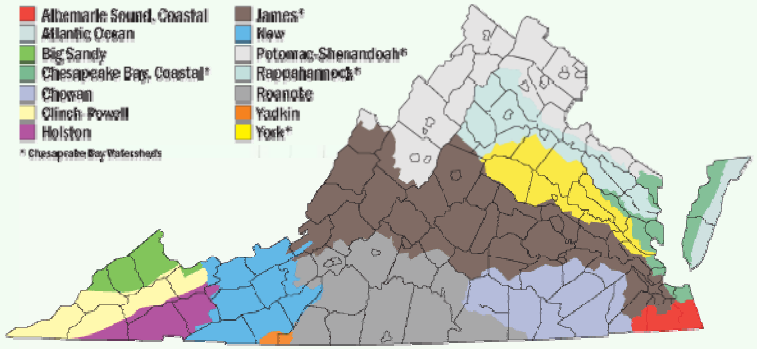
Total Nitrogen (TN) Loads by Watershed

Watershed[1]	Population[2]	Septic + Urban + Wastewater[3]	
		TN (total)	TN (unit)
		lb/yr	lb/cap.-yr
Potomac	2,769,358	6,975,000	2.52
Rappahannock	275,000	1,365,000	4.96
York	423,550	2,133,000	5.04
James	2,499,455	15,948,000	6.38
Eastern Shore	51,594	213,000	4.13
Total	6,018,957	26,634,000	4.43

[1] Analysis represents only the portions of each watershed within Virginia. Portions of the watersheds that extend outside of Virginia are not included in this analysis.

[2] U.S. Census Bureau, Population Division, 2009 Population Estimate, obtained from http://www.census.gov/popest/files/CO-EST-2009-ALLDATA.csv on 8/30/2010.

[3] Allocations are based on the Virginia Chesapeake Bay TMDL Phase I Watershed Implementation Plan, Public Review Draft (Sept. 2010).



Chesapeake Bay TMDL - Equitability

Waste Loads (related to people) are un-equitably shared by basins in the WIP

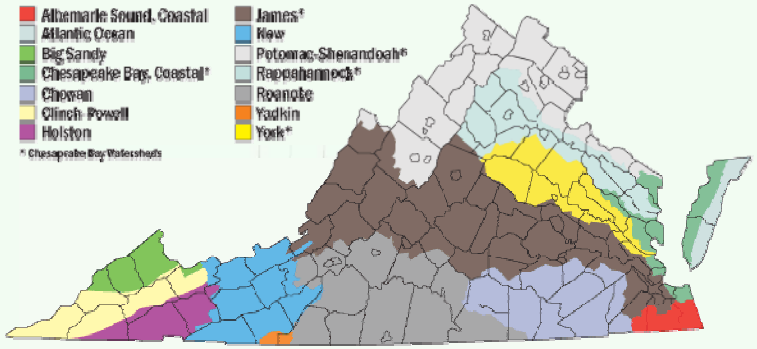
Total Phosphorus (TP) Loads by Watershed

Watershed[1]	Population[2]	Septic + Urban + Wastewater[3]	
		TP (total)	TP (unit)
		lb/yr	lb/cap.-yr
Potomac	2,769,358	551,000	0.20
Rappahannock	275,000	173,000	0.63
York	423,550	245,000	0.58
James	2,499,455	1,495,000	0.60
Eastern Shore	51,594	17,000	0.33
Total	6,018,957	2,481,000	0.41

[1] Analysis represents only the portions of each watershed within Virginia. Portions of the watersheds that extend outside of Virginia are not included in this analysis.

[2] U.S. Census Bureau, Population Division, 2009 Population Estimate, obtained from http://www.census.gov/popest/files/CO-EST-2009-ALLDATA.csv on 8/30/2010.

[3] Allocations are based on the Virginia Chesapeake Bay TMDL Phase I Watershed Implementation Plan, Public Review Draft (Sept. 2010).



Chesapeake Bay Model Problem

The Chesapeake Bay Community Watershed Model (Phase 5.3) drives the TMDL, but the model is still in flux. EPA will revise the model and the TMDL in 2011; however, because urban pollutant loads are directly related to impervious and pervious acreage, the loads (and allocations) are also likely to change drastically.

Model Version	Impervious Surface (acres)	Pervious Surface (acres)
Phase 5.3 (current model input)	675,917	1,885,935
Phase 5.3mod (proposed model input)	1,569,377	3,442,346

- Expect the impervious load to double
- Expect the pervious load to stay the same (or close)
  - The Model's pervious load is based on fertilizer sales

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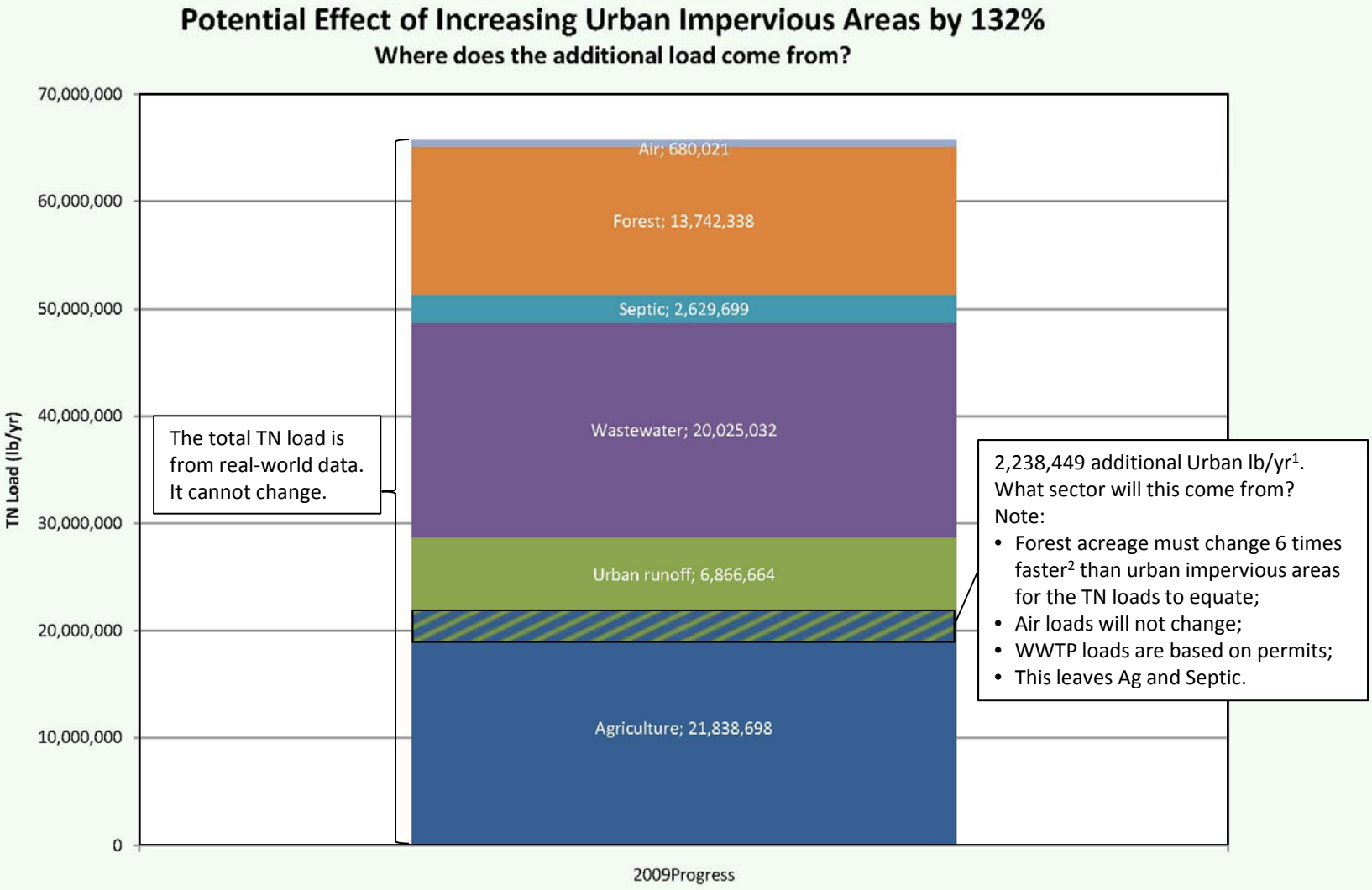
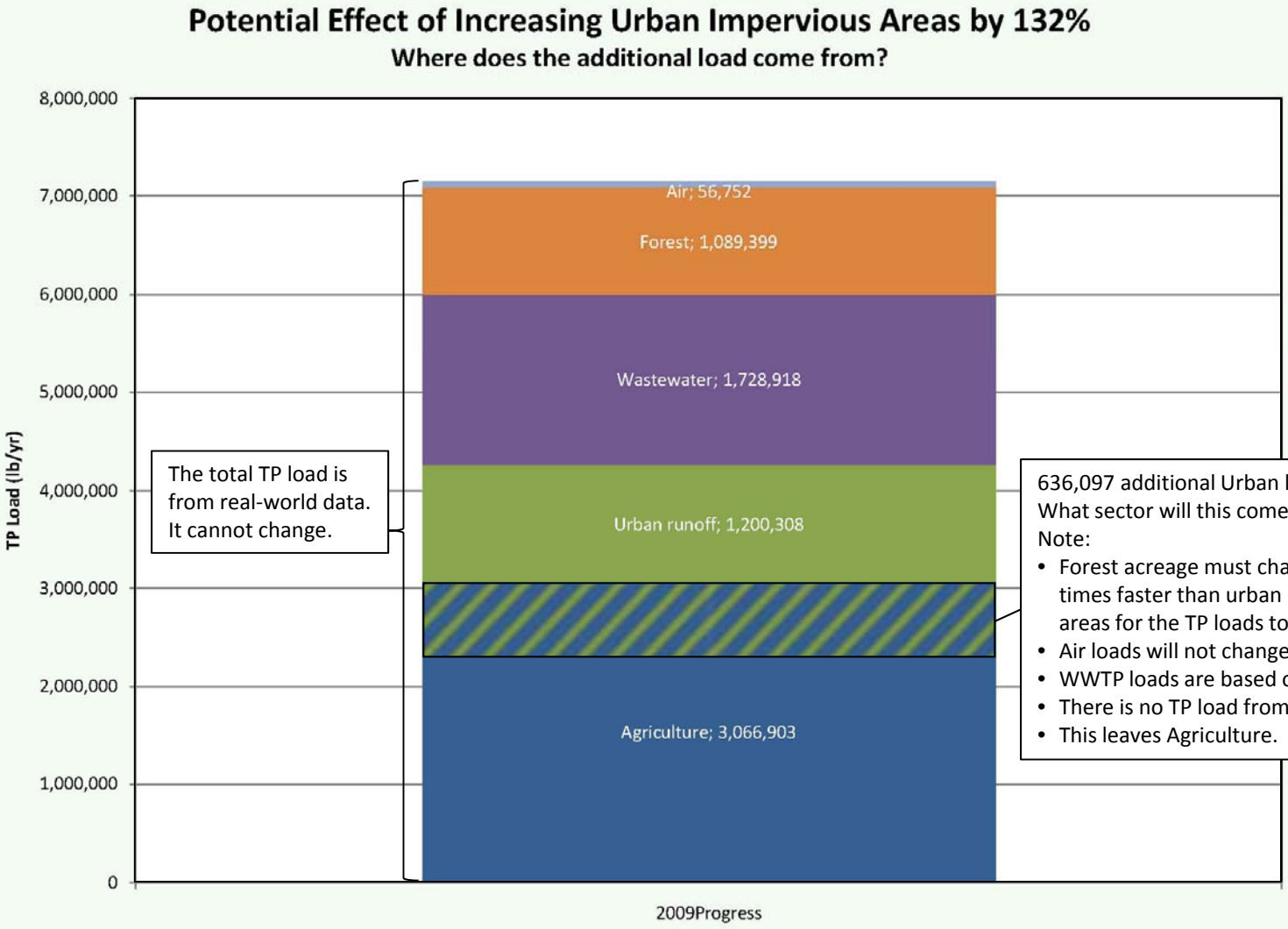
Potential Effect on TN Loads:



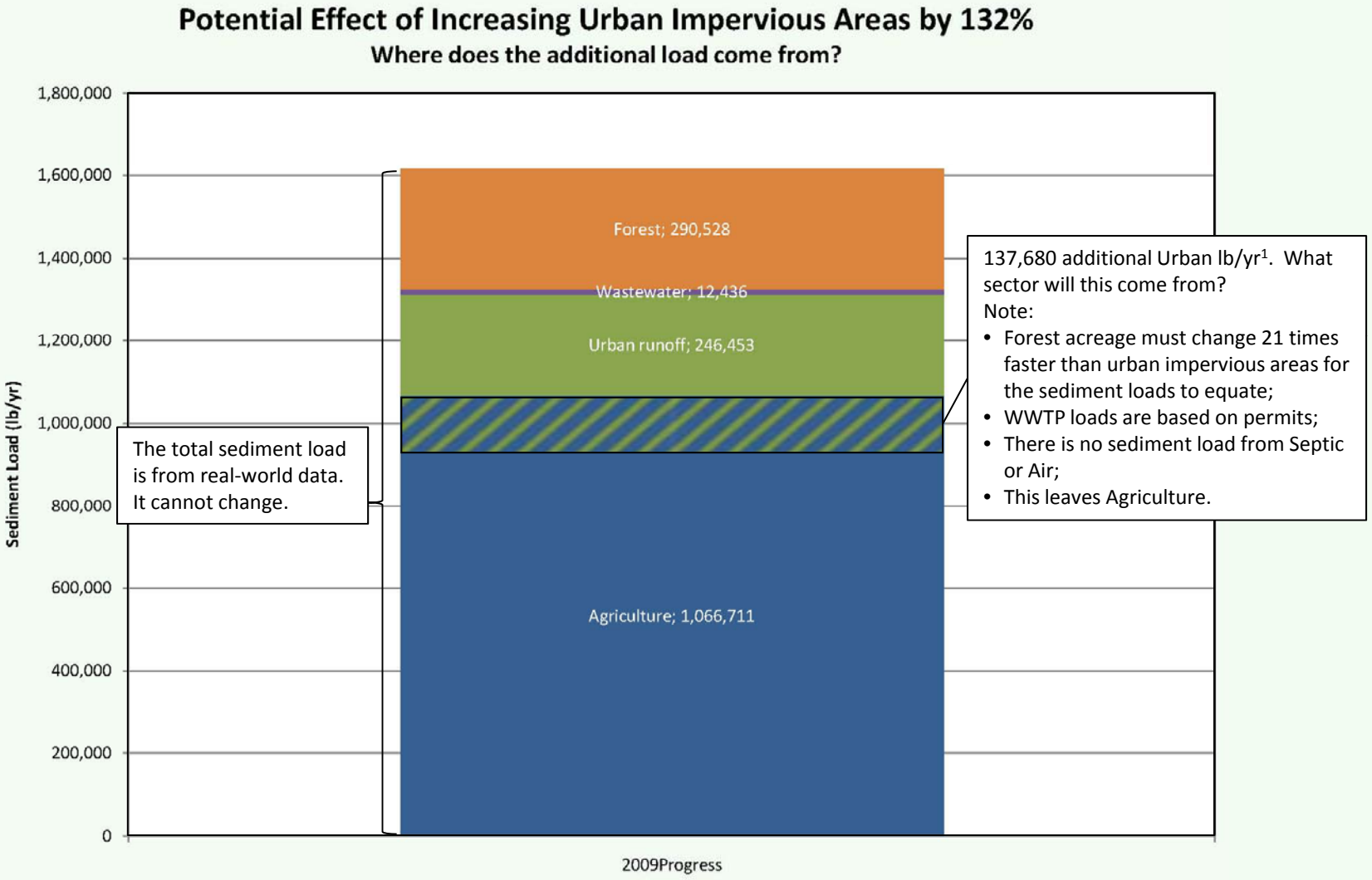
1. The additional urban load equates to the 2009Progress TN load from impervious urban surfaces (1,695,795 lb/ac/yr) times 132%. WSSI assumed no change in the TN load from pervious surfaces.
2. Urban impervious TN loading rate = 11.8 lb/ac/yr
   Forested TN loading rate = 2.0 lb/ac/yr
   Ratio = 12:1

Potential Effect on TP Loads:



1. The additional urban load equates to the 2009Progress TP load from impervious urban surfaces (481,891 lb/ac/yr) times 132%. WSSI assumed no change in the TP load from pervious surfaces.
2. Urban impervious TP loading rate = 2.1 lb/ac/yr
   Forested TN loading rate = 0.1 lb/ac/yr
   Ratio = 21:1

Potential Effect on Sediment Loads:



1. The additional urban load equates to the 2009Progress sediment load from impervious urban surfaces (104,303 lb/ac/yr) times 132%. WSSI assumed no change in the sediment load from pervious surfaces.
2. WSSI assumes sediment to be proportional to TP.

The Urban Sector - Overview

WIP Requirements

Scoping Levels 2 and 3

Contingency Plans – Virginia and EPA

Urban Sector Concerns

- BMP Efficiencies
- Model Loading Rates
- Stormwater Regulation

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Urban Sector WIP Requirements

New Development

- Meet pre-development loads from a generic pre-development acre.
- Tier I: Load balancing between pre- and post-development land uses.
- Tier 2: Identifying and promoting land use practices that minimize impact.

Existing Non-Federal MS4s

- Meet *Scoping Scenario Level 2*.
- Flexibility for varied management technologies.
- Three permit cycles (15 years) to implement the reductions:
  - 5% by the end of the first permit cycle;
  - 35% by the end of the second permit cycle; and
  - 100% by the end of the third permit cycle.

Existing Federal MS4s

- Meet *Scoping Scenario Level 3*.
- Federal SW guidance 40 CFR Section 122.26(d)(2) and 40 CFR Section 122.34(b)(5).

Existing Non-MS4 Lands

- No retrofit requirements proposed.

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Urban Sector WIP Requirements

Urban Nutrient Management

- Voluntary as long as 90% compliance is projected.
- If less than 90% compliance, may become mandatory:
  - Collect and report annual fertilizer applications by lawn care operators;
  - Require nutrient management plans for municipal/county lands and golf courses;
  - Ban phosphorus unless establishing or re-establishing a lawn, or if needed after soil tests;
  - Implement time-of-year application restrictions and prohibit nitrogen-containing deicers;
  - Slow-release nitrogen; and
  - Require proper storage and disposal by retailers.

Offsets

- May not provide adequate protection for local streams.
- Should be installed close to the impacting growth area. (Mandatory where local waterbody impairments or local TMDLs exist.)
- Must be perpetual.

Erosion and Sediment Control

- No new requirements proposed.
- Model assumes 40% efficiency; could be 80-90% with programmatic changes.

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The Urban Sector - Overview

WIP Requirements

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Urban Sector Concerns

- BMP Efficiencies
- Model Loading Rates
- Stormwater Regulation

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Urban Sector

Scoping Scenario Levels 2 and 3 Requirements

Urban/Suburban Stormwater Scoping Scenario Levels 2 and 3

Land Use Category	Practice Description	L2 % Coverage	L3 % Coverage
High-Intensity Impervious Urban	Impervious Cover Reduction	10%	20%
	Filtration Practices	10%	20%
	Infiltration Practices	5%	10%
Low-Intensity Impervious Urban	Impervious Cover Reduction	5%	10%
	Filtration Practices	5%	10%
	Infiltration Practices	10%	20%
High-Intensity Pervious Urban	Impervious Cover Reduction	N/A	N/A
	Filtration Practices	5%	10%
	Infiltration Practices	5%	10%
Low-Intensity Pervious Urban	Impervious Cover Reduction	N/A	N/A
	Filtration Practices	5%	10%
	Infiltration Practices	5%	10%

Includes urban nutrient management on 522,740 acres;
2,142 acres of non-agricultural land receiving nutrients;
5,000 acres of VDOT property receiving nutrients;
142,000 acres of lawn service and 26,000 acres of golf courses;
TN and TP controlled on 90% (297,000 acres) of do-it-yourself lawn fertilizer applications;
50,000 acres of nutrient management at office parks, municipal lands, etc.; and
Street sweeping on 20,000 acres.

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Urban Sector

Scoping Scenario L2 Effective Reduction (Non-Federal MS4s)

The WIP

- Combines high- and low-intensity pervious and impervious areas, below;
- Provides flexibility by not requiring specific technologies;
- Only agrees to percentage reductions: this will be a problem when the urban areas are revised in 2011!

Urban/Suburban Stormwater Scoping Scenario Level 2 Effective Net Reductions Using Phase 5.3 Land Loads

Land Use Category	Effective Net Reduction over Entire Land Use Category Acreage		
	TN	TP	Sediment
Impervious Urban (average of high- and low-intensity)	**9%**	**16%**	**20%**
Pervious Urban (average of high- and low-intensity)	**6%**	**7.25%**	**8.75%**

Nutrient Reduction Efficiencies:
Impervious Cover Reduction: 2% TN, 65% TP, 85% Sediment
Filtration Practices: 40% TN, 60% TP, 85% Sediment
Infiltration Practices: 80% TN, 85% TP, 95% Sediment

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Scoping Scenario L3 Effective Reduction (Federal MS4s)

Urban/Suburban Stormwater Scoping Scenario Level 3 Effective Net Reductions Using Phase 5.3 Land Loads

Land Use Category	Effective Net Reduction over Entire Land Use Category Acreage		
	TN	TP	Sediment
Impervious Urban (average of high- and low-intensity)	**18%**	**32%**	**40%**
Pervious Urban (average of high- and low-intensity)	**12%**	**14.5%**	**17.5%**

Nutrient Reduction Efficiencies:
Impervious Cover Reduction: 2% TN, 65% TP, 85% Sediment
Filtration Practices: 40% TN, 60% TP, 85% Sediment
Infiltration Practices: 80% TN, 85% TP, 95% Sediment

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Urban Sector

The Potential Local Cost of Achieving L2

County	Impervious Area (ac)	23.0% Total L2 Coverage[2] (ac)	Retrofit Unit Cost ($/ac)	Total Cost by 2025 (million $)	Yearly Cost[3] (million $)
Fairfax	44,474	10,229	$102,520[1]	**1,049**	**70**
Loudoun	15,371	3,535		**362**	**24**
Prince William	14,651	3,370		**345**	**23**

1. Center for Watershed Protection, Urban Subwatershed Restoration Manual Series, Manual 3, Urban Stormwater Retrofit Practices, Version 1.0, Appendix E.1, 2007. The average cost is listed as $88,000/impervious acre treated. This is scaled up based on the ENR Construction Cost Index (20-city average). January 2006: 7660; October 2010: 8921; Resulting Index = 8921/6130 = 1.165. Resulting cost = 102,520.
2. Weighted average of requirements on high- and low-density pervious and impervious land.
3. Yearly cost = total cost / 15 years (2010-2025)

This analysis includes VDOT roadways; is VDOT or the County responsible for that cost?

Less expensive urban BMPs are needed:

- Street sweeping;
- Urban nutrient management;
- Goose control;
- Others??

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The Urban Sector - Overview

WIP Requirements

Scoping Levels 2 and 3

Contingency Plans – Virginia and EPA

Urban Sector Concerns

- BMP Efficiencies
- Model Loading Rates
- Stormwater Regulation

Urban Sector

Virginia's Urban Contingency Plan

New Development

- Preserve or restore site hydrology to the maximum extent practicable
- Post-development loads to be *lower* than the aggregate pre-development load
- Impervious cover limits
- Enhanced vegetation plans in open space and pervious areas

Redevelopment

- Require pollutant reductions greater than 20%

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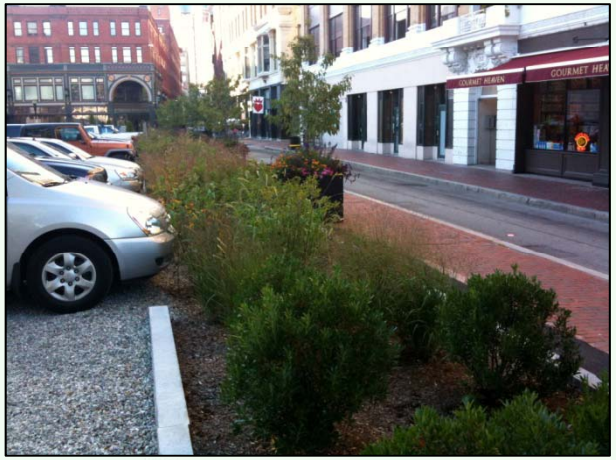
Urban Sector

EPA Enhanced Oversight

If additional reasonable assurance is not provided, EPA may subject more stormwater to NPDES permit requirements.



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The Urban Sector - Overview

WIP Requirements

Scoping Levels 2 and 3

Contingency Plans – Virginia and EPA

Urban Sector Concerns

- ***BMP Efficiencies***
- ***Model Loading Rates***
- ***Stormwater Regulation***

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Urban Sector Concerns

BMP Efficiencies

"**While the state program may show that the load and waste load have been met with the state BMP efficiency, the model may show noncompliance with the segment-shed load and waste load allocation.** Therefore, model and state program BMP efficiencies must be evaluated and, if necessary, made consistent by the end of the 2013 milestone period." (Final WIP, page 88)

Practice	VRRM	TMDL
	Total TP Removal (%)	Total TP Removal (%)
Grass Channel	24-41	10-45
Permeable Pavement	59-81	10-80
Infiltration	63-93	80-85
Bioretention	55-95	25-80
Dry Swale	52-76	70
Filtering Practice	60-65	40-60
Constructed Wetland	50-75	45
Wet Pond	45-75	45
Extended Detention Pond	15-31	20

Note: Ranges are given because efficiency rates vary based on soil type and/or level of design.

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Urban Sector Concerns

Model Loading Rates

A similar problem exists for land use loading rates: the rates used by the TMDL and the Virginia Runoff Reduction Method (VRRM) do not match. Therefore, a site may show a lower load when modeled with the VRRM than when modeled with the Chesapeake Bay Model.

Land Use Type	TP Load (lb/ac/yr)		TN Load (lb/ac/yr)	
	VRRM[1]	TMDL	VRRM [1]	TMDL
Impervious	2.17	2.1	15.50	11.8
Pervious	0.49	1.1	3.50	8.7
Forest	0.08	0.1	0.59	2.0

1. Weighted average for all hydrologic soil groups

Currently, VRRM does not calculate the load from forest.

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Urban Sector Concerns

Stormwater Regulation

Current (and proposed) Virginia stormwater regulation only addresses TP, although the VRRM has the capacity to determine TN loads.

The upcoming regulations may revise "the allowable concentration value for phosphorus, *and possibly nitrogen and sediment*, depending on which pollutant (N, P, or sediment) is expected to be most restrictive for new development based on the TMDL allocations." (Final WIP, page 87)

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The Wastewater Sector - Overview

WIP Requirements

WIP Contingency Plan

Wastewater Sector WIP Requirements

Significant Dischargers

Despite being the most relatively cost-effective sector (which also provides the most reasonable assurance in which to achieve nutrient reductions, wastewater has very few requirements to reduce loads:

Significant Dischargers

(Discharge 0.5 MGD if above the fall line or 0.1 MGD if below the fall line)

- No new requirements except for the James and York watersheds.

James Watershed Significant Dischargers:

- Hampton Roads Sanitation District – TN concentration reduced to 6.0 mg/l (currently 12.7 mg/l)

- Publicly-owned treatment plants – TP concentration reduced to 0.4 mg/l (currently 0.5 to 0.6 mg/l)

Flow Weighted Average for Concentrations (mg/L) used for Current WLAs for Significant Dischargers by Basin

Basin[1]	Flow-weighted Average Concentration (mg/l)	
	TN	TP
Shenandoah-Potomac	4.12	0.20
Rappahannock	4.00	0.30
York	3.08	0.50
James	6.95	0.65
Eastern Shore	4.93	0.30
***Total* Flow Weighted Average**	**5.55**	**0.48**
Potomac Embayment	**3.0**	**0.18**

York Watershed Significant Dischargers:

- Publicly-owned treatment plants – TP concentration limit of 0.4 mg/l
- Additional 20% reduction from significant industrial dischargers

Wastewater Sector Contingencies

WIP Contingency Plan

The Commonwealth appears confident that the wastewater sector will meet its allocation. No contingencies are defined, and the Commonwealth intends to use this sector to help offset other sectors as needed.

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The On-Site Septic Sector - Overview

WIP Requirements

WIP Contingency Plan

On-Site Septic Sector WIP Requirements

Alternative systems

- Require 50% TN reduction for new small systems
- Cap new large systems at 3 mg/l TN per year (from 5mg/l currently)

New and replacement systems

- Utilize “shallow-placed” systems or denitrification technology

Other measures

- Promote community onsite systems
- Establish a 5-year pumpout requirement
- Establish tax credits for upgrading/replacing conventional systems
- Encourage the use of Betterment Loans for existing system repairs

- **Problem:** The WIP proposes to reduce the on-site septic load from 2,630,000 lb/yr to 2,405,000 lb/yr.
  - Will voluntary programs achieve this reduction (coupled with growth)?

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On-Site Septic Sector Contingencies

WIP Contingency Plan

- Expand the nutrient credit exchange to offset growth in this sector.
- No other contingencies are planned.
- EPA did not define a backstop for on-site septic.

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The Agricultural Sector - Overview

WIP Requirements

WIP Contingency Plans

Agricultural Sector Concerns

Agricultural Sector WIP Requirements

- Continue to implement the "Five Priority Practices," namely:

  1. Nutrient Management;
  2. Vegetative Buffers (grass and forest);
  3. Conservation Tillage;
  4. Cover Crops; and
  5. Livestock Stream Exclusion

- Ramp up technical staff at 47 Soil and Water Conservation Districts
- Offer financial incentives through the Virginia Agricultural BMP Cost-Share Program
- Implement an extensive public relations and education campaign

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Agricultural Sector WIP Requirements

Input Deck BMPs	2009% Treatment	2017 Coverage Level	2025 Coverage Level
Forest Buffers Riparian Cropland and Specialty Crops	1%	3%	5%
Forest Buffers Riparian Hay	0%	1%	5%
Forest Buffers Riparian Pasture	8%	10%	10%
Grass Buffers Riparian Cropland and Specialty Crops	9%	30%	90%
Grass Buffers Riparian Hay	0%	1%	90%
Grass Buffers Riparian Pasture	12%	15%	20%
Land Retirement Ag	3%	5%	5%
Upland Tree Planting Ag	0.7%	5%	5%
Wetland Restoration	5%	15%	20%
Continuous No-Till	11%	35%	60%
Conservation Till (Includes CNT Acres)	57%	80%	90%
Conservation Plan Cropland and Specialty Crops	60%	65%	95%
Conservation Plan Hay	7%	40%	95%
Conservation Plan Pasture	41%	50%	95%
Cover Crop Standard Planting	4%	10%	10%
Cover Crop Early Planting	3%	10%	20%
Commodity Cover Crop Early Planting	4%	10%	15%
Stream Protection with Fencing (Linear Feet)	15%	45%	95%

Continued on next slide...

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Agricultural Sector WIP Requirements

Input Deck BMPs (Continued from previous slide)	2009% Treatment	2017 Coverage Level	2025 Coverage Level
Stream Protection with Fencing (Linear Feet)	15%	45%	95%
Alternative Water Pasture	2%	2%	0%
Prescribed Grazing Pasture	20%	40%	60%
Animal Waste Management System	25%	34%	95%
Nutrient Management Cropland and Specialty Crops	59%	90%	95%
Nutrient Management Hay	18%	90%	95%
Nutrient Management Pasture	5%	15%	20%
Non-Urban Stream Restoration (Linear Feet)	2%	11%	22%
Poultry Mortality Composters	--	100%	100%
Swine Mortality Composters	--	95%	95%
Water Control Structures	--	--	1,000 Acres
Manure Transport (Exported from Rockingham and Page to Outside the Bay Watershed)	--	5000 Tons	75,000 Tons
Manure Transport (Exported from Rockingham and Page but Within the Bay Watershed)	--	75,000 Tons	75,000 Tons
Poultry Phytase Phosphorus 30% Reduction in Broilers and Turkeys	60%	100%	100%
Swine Phytase Phosphorus 35% Reduction	60%	100%	100%
Precision/Decision Agriculture on Cropland	--	50,000 Acres	50%
Container Nursery and Greenhouse Runoff/Leachate Recovery	--	--	95%

Note: 2,817,228 total agricultural acres in 2009

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Agricultural Sector WIP Requirements

Agricultural milestones toward total load reduction:

- Ending 2013: 15%;
- Ending 2015: 35%;
- Ending 2017: 60%; and
- Ending 2025: 100%.

Implementation is voluntary unless milestones are not met (except for existing requirements under other programs).

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Agricultural Sector Contingencies

WIP Contingency Plan

- Mandate Nutrient Management Plans;
- Mandate Soil Conservation Plans to control soil loss;
- Mandate livestock stream exclusion;
- Mandate grass or forest buffers between crop land or hay fields and streams; and
- Require BMPs on land enrolled in a local use value assessment/taxation programs.

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Agricultural Sector Concerns

Grass and forest buffers are only required along perennial surface waters, defined as "blue line features on pre-1994 USGS topographic maps." However:

- Pre-1994 maps have been superseded by newer maps in many locations
  - Therefore, pre-1994 maps are difficult to obtain
- Post-1994 maps use "thick" blue lines for perennial streams and "thin" blue lines for intermittent streams
- USGS maps tend to seriously underestimate the limits of perenniality
  - Therefore, many perennial streams will not be buffered using the above definition
  - Loudoun County estimates that USGS maps define 500 miles of streams within the County vs. 1,500 actual miles of perennial streams

The Model and EPA do not count many voluntary BMP due to reporting issues and non-NRCS standard practices

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TMDL Summary

- Virginia's WIP meets EPA's required TP and TN allocations except in the James Watershed.
- Waste Loads Related to People are un-equitably shared by basins in the WIP.
- The Chesapeake Bay Community Watershed Model (Phase 5.3) drives the TMDL, but the model is still in flux. Pervious and impervious loads (and allocations) are likely to change drastically.
- Urban Sector:
  - L2 for MS4 lands and L3 for Federal MS4 lands.
  - Urban nutrient management is voluntary.
  - No new requirements for Erosion and Sediment control.
- Wastewater Sector:
  - No new requirements except for the James and York watersheds.
- On-site Septic Sector:
  - 50% TN reduction for new small alternative systems.
  - 25-50% TN reduction for new conventional systems.
- Agriculture Sector:
  - Continue to implement the "Five Priority Practices."
  - Agricultural measures are voluntary.

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Virginia SWM Regulation

Virginia SWM Regulation

Where Have We Been?

December 9, 2009

- Virginia Soil and Water Conservation Board (SWCB) approved final stormwater management regulations (4VAC50-60)

February 15, 2010

- SWCB suspended 4VAC50-60

Spring 2010

- HB 1220 (March 11) and SB 395 (April 10) delay regulations until 280 days after approval of the TMDL but no longer than December 1, 2011

Need to complete the regulation revisions by May 2011 for SWCB to meet the expected deadline of October 7, 2011 (assuming TMDL is published on 12/31/2010)

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Virginia SWM Regulation

Where Are We Now, and Where Are We Going?

Regulatory Advisory Panel (RAP) was formed with subcommittees on:

- Quantity Control
- Quality Control
- Offsets/credits
- Grandfathering
- Local Program Criteria

Quantity Control

4VAC50-60-66

Significant Regulation Elements

1. Channel Protection
   - Three Conditions based on “One Percent Rule”:
     1. Flow to manmade stormwater conveyance systems
     2. Flow to restored stormwater conveyance systems
     3. Flow to stable natural stormwater conveyance systems

2. Flood Protection

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Quantity Control

Federal Guidance Requirements – For Context

Executive Order 13508, Section 502 Guidance, Chapter 3:
Maintain the predevelopment hydrology with respect to volume, flow rate, and temperature.

Predevelopment hydrology is based on the site's historic (pre-colonial) land cover (forest or meadow). Predevelopment hydrology is **not** the site's existing condition directly before the development or redevelopment activity takes place.

Maintaining predevelopment hydrology will help decrease Urban Stream Syndrome.

The Section 502 Guidance gives two design options for meeting the above criteria.

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Quantity Control

Federal Guidance Requirements – For Context

Option 1

- Retain the 95th percentile storm event (approximately 1.7” in the Washington, D.C. area).

  Retention means that the water will be evapotranspired, infiltrated, or used onsite. Retention does **not** mean that the water will be temporarily detained and discharged slowly over some predetermined period.

Option 2

- Site-specific hydrologic analysis to mimic pre-development hydrology.

Neither option allows water to be released from the site until the threshold (1.7” or pre-development runoff) is reached. EPA did not discuss the effect of back-to-back storms, which could drastically increase facility size.

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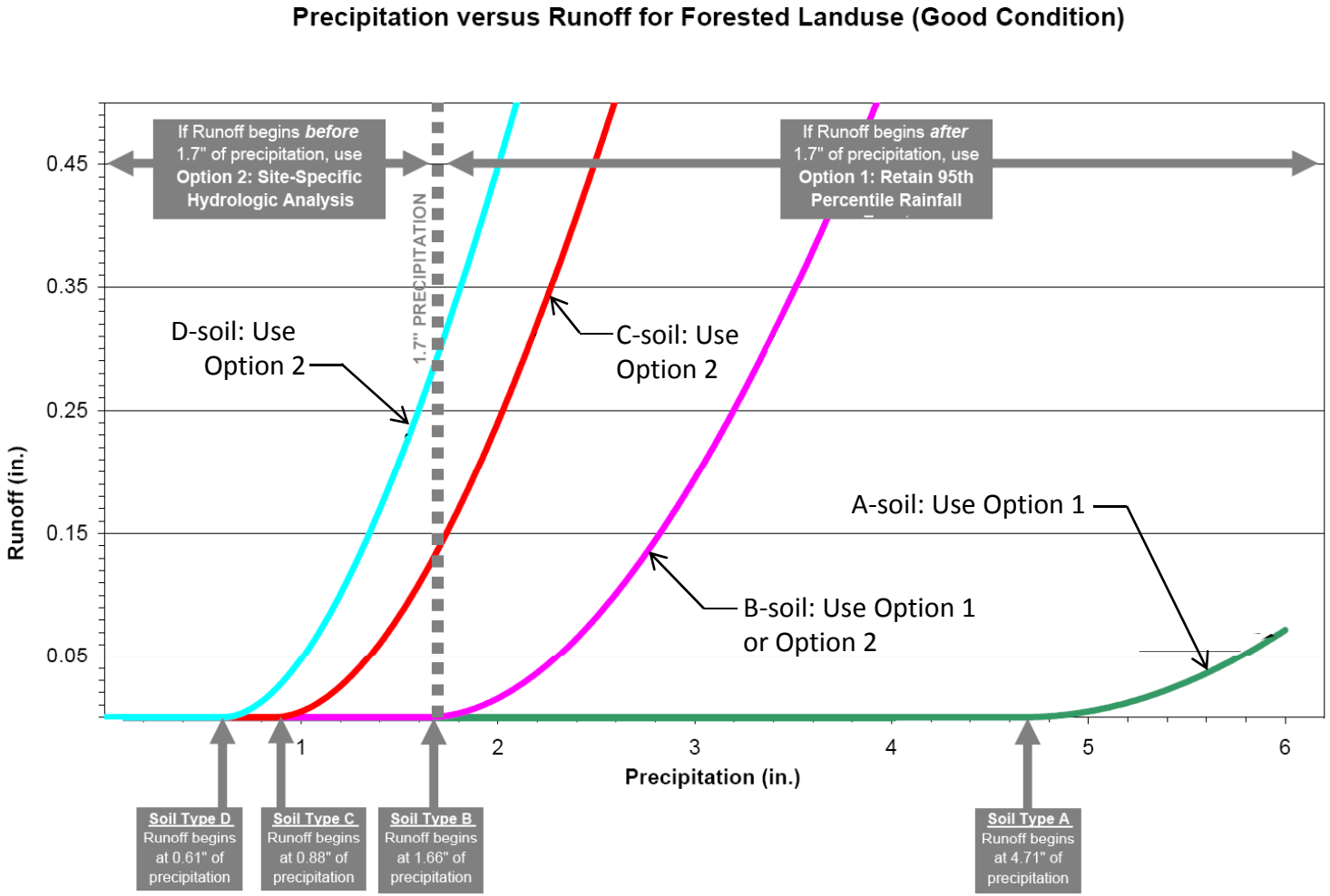
Quantity Control

Option 1 vs. Option 2 – For Context



This figure was developed using Equations 2-3 and 2-4 from *TR-55: Urban Hydrology for Small Watersheds* (Soil Conservation Service, 1986). The CN's used for soil types A, B, C, and D were respectively 30, 55, 70, and 77 (*TR-55: Urban Hydrology for Small Watersheds*; Table 2-2c. Runoff curve numbers for other agricultural lands).

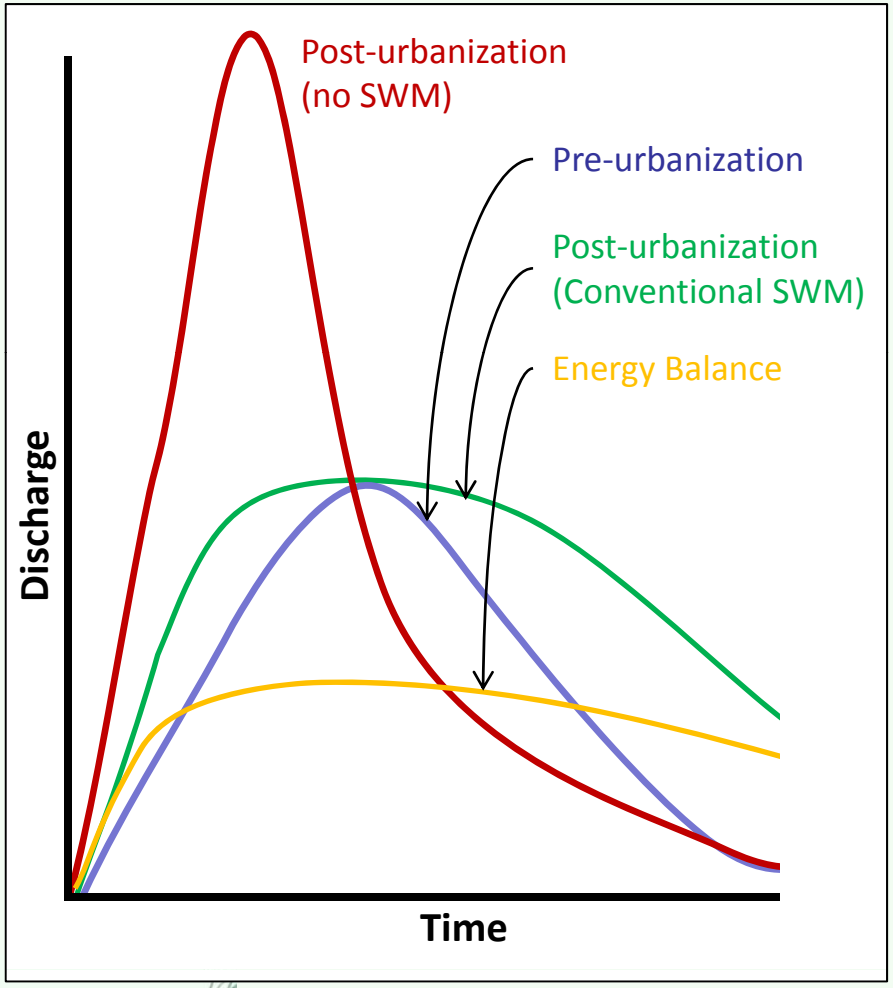
Quantity Control

Energy Balance (or Power Balance)

1. Energy (Joule or Nm)
   - The ability to do work
     - Work = Force x Distance ($F_x \Delta x$)

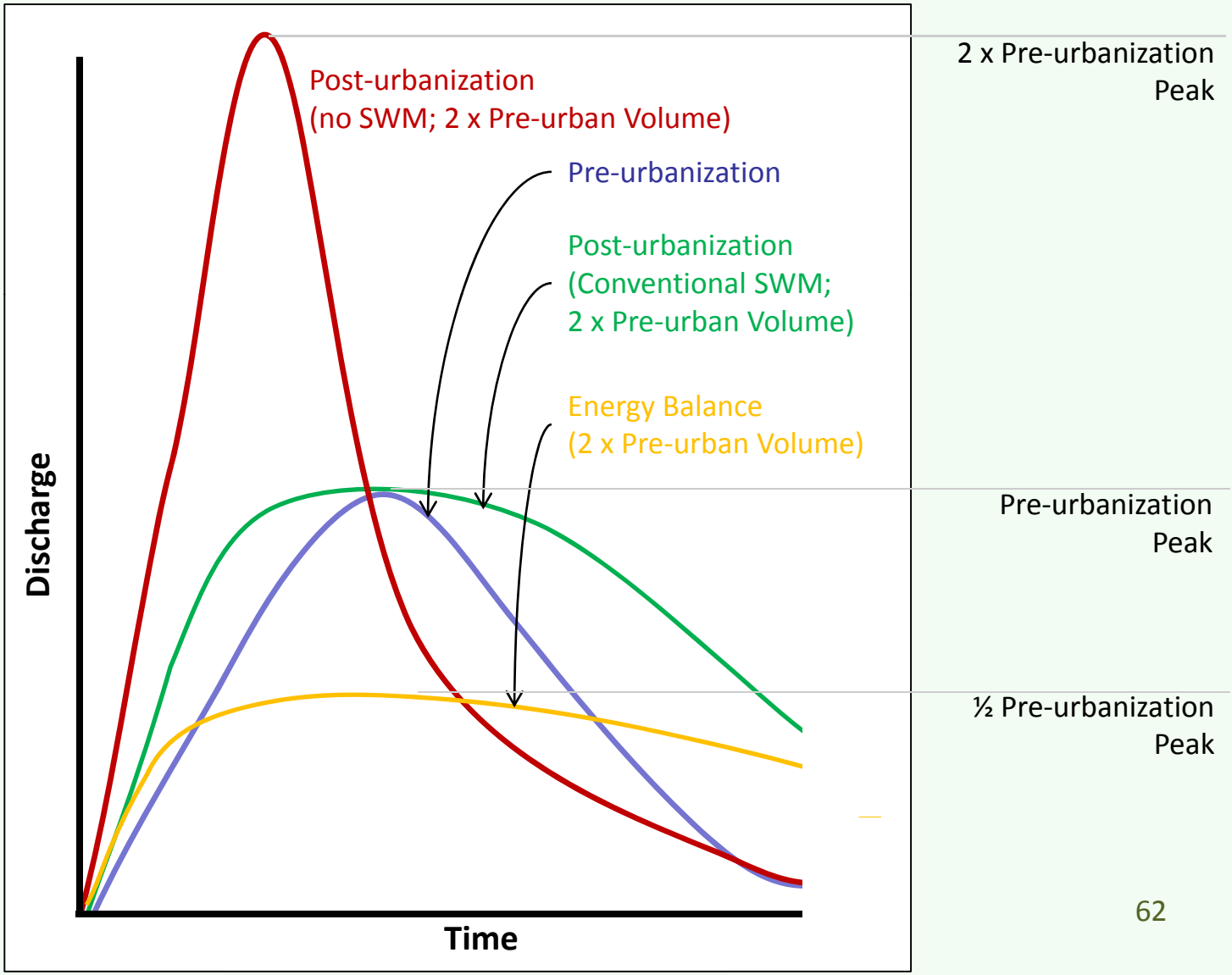
2. Power (Watt or J/s)
   - The rate at which force does work
   - Power = Work / Time

   - The Energy Balance Method is really Power Balance because it relies on Q (discharge, cfs)



Quantity Control

Energy Balance (or Power Balance) – Generic Example



Quantity Control

4VAC50-60-66 (RAP Proposal)

Outfall condition 1: Manmade conveyance systems

1. Convey the 2-year, 24-hour storm (after SWM) without erosion to a point that meets the "One Percent Rule," OR

2. Allowable 1-yr, 24-hr peak flow rate for all conditions:
   - $Q_{developed} \leq IF \times Q_{pre\text{-}developed} \times RV_{pre\text{-}developed} / RV_{developed}$
   - $Q_{developed}$ shall not be required to be less than $[Q_{forested} \times RV_{forested}] / Rv_{developed}$
   - $Q_{developed}$ must be $\leq Q_{pre\text{-}developed}$

   Where:
   - Q = Peak flow rate of runoff
   - RV = Volume of runoff
   - Improvement Factor (IF) = 0.8 for sites > 1 ac
     0.9 for sites $\leq$ 1 ac
   - Pre-developed = conditions prior to development, not pre-colonial conditions

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Quantity Control

4VAC50-60-66 (RAP Proposal)

"One Percent Rule"

If either of the following criteria are met, then there are **no requirements for quantity control on the site**:

1. Based on area
   Prior to any land disturbance, the site's contributing drainage area to site discharge point is ≤ 1.0% of total watershed area draining to that point of discharge; or

2. Based on peak flow rate
   Based on the postdevelopment land cover without quantity control measures, the 1-year, 24-hour peak flow rate increases by < 1.0% over the existing 1-year, 24-hour peak flow rate generated by the total watershed area.

Quantity Control

4VAC50-60-66 (RAP Proposal)

Outfall condition 2: Restored conveyance systems

1. Discharge was considered in the design of the restored system, OR

2. Allowable 1-yr, 24-hr peak flow rate for all conditions:
   - $Q_{developed} \leq IF \times Q_{pre\text{-}developed} \times RV_{pre\text{-}developed} / RV_{developed}$
   - $Q_{developed}$ shall not be required to be less than $[Q_{forested} \times RV_{forested}] / Rv_{developed}$
   - $Q_{developed}$ must be $\leq Q_{pre\text{-}developed}$

   Where:
   - Q = Peak flow rate of runoff
   - RV = Volume of runoff
   - Improvement Factor (IF) = 0.8 for sites > 1 ac
     0.9 for sites $\leq$ 1 ac
   - Pre-developed = conditions prior to development, not pre-colonial conditions

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Quantity Control

4VAC50-60-66 (RAP Proposal)

Outfall condition 3: Natural conveyance systems

Allowable 1-yr, 24-hr peak flow rate for all conditions:

- $Q_{developed} \leq IF \times Q_{pre\text{-}developed} \times RV_{pre\text{-}developed} / RV_{developed}$
- $Q_{developed}$ shall not be required to be less than $[Q_{forested} \times RV_{forested}] / Rv_{developed}$
- $Q_{developed}$ must be $\leq Q_{pre\text{-}developed}$

Where:

- Q = Peak flow rate of runoff
- RV = Volume of runoff
- Improvement Factor (IF) = 0.8 for sites > 1 ac
  0.9 for sites $\leq$ 1 ac
- Pre-developed = conditions prior to development, not pre-colonial conditions

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Quantity Control

4VAC50-60-66 (RAP Proposal)

For all 3 outfall conditions:

Another methodology may be used if:

1. It achieves equivalent results as demonstrated by the local program; and
2. It is approved by the Board.

Quantity Control

4VAC50-60-66 (RAP Proposal)

Flood Protection - Definitions

"**Stormwater conveyance system**"
Drainage components used to convey stormwater discharge

1. **Manmade stormwater conveyance system**
   Constructed by man (does not include restored stormwater conveyance systems)

2. **Natural stormwater conveyance system**
   Main channel of natural stream and adjacent flood-prone area (Not just the stream channel)

3. **Restored stormwater conveyance system**
   Designed and constructed using natural channel design concepts;
   Includes main channel and adjacent flood-prone area

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Quantity Control

4VAC50-60-66 (RAP Proposal)

Flood Protection

Concentrated stormwater flow must:

1. Be released into a stormwater conveyance system, **and**

2. Meet one of the following during the 10-year, 24-hour storm event:

   a. Stormwater conveyance systems that ***do not*** experience localized flooding:
   - Confine postdevelopment peak flow rate within stormwater conveyance system; or

   b. Stormwater conveyance systems that ***do*** experience localized flooding, either:
   - Confine the postdevelopment peak flow rate, or
   - Release a postdevelopment peak flow rate less than the predevelopment peak flow rate

Based on the March 9 RAP meeting, flood control may require the Energy Balance Method on the 10-year storm

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Quantity Control

What Will this Mean for the Development Industry?

- Adequate Outfall (MS-19) no longer needs to be analyzed
- Pond footprints will be similar (±20%) because the 10-year Flood Protection governs the overall size (which matches most current requirements)
- The 2-year orifice will be reduced to meet 1-year Energy Balance requirement
- The 1-year detention volume will usually be greater than the current 2-year volume requirement
- **The full revised regulations need to be tested on actual development sites to determine any unforeseen impacts**

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Potential Effect

Of 4VAC50-60-66

HSG	Development Type	Overall ED Pond Size (proposed / existing regulations)	
		Pasture (I.F. = 0.8)	Forest (I.F. = 1.0)
B	Residential, 1-ac lots	100%	106%
	Residential, 0.25-ac lots	101%	104%
	Townhouse	107%	106%
	Commercial	111%	109%
	Paved	115%	111%
C	Residential, 1-ac lots	100%	103%
	Residential, 0.25-ac lots	100%	101%
	Townhouse	102%	102%
	Commercial	103%	103%
	Paved	104%	105%
D	Residential, 1-ac lots	107%	103%
	Residential, 0.25-ac lots	101%	101%
	Townhouse	101%	101%
	Commercial	101%	102%
	Paved	102%	102%

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Quality Control Overview

4VAC50-60-63

Significant Regulation Elements

1. Requirements for new development:
   - Statewide: ***x*** **lb/ac/yr** TP
   - Chesapeake Bay TMDL/WIP: ***y*** **lb/ac/yr** TP

2. Requirements for development on prior developed lands
   - Sites **≥ 1 acre**: **20%** below the predevelopment TP load
   - Sites **< 1 acre**: **10%** below the predevelopment TP load

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Quality Control

Chesapeake Bay Watershed Requirement

What should the allowable loading rate be for New Development?

- Original 2009 Draft regulation: **0.28 lb/ac/yr** TP
- 2009 Final regulation (suspended): **0.45 lb/ac/yr** TP
- September 2010 Draft Phase I Virginia WIP: **0.26 lb/ac/yr** TP[1]

  "*Allocations for newly developed land will be set at a level that results in no increase above allowable 2025 average nutrient loads per acre from previous land uses*." (Final WIP, pg. 13; may change from previous land assumption or WIP revisions.)

- November 2010 Final Phase I Virginia WIP: **Debate Ongoing** (**0.25 – 0.56 lb/ac/yr** TP)

  "The Tier 1 load-balancing approach uses the allocation loads for forest, cropland, pasture, and hay land uses in the Chesapeake Bay Program's Phase 5.3 Watershed Model to calculate the average pollutant loads from a generic pre-development acre based on the mix of projected land to be developed for Virginia's Chesapeake Bay watershed." (Final WIP, pg. 86)

[1] Calculation includes urban land.

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Quality Control

State-wide Requirement

How should the allowable loading rate be calculated state-wide?

- The subcommittee originally recommended ***0.32 lb/ac/yr*** TP based on the VRRM (which does not account for forest):
  - Assumes 10% impervious cover
  - Equates to 10% impervious, 20% turf, and 70% forest on Hydrologic Soils Group (HSG) C

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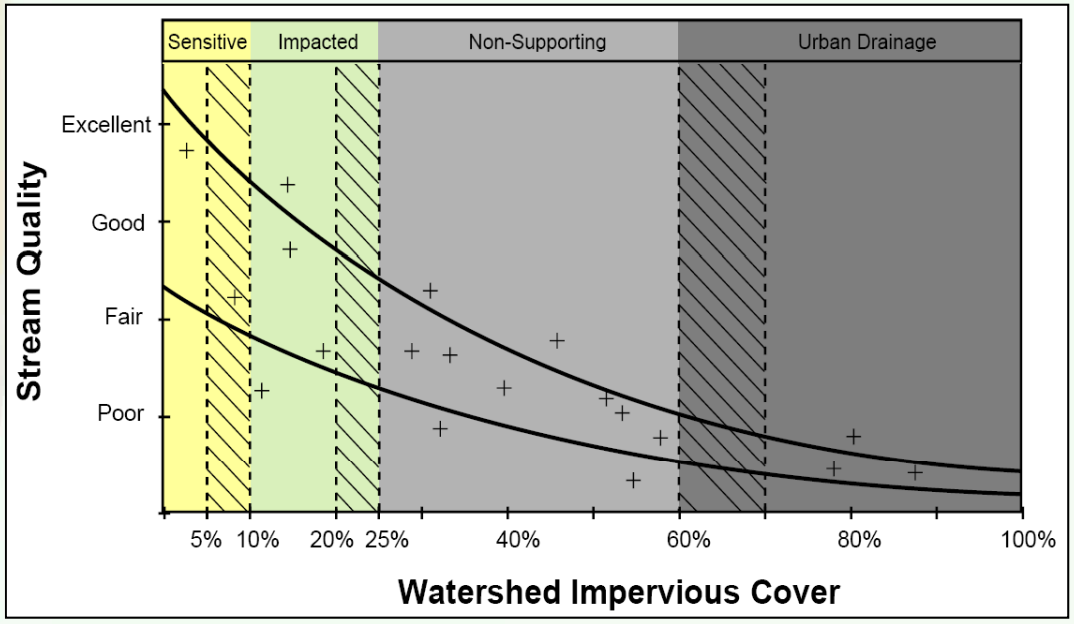
Quality Control

State-wide Requirement

How should the allowable loading rate be calculated state-wide?

- The subcommittee now recommends ***0.36 lb/ac/yr*** TP based on a Modified VRRM calculation (to account for forest):
  - Assumes 7.5% impervious cover[1], 30% turf, and 62.5% VA-average forest cover
  - Assumes 1.15% HSG A, 61.28% HSG B, 28.60% HSG C, and 8.97% HSG D[2]

- Other Options:
  - 10% impervious cover, 30% turf, 60% forest = **0.41 lb/ac/yr**
  - 5% impervious cover, 30% turf, 65% forest = **0.30 lb/ac/yr**



[1] Schueler, T., Fraley-McNeal, L., and Cappiella, K. "Is Impervious Cover Still Important? Review of Recent Research." Journal of Hydrologic Engineering, April, 2009.

[2] Weighted average soil cover was derived from STATSGO state-wide soils database soils breakdown for Virginia outside of the Chesapeake Bay Watershed. STATSGO breakdown: 210 mi^2 HSG A; 0 mi^2 HSG A/D; 11,207 mi^2 HSG B; 0 mi^2 HSG B/D; 5,231 mi^2 HSG C; 373 mi^2 HSG C/D; 1,153 mi^2 HSG D; 115 mi^2 Unrated. C/D and unrated soils were assigned to HSG D.

New Development Land-Use Pattern

Jantz, P., Goetz, S., and Jantz, C. 2005. *Urbanization and the Loss of Resource Lands in the Chesapeake Bay Watershed*. Journal of Environmental Management. 36 (6): 808-825.

Page 823 –

In our most conservative estimate, we calculate that at least 388 km^2 of forest lands, 1,016 km^2 of agricultural lands, and 2 km^2 of wetlands, have been lost to commercial and residential development within the CBW since 1990. As much as 826 km^2 of forests, 1,543 km^2 of agricultural lands, and 60 km^2 of wetlands have been converted, although we emphasize the more moderate results derived from the land cover agreement map indicating losses of 504 km^2 for forests, 1,266 km^2 for agricultural lands, and 2 km^2 for wetlands. However, we would expect functional losses,

Chesapeake Bay Watershed:

Conservative Estimate
388 + 1,016 + 2 = 1,406 km^2 converted
390 / 1,406 = **28%** converted from forest (with wetlands)
1,106 / 1,406 = **72%** converted from agriculture

Unconservative Estimate
826 + 60 + 1,543 = 2,429 km^2 converted
886 / 2,429 = **36%** converted from forest (with wetlands)
1,543 / 2,429 = **64%** converted from agriculture

Moderate Estimate
504 + 1,266 + 2 = 1,772 km^2 converted
506 / 1,722 = **29%** converted from forest (with wetlands)
1,266 / 1,722 = **71%** converted from agriculture

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Potential New Development Unit Loads

Based on Landuse Trends

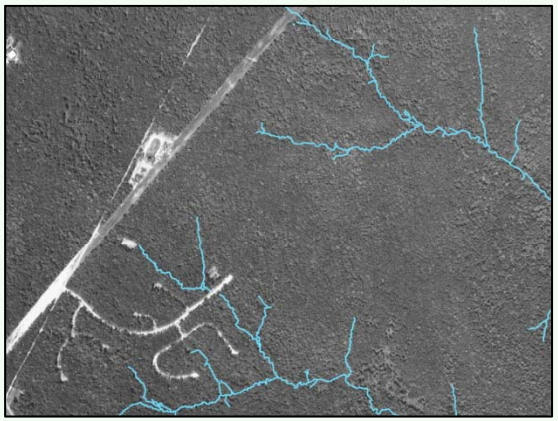
Based on historic development trends per Jantz et. al, **TP = 0.51 to 0.56 lb/ac/yr** to achieve no-net-increase above the allowable average 2025 nutrient loads from previous land uses per the November 2010 WIP.

TP Load Based on Varying Percentages of Previous Land Uses Converted to Development					
Source[1]	% Forest	Forest TP Load (lb/ac/yr)[2]	% Agriculture	Agriculture TP Load (lb/ac/yr)[2]	**Total TP Load (lb/ac/yr)[3]**
Conservative Estimate	28%	0.11	72%	0.74	**0.56**
Unconservative Estimate	36%		64%		**0.51**
Moderate Estimate	29%		71%		**0.56**

1. Historic development trends were derived from: Jantz, P., Goetz, S., and Jantz, C. 2005. *Urbanization and the Loss of Resource Lands in the Chesapeake Bay Watershed*. Journal of Environmental Management. 36 (6): 823.

2. Calculated as the draft WIP 2025 forest and agricultural allocations divided by 2010 sector acreages (which were transmitted to WSSI via e-mail from Russ Perkinson on 8/12/2010).
(For forest: 1,072,000 lb/yr / 9,776,274 ac = 0.11 lb/ac/yr. For agriculture: 2,097,000 lb/yr / 2,836,970 ac = 0.74 lb/ac/yr)

3. Total TP Load is calculated as the sum of (% Forest x Forested TP Load + % Agriculture x Agriculture TP Load)



Water Quality Regulation

Allowable Loading Rate for New Development

November 2010 Final Phase I Virginia WIP:

"The Tier 1 load-balancing approach uses the allocation loads for forest, cropland, pasture, and hay land uses in the Chesapeake Bay Program's Phase 5.3 Watershed Model to calculate the average pollutant loads from a generic pre-development acre based on the mix of projected land to be developed for Virginia's Chesapeake Bay watershed."
(Final WIP, pg. 86)

State-wide Requirement Based on Percentage of Impervious Cover and STATSGO average soil cover		Current Compromise	Chesapeake Bay Requirement Based on "No Increase" from previous land uses	
5% impervious, 65% forest, 30% turf	**0.30**	**0.41**	**0.51**	36% forest, 64% agriculture
7.5% impervious, 62.5% forest, 30% turf	**0.36**		**0.56**	28% forest, 72% agriculture
10% impervious, 60% forest, 30% turf	**0.41**		**0.56**	29% forest, 71% agriculture

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Quality Control

Effect of Variation in Allowable Loading Rate

Will the allowable loading rate have a great effect on future water quality in the Chesapeake Bay?

Effect of Stormwater Management Loading Rates					
Land Use	Area (ac)[1]	TP Unit Load (lb/ac/yr)	Total TP Load (lb/yr)	Annual Difference from 0.26 (lb/yr)	Total Difference in 2025 (lbs)
Total Bare Construction	13,965	0.26	3,631	--	--
		0.36	5,027	1,396	20,940
		0.40	5,586	1,955	29,325
		0.45	6,284	2,653	39,795
		0.52	7,262	3,631	54,465
		0.55	7,680	4,049	60,735

[1] In Virginia for the 2009Progress model year; based on the Phase 5.3 Chesapeake Bay Model released 7/21/2010.

Versus overall 2025 VA TMDL allocation of 5.36 Million lbs.

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Quality Control

Requirements for Development on Prior Developed Lands

1. Projects with **no net increase in impervious cover** from the predeveloped condition:
   - Sites **≥ 1 acre**: P load shall be reduced at least **20% below** the predevelopment total P load
   - Sites **< 1 acre**: P load shall be reduced at least **10% below** the predevelopment total P load

2. Projects with a **net increase in impervious cover** from the predeveloped condition:
   - Design criteria for new development shall be applied to entire disturbed acreage, OR
   - For linear projects on prior developed lands: Total phosphorus load may be reduced by 20%
     - Issue: This will still require many more BMPs for road improvements

3. Qualifying local program can establish a more stringent standard

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Best Management Practices

Current (Fairfax County Example) and Proposed (VRRM)

Practice	Virginia Runoff Reduction Method (VRRM)			Fairfax County PFM
	Volume Reduction (%)	TP Removal Efficiency (%)	**Total TP Removal (%)**	**TP Removal (%)**
Rooftop Disconnection	25-50[1]	0	**25-50**	--
Sheetflow to Vegetated Filter	25-75[2]	0	**25-75**	--
Grass Channel	10-30[3]	15	**24-41**	--
Vegetated Roof	45-60[4]	0	**45-60**	**40**
Rainwater Harvesting	Up to 90	0	**Up to 90**	--
Permeable Pavement	45-75[4]	25	**59-81**	**35-65**
Infiltration	50-90[4]	25	**63-93**	**50-70**
Bioretention	40-80[4]	25-50[4]	**55-95**	**50-65**
Dry Swale	40-60[4]	20-40[4]	**52-76**	**30-65**
Wet Swale	0	20-40[4]	**20-40**	--
Filtering Practice	0	60-65[4]	**60-65**	**60**
Constructed Wetland	0	50-75[4]	**50-75**	--
Wet Pond	0	45-75[4]	**45-75**	**45-50**
Extended Detention Pond	0-15[4]	15	**15-31**	**40**
Natural Open Space	--	--	--	**100**
Tree Box Filter	--	--	--	**50-65**
Reforestation	--	--	--	**70**

1. Lower efficiency on Hydrologic Soil Group (HSG) C or D soils; higher efficiency on HSG A or B soils
2. 25% for Level 1 on HSG C or D soils; 50% for Level 1 on HSG A or B soils or Level 2 on C or D soils; 75% for Level 2 on HSG A or B soils
3. 10% on HSG C or D soils; 20% on HSG A or B soils; 30% on compost-amended soils (all HSGs)
4. Lower efficiency for Level 1 design; higher efficiency for Level 2 design

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Offsets/Credits

Current State Fund and Establishing Future Pricing

2009 Suspended Regulations:

- **$15,000/lb** in Urban Development Areas
  - "Urban development area" is an area designated by a locality that is:
    - (i) appropriate for higher density development due to proximity to transportation facilities, availability of a public or community water and sewer system, or developed area; and
    - (ii) to the extent feasible, to be used for redevelopment or infill development.
- **$23,900/lb** in all other areas (Based on EPA's "The Next Generation of Tools and Actions to Restore Water Quality in the Chesapeake Bay: A Draft Report Fulfilling Section 202a of Executive Order 13508")

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Offsets/Credits

Current State Fund and Establishing Future Pricing

How Should Future Pricing be Established?

Order-of-Magnitude Cost Estimate for Urban Retrofits,
Wastewater Treatment Plant (WWTP) Upgrades, and Agricultural BMPs

Nutrient Reduction Option	Removal Cost ($/lb-yr; 2010 Dollars)	
	TN	TP
Urban Retrofit - CWP[1]	6,000	33,500
Urban Retrofit - EPA[2]	3,100	24,000
WWTP[3]	250	2,700
Agricultural BMP: Enhanced Nutrient Management[4]	125	2,750

[1] Calculated from Center for Watershed Protection, Urban Subwatershed Restoration Manual Series, Manual 3, Urban Stormwater Retrofit Practices, Version 1.0, Appendix E, Table E.1, 2007. The average cost is listed as $88,000/impervious acre treated. Scaling up based on the ENR Construction Cost Index (20 city average): January 2006: ----- 7660; October 2010:------ 8921; Resulting Index = 8921/6130 = 1.165; CC = $102,520. Assuming a 30 year life and a rate of 4%, present worth = $6,000 and $33,500.

[2] EPA, "The Next Generation of Tools and Actions to Restore Water Quality in the Chesapeake Bay," September, 2009. The cost/lb for TN and TP is reported as $3,088 and $23,984, respectively. Scaling up based on the Consumer Price Index (US City average): September 2009: ----- 215.969; September 2010:------ 218.439; Resulting Index = 218.439/215.969 = 1.011; CC = $3,122/lb of TN and $24,248/lb of TP.

[3] Chesapeake Bay Program. "Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed," November, 2002.

[4] Calculated from Chesapeake Bay Commission. Cost-Effective Strategies For the Bay: 6 Smart Investments for Nutrient and Sediment Reduction, December, 2004. The cost/lb for TN and TP is reported as $4.41 and $95.79, respectively. Scaling up based on the Consumer Price Index (US City average): December 2004: ----- 190.3; September 2010:------ 218.439; Resulting Index = 218.439/190.3 = 1.148; CC = $5.06/lb of TN and $109.97/lb of TP. Assuming a capitalization rate of 4%, capitalized values are $126.50 and $2,749.25.

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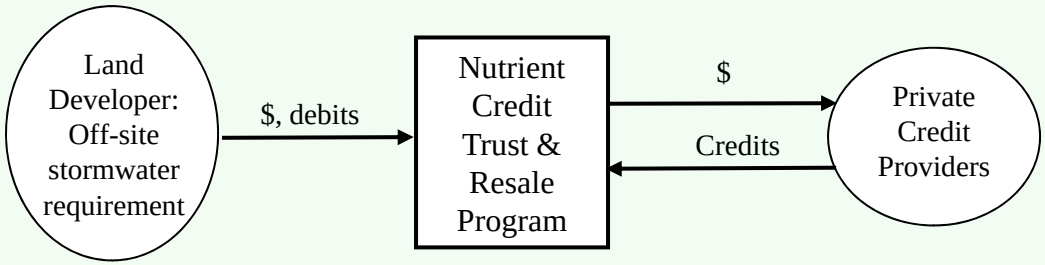
Offsets/Credits

Additional Subcommittee Considerations

1. Floor
   - Quantity and quality recommendations for the "floor" load
   - What is the baseline load that developers will need to attain?
     Suspended regulation: 0.45 lb/ac/yr
     Current idea: the quality level achievable when quantity requirement is met

2. Trading Area
   - Limited by locality, watershed, or rivershed?

3. Organizing entity
   - State Fund, Permittee's responsibility, or 3rd Party Bank?



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Grandfathering

Subcommittee Current Recommendations

1. What projects should be grandfathered?

- Proffered or conditional zoning plan, preliminary or final subdivision plat, preliminary or final site plan, or zoning with a plan of development
  - Provides for a "layout:" conceptual drawing sufficient to provide for the specified stormwater management facilities required at the time of approval
  - Alternate is "Full Design" of SWM/BMP
- Local, state, or federal projects with approved funding
- Land disturbing activity part of "common plan of development or sale" with VSMP by July 1, 2014
- Project with issued governmental bonding or public debt financing by July 1, 2014

2. For how long should projects be grandfathered?

- Until June 30, 2019; Alternate is June 30, 2014

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Local Program Criteria

Subcommittee Current Recommendations

1. Goal: One-Stop Shop

2. Still in great flux (being reviewed/revised)

3. Fees

4. "Qualified Local Program" should have the following requirements (from EPA):
   - E & S Control Program
   - Construction Waste Control
   - Preparation and Implementation of a Stormwater Pollution Prevention Plan
   - Site Plan Approval

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Local Program Criteria

Subcommittee Current Recommendations

5. SWCB will continue to issue VSMP construction permits:
   - Locality will provide VSMP general construction permit number
   - Approved locality will enforce VSMP through local ordinances
     - Issue: The General Permit is still separate from local ordinance

6. Post-construction quality requirements belong in stormwater regulations:
   - Should be removed from VSMP permit requirements

7. SWCB should make general finding that projects complying new stormwater regulation requirements also comply with MS-19:
   - SW regulations will be more stringent, so this avoids duplication

8. Topic of contention: Fees will be difficult to manage

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Virginia Runoff Reduction Method (VRRM) Issues

1. The VRRM removes forest nutrient loads from overall nutrient load calculations
   - This results in lower modeled loads than actual loads.

2. The VRRM loading rates do not match loading rates from the Bay Act Simple Method; therefore, the two are not comparable.
   - 0.45 lb/ac/yr (VRRM) is not the same as 0.45 lb/ac/yr (Simple Method)!
   - The Simple Method calculation relies solely on impervious area
   - The VRRM accounts for impervious and turf areas (but not forest)

3. The VRRM loading rates do not match loading rates from the TMDL; therefore, these two are also not comparable.

4. VA regulations only address TP; TMDL addresses TN and TP (VRRM calculates TN)

We invite those with additional interest in this topic to review the material at the end of this presentation.

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Questions?

References

Chesapeake Bay TMDL

http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/drafttmdlexec.html

http://newsletters.wetlandstudies.com/docUpload/Complete_Draft_TMDL.pdf

Virginia WIP

http://www.deq.state.va.us/tmdl/chesapeakebay.html

http://www.dcr.virginia.gov/soil_and_water/baytmdl.shtml

Virginia Stormwater Regulation

http://www.dcr.virginia.gov/lr2d.shtml

http://www.wetlandstudies.com/portals/4/TMDL/VA_CBay_TMDL_WIP_November_29_FINAL.pdf

http://www.wetlandstudies.com/portals/4/TMDL/2010-12-09_Seminar_FINAL.pdf

Virginia Final WIP TN Allocations

vs. 2009Progress Loads

Virginia's WIP meets EPA's required TN allocation except in the James Watershed.

- The Commonwealth is conducting a special Chlorophyll-*a* study in the James

Total Nitrogen Loads: 2009Progress vs. VA WIP

Sector	Potomac		Rappahannock		York		James		Eastern Shore		VA TOTAL	
	2009	WIP	2009	WIP	2009	WIP	2009	WIP	2009	WIP	2009	WIP
Agriculture	8.913	6.359	3.782	2.515	2.280	1.404	5.439	4.253	1.424	0.890	21.839	15.421
Urban	2.885	2.635	0.460	0.403	0.518	0.445	2.946	2.534	0.058	0.050	6.867	6.067
Wastewater	3.580	3.743	0.455	0.640	1.171	1.201	**15.669**	**12.491**	0.150	0.087	20.025	18.162
Septic	0.642	0.597	0.535	0.322	0.536	0.487	1.014	0.923	0.085	0.076	2.630	2.405
Forest	3.997	4.197	1.861	1.886	1.761	1.782	5.968	6.048	0.156	0.162	13.742	14.076
Air	0.109	0.103	0.082	0.073	0.100	0.089	0.356	0.320	0.033	0.032	0.680	0.617
Total	20.126	**17.634**	7.175	**5.839**	6.366	**5.408**	31.392	**26.569**	1.906	**1.297**	65.783	**56.748**
Allocation	**17.77**		**5.84**		**5.41**		**23.09**		**1.31**		**53.42**	

WIP allocation (meets EPA allocation)
WIP allocation (does not meet EPA allocation)
EPA allocation

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Virginia Final WIP TP Allocations

vs. 2009Progress Loads

Virginia's WIP meets EPA's required TP allocation except in the James Watershed.

- The Commonwealth is conducting a special Chlorophyll-*a* study in the James

Total Phosphorus: 2009Progress vs. VA WIP

Sector	Potomac		Rappahannock		York		James		Eastern Shore		VA TOTAL	
	2009	WIP	2009	WIP	2009	WIP	2009	WIP	2009	WIP	2009	WIP
Agriculture	0.976	0.674	0.709	0.533	0.247	0.157	0.974	0.622	0.161	0.111	3.067	2.097
Urban	0.318	0.273	0.109	0.094	0.112	0.090	0.651	0.528	0.011	0.009	1.200	0.994
Wastewater	0.436	0.278	0.082	0.079	0.127	0.155	**1.080**	**0.967**	0.004	0.008	1.729	1.487
Forest	0.198	0.205	0.180	0.183	0.130	0.126	0.566	0.543	0.014	0.015	1.089	1.072
Air	0.008	0.008	0.007	0.007	0.010	0.009	0.030	0.030	0.002	0.002	0.056	0.056
Total	1.936	**1.438**	1.087	**0.896**	0.626	**0.537**	3.301	**2.690**	0.192	**0.145**	7.141	**5.707**
Allocation	**1.41**		**0.90**		**0.54**		**2.37**		**0.14**		**5.36**	

WIP allocation (meets EPA allocation)
WIP allocation (does not meet EPA allocation)
EPA allocation

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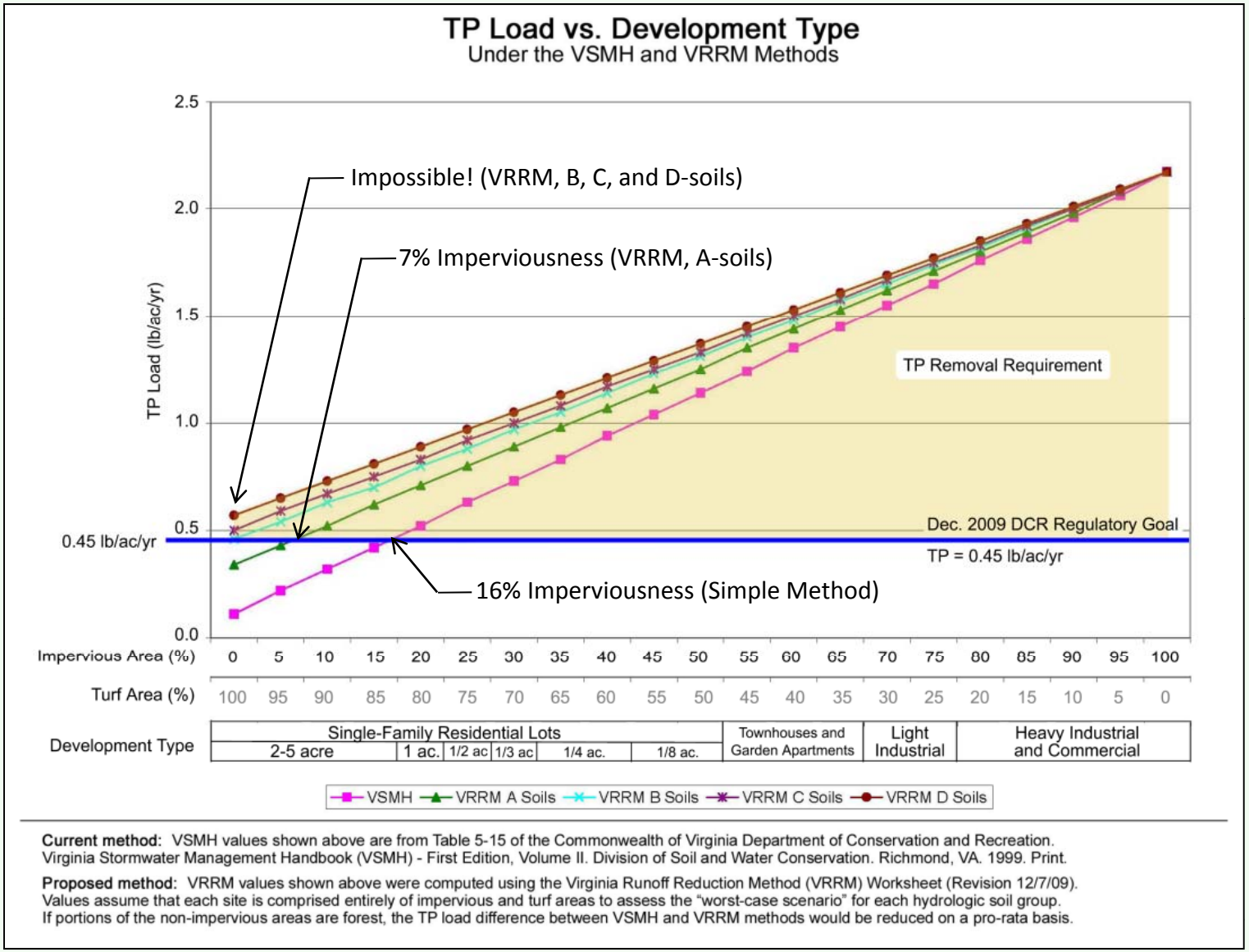
VRRM TP Load with and without Forest

	Cover Type %		Resulting TP Load (lb/ac/yr)		% Load Increase w/Forest
	Pervious	Forest	VRRM w/o Forest	VRRM w/Forest	
10% Impervious	0	90	0.22	0.29	32%
	10	80	0.27	0.33	22%
	20	70	0.31	0.37	19%
	30	60	0.36	0.41	14%
	40	50	0.41	0.45	10%
	50	40	0.46	0.49	7%
	60	30	0.51	0.53	4%
	70	20	0.56	0.57	2%
	80	10	0.60	0.61	2%
	90	0	0.65	0.65	0%
30% Impervious	0	70	0.65	0.71	9%
	10	60	0.70	0.75	7%
	20	50	0.75	0.79	5%
	30	40	0.80	0.83	4%
	40	30	0.84	0.87	4%
	50	20	0.89	0.91	2%
	60	10	0.94	0.95	1%
	70	0	0.99	0.99	0%
50% Impervious	0	50	1.08	1.12	4%
	10	40	1.13	1.17	4%
	20	30	1.18	1.21	3%
	30	20	1.23	1.25	2%
	40	10	1.28	1.29	1%
	50	0	1.33	1.33	0%

Weighted average soil cover was derived from SSURGO state-wide soils database soils breakdown for Virginia. SSURGO breakdown: 2,798 mi^2 HSG A; 135 mi^2 HSG A/D; 21,464 mi^2 HSG B; 1,400 mi^2 HSG B/D; 28,771 mi^2 HSG C; 1,755 mi^2 HSG C/D; 5,206 mi^2 HSG D; 2,958 mi^2 Unrated. A/D, B/D, and C/D soils were broken equally and added to each respective soil group (i.e., B/D soils were split equally, and 10,732 mi^2 each were added to HSG B and HSG D). Unrated soils were broken equally and 739.5 mi^2 were added to each soil group. The resulting soil breakdown is as follows: 3,605 mi^2 (5.6%) HSG A, 22,904 mi^2 (35.5%) HSG B, 30,388 mi^2 (47.1%) HSG C, and 7,591 mi^2 (11.8%) HSG D.

VRRM vs. VSMH



Current method: VSMH values shown above are from Table 5-15 of the Commonwealth of Virginia Department of Conservation and Recreation. Virginia Stormwater Management Handbook (VSMH) - First Edition, Volume II. Division of Soil and Water Conservation. Richmond, VA. 1999. Print.

Proposed method: VRRM values shown above were computed using the Virginia Runoff Reduction Method (VRRM) Worksheet (Revision 12/7/09). Values assume that each site is comprised entirely of impervious and turf areas to assess the "worst-case scenario" for each hydrologic soil group. If portions of the non-impervious areas are forest, the TP load difference between VSMH and VRRM methods would be reduced on a pro-rata basis.

VRRM vs. TMDL Loading Rates

The VRRM loading rates do not match loading rates from the TMDL; therefore, the two are not comparable

- Policy issue – WIP uses load from TMDL

Comparison of VRRM and TMDL Loading Rates						
Land Use Type	TP Load (lb/ac/yr)			TN Load (lb/ac/yr)		
	VRRM*	VRRM* (Weighted Average for all HSGs)	TMDL	VRRM*	VRRM* (Weighted Average for all HSGs)	TMDL
Impervious	2.17	-	2.1	15.50	-	11.8
Pervious – HSG A	0.34	0.49	1.1	2.45	3.50	8.7
Pervious – HSG B	0.46			3.26		
Pervious – HSG C	0.50			3.59		
Pervious – HSG D	0.57			4.08		
Forest – HSG A	0.05	0.08	0.1	0.33	0.59	2.0
Forest – HSG B	0.07			0.49		
Forest – HSG C	0.09			0.65		
Forest – HSG D	0.11			0.82		

*Analysis assumes 43” of annual precipitation.

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VRRM vs. TMDL Loads - TN

% Impervious	% Pervious (turf; no forest)	Development Type	TMDL	VRRM*				
			All Soils	A Soils	B Soils	C Soils	D Soils	Weighted Average
			Calculated TN Load	Calculated TN Load	Calculated TN Load	Calculated TN Load	Calculated TN Load	
			lb/ac/yr	lb/ac/yr	lb/ac/yr	lb/ac/yr	lb/ac/yr	lb/ac/yr
0	100	2-5 Acre Residential	8.70	2.45	3.26	3.59	4.08	3.47
5	95		8.86	3.10	3.88	4.19	4.65	4.07
10	90		9.01	3.75	4.49	4.78	5.22	4.67
15	85		9.17	4.41	5.10	5.38	5.79	5.27
20	80	1/3 to 1 Acre Residential	9.32	5.06	5.71	5.97	6.36	5.87
25	75		9.48	5.71	6.32	6.57	6.93	6.48
30	70		9.63	6.36	6.93	7.16	7.51	7.07
35	65	1/4 Acre Residential	9.79	7.02	7.55	7.76	8.08	7.68
40	60		9.94	7.67	8.16	8.35	8.65	8.28
45	55	1/8 Acre Residential	10.10	8.32	8.77	8.95	9.22	8.88
50	50		10.25	8.97	9.38	9.54	9.79	9.48
55	45	Townhouses and Garden Apartments	10.41	9.63	9.99	10.14	10.36	10.08
60	40		10.56	10.28	10.61	10.74	10.93	10.69
65	35		10.72	10.93	11.22	11.33	11.50	11.29
70	30	Light Industrial	10.87	11.58	11.83	11.93	12.07	11.89
75	25		11.03	12.24	12.44	12.52	12.64	12.49
80	20	Heavy Industrial and Commercial	11.18	12.89	13.05	13.12	13.22	13.09
85	15		11.34	13.54	13.66	13.71	13.79	13.69
90	10		11.49	14.19	14.28	14.31	14.36	14.30
95	5		11.65	14.85	14.89	14.90	14.93	14.90
100	0	Pavement	11.80	15.50	15.50	15.50	15.50	15.50

VRRM calculates a lower load than TMDL

VRRM and TMDL calculate the same load

VRRM calculates a higher load than TMDL

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VRRM vs. TMDL Loads - TP

% Impervious	% Pervious (turf; no forest)	Development Type	TMDL	VRRM*				
			All Soils	A Soils	B Soils	C Soils	D Soils	Weighted Average
			Calculated TP Load	Calculated TP Load	Calculated TP Load	Calculated TP Load	Calculated TP Load	
			lb/ac/yr	lb/ac/yr	lb/ac/yr	lb/ac/yr	lb/ac/yr	lb/ac/yr
0	100	2-5 Acre Residential	1.10	0.34	0.46	0.50	0.57	0.49
5	95		1.15	0.43	0.54	0.59	0.65	0.57
10	90		1.20	0.52	0.63	0.67	0.73	0.65
15	85		1.25	0.62	0.70	0.75	0.81	0.73
20	80	1/3 to 1 Acre Residential	1.30	0.71	0.80	0.83	0.89	0.82
25	75		1.35	0.80	0.88	0.92	0.97	0.90
30	70		1.40	0.89	0.97	1.00	1.05	0.99
35	65	1/4 Acre Residential	1.45	0.98	1.05	1.08	1.13	1.07
40	60		1.50	1.07	1.14	1.17	1.21	1.16
45	55	1/8 Acre Residential	1.55	1.16	1.23	1.25	1.29	1.24
50	50		1.60	1.25	1.31	1.33	1.37	1.32
55	45	Townhouses and Garden Apartments	1.65	1.35	1.40	1.42	1.45	1.41
60	40		1.70	1.44	1.48	1.50	1.53	1.49
65	35		1.75	1.53	1.57	1.58	1.61	1.58
70	30	Light Industrial	1.80	1.62	1.65	1.67	1.69	1.66
75	25		1.85	1.71	1.74	1.75	1.77	1.75
80	20	Heavy Industrial and Commercial	1.90	1.80	1.82	1.83	1.85	1.83
85	15		1.95	1.89	1.91	1.92	1.93	1.92
90	10		2.00	1.98	2.00	2.00	2.01	2.00
95	5		2.05	2.08	2.08	2.08	2.09	2.08
100	0	Pavement	2.10	2.17	2.17	2.17	2.17	2.17

VRRM calculates a lower load than TMDL

VRRM and TMDL calculate the same load

VRRM calculates a higher load than TMDL

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