Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management

Chesapeake Bay Program
A Watershed Partnership

Panel Charge

- Review available literature on the nutrient and sediment loading rates from turf under various conditions, accounting, if possible, for regional and terrain differences
- Review CBWM 5.3.2 land use data for urban pervious areas and recommend potential disaggregation of current pervious land category (e.g. fertilization status, risk level for nutrient transport)
- Review whether the nutrient removal rates for UNM practices developed in 2003 are still reliable
- Develop a new urban nutrient management BMP, including a specific definition for the practice, how the practice is reported to the Bay Program and how a locality can receive a nutrient reduction credit
- Determine verification procedures for the urban nutrient management BMP

Comparison of Total Urban Pervious Areas and Anticipated Acres Under Urban Nutrient Management by 2025

State	Urban Pervious Area [1]	Urban Nutrient Management [2]	Urban nutrient management acres reported in 2013 Progress scenario[3]
	Acres		
Delaware	36,481	34,584	496
District of Columbia	17,206	42,240	-
Maryland	990,291	555,575	240,672
New York	170,716	170,654	-
Pennsylvania	1,052,558	311,154	-
Virginia	1,195,567	517,058	28,856
West Virginia	88,218	347	-
TOTAL	3,551,037	1,631,612	270,024

[1] Acres of Urban Pervious Area in Version 5.3.2 of Chesapeake Bay Watershed Model

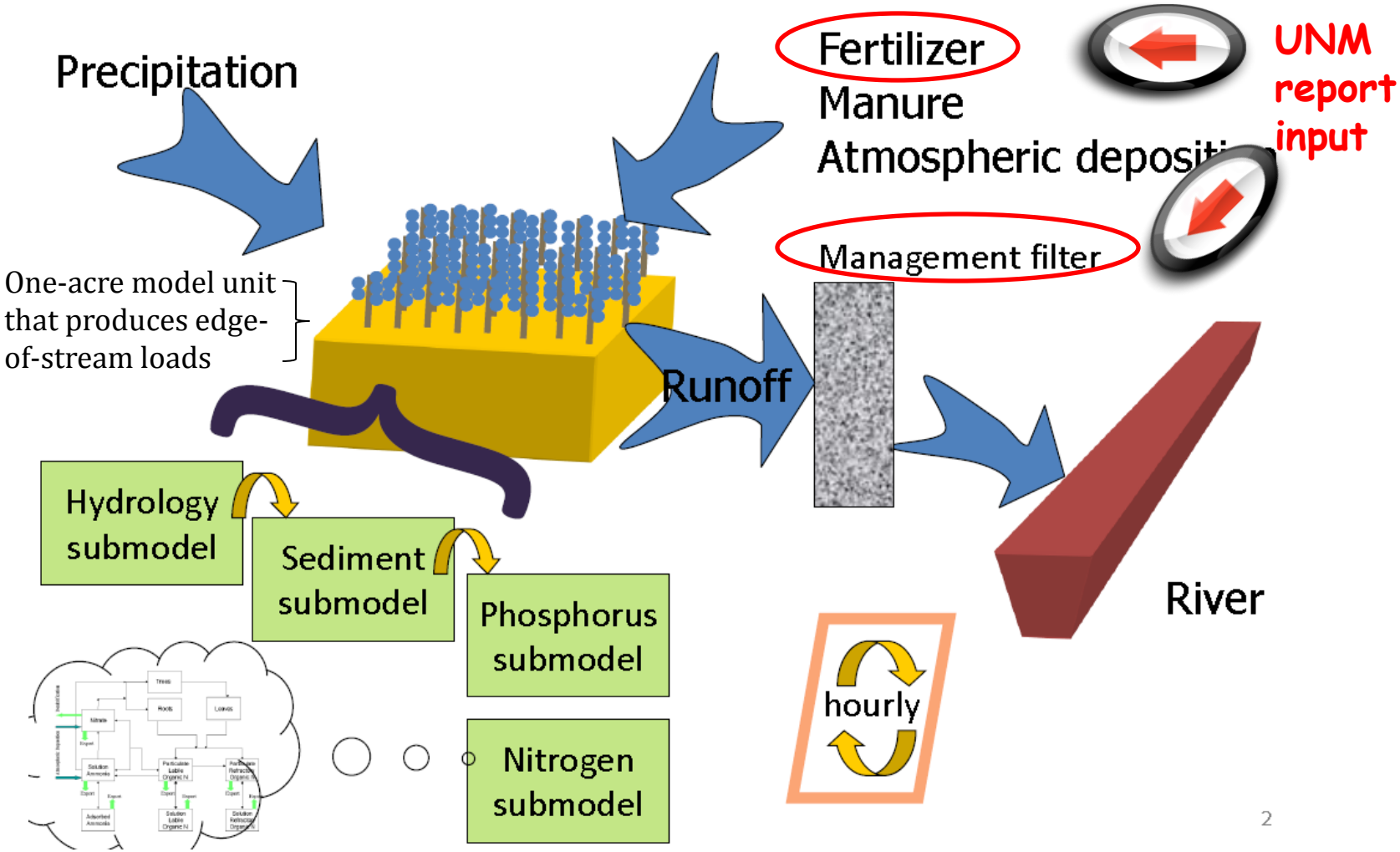
[2] Acres under urban nutrient management in each state by 2025 as reported in the Phase 2 Watershed Implementation Plan submissions to EPA in 2012, as summarized in spreadsheet by Jeff Sweeney, EPA CBPO

[3] Data from Matt Johnston, CBPO, April 2014

Adaptive Management Approach

- Panel acknowledges that while we have a lot more science than we had ten years ago, there are still gaps in our understanding of nutrient dynamics on turf
- Nutrient reduction credits were developed with the notion that they could be improved upon/refined over time as better research and fertilizer statistics become available
- Some research and management recommendations provided to increase confidence in the methods, implementation and delivery of UNM
- Protocols should be revisited in 2017 when more research, better practitioner experience, and an improved CBWM model all become available to Bay managers.

Watershed model schematic



In the real world…

Pervious Land ≠ Turf

- *Pervious Land*: catch-all term used to describe urban and suburban land that is not impervious in the Chesapeake Bay Watershed Model (CBWM). This land use category predominately includes residential lawns, but may also include landscaping, gardens, parks, rights of way, vacant lots and open areas….may also include a limited amount of forest canopy.

- *Turf* (aka lawns, turf grass, turf cover): refers to a subset of pervious areas managed to attain dense grass cover, which may involve fertilization, irrigation, weed control and other turf management practices.

Current Model Assumptions

- All pervious acres receive uniform fertilizer input
  - For P, 1.3 lbs/acre/year
  - For N, 43 pounds/acre/year
- Sensitivity of inputs to outputs
  - For P, 50 percent
  - For N, 30 percent
- P fate and transport -- routed through P-QUAL
- N fate and transport -- through AgChem

Panel Recommendation: Statewide Credits

Based on state laws or changing industry practice

- State laws
  - MD, VA, NY have restrictions on P use in lawn fertilizer
  - MD has restrictions on N use in lawn fertilizer
- Industry practice
  - As reflected in state fertilizer sales data

Industry Reported Change in P Fertilizer Sales in the Bay States, 2006 to 2010 [1]			
State [2]	2006 Millions of Pounds	2010 Millions of Pounds	Percent reduction
Pennsylvania	1.41	0.26	82 %
Maryland	0.68	0.10	85 %
Virginia	0.60	0.22	63 %
Delaware	0.09	0.04	55 %
West Virginia	0.07	0.02	71 %
Total	**2.85**	**0.655**	**77%**

[1] annual sales data reported by Scotts (2011) for non-farm fertilizer sales by state. Scott's currently has a 60% market share, and has committed to a full phase out of P in its fertilizer products by January 1, 2013. Analysis performed by Gary Felton, 2012.

2 Note that the statistics on P sales are provided for each state as a whole, and NOT the fraction of the state located within the Bay watershed

Evidence that P fertilizer sales have declined in states without legislation

Change in Non-Farm Sales of Phosphate Fertilizer in Delaware 2006 to 2010						
Million lbs of P_2O_5	2006	2007	2008	2009	2010	Change
	0.934	1.114	0.584	0.308	0.132	- 86%
Source: Delaware Department of Agriculture, as Reported in DE Final Phase 2 Watershed Implementation Plan (May, 2012)						

Panel concluded that more accurate non-farm fertilizer sales data that accounts for actual N and P content of fertilizer being sold is essential to verify any state-wide credits**…..and needed for Phase 6 of CBWM**

Fertilizer sales data led to:

Panel recommendation: automatic reduction in TP fertilizer inputs on all pervious acres (for states that HAVE adopted legislation)

Bay State	TP Reduction (million pounds)[1]	% Change in Pervious Load	% Change in Urban Load
MD	0.060	- 25.1	- 8.6
NY	0.012	- 26.5	- 11.6
PA [2]	0.053	- 23.3	- 10.4
VA	0.125	- 26.7	- 10.2

[1] The "zero P" fertilizer scenario was multiplied by 0.7 to provide the statewide loading credit

[2] PA UNM legislation is still under consideration, no credit is allowed until it has passed

Source: Gary Shenk, CBPO, April 10, 2012, spreadsheet of CBWM 5.3.2. model runs assuming 0% P application rates

Conservative assumption: **70%** Reduction in TP fertilizer Inputs to pervious land in model

Fertilizer sales data led to:

Panel recommendation: automatic reduction in TP fertilizer inputs on all pervious acres (for states that HAVE NOT adopted legislation)

Bay State	TP Reduction (million pounds)[1]	% Change in Pervious Load	% Change in Urban Load
DE	0.0018	- 19.0	- 7.8
DC	0.0006	- 21.2	- 3.6
PA [2]	0.046	-20.0	-8.9
WV	0.0048	-21.1	- 4.4

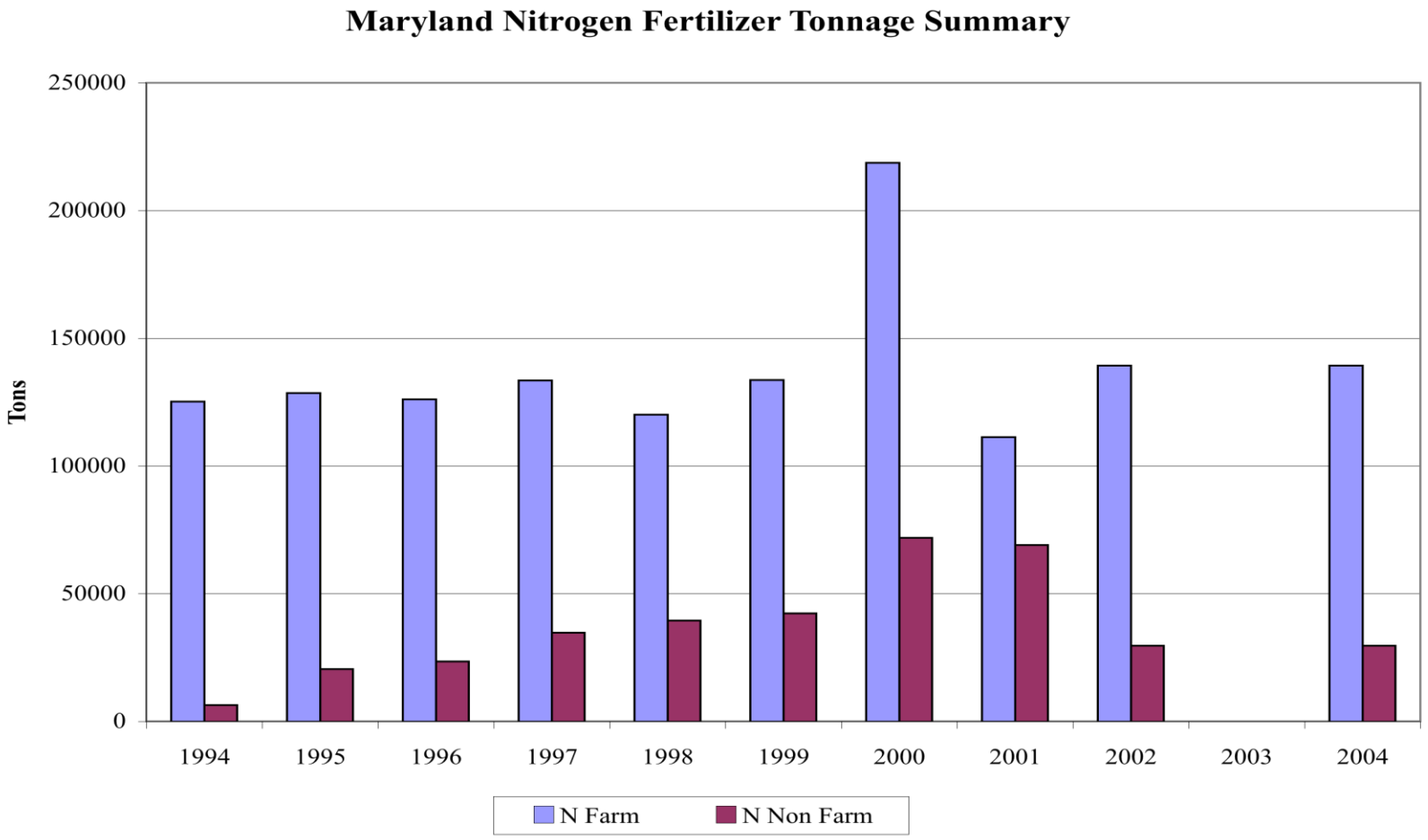
[1] The "zero P" fertilizer scenario was multiplied by 0.6 to provide the statewide loading credit

[2] PA UNM legislation is still under consideration, so this credit applies until it has passed

Source: Gary Shenk, CBPO, April 10, 2012, spreadsheet of CBWM 5.3.2. model runs assuming 0% P application rates

Conservative assumption: **60%** Reduction in P fertilizer inputs to pervious land in model

N fertilizer sales data unreliable, incomplete



Non-farm N fertilizer data, as compiled by Gary Felton in 2007

Panel Recommendation: possible N reduction in states other then MD

- Load reduction credit contingent on the expected decline in N fertilizer sales over time.
- Credit would be based on **adjusting current model assumption of 43 lbs/ac/year** for every pervious acre -- according to statewide N non-farm fertilizer sales data
- Subject to biannual verification

Panel recommendation: Statewide Nitrogen Reduction Credit for MD

- Based on Maryland's Fertilizer Use Act of 2011
- Regulations implemented as of October 2013
- Restrictions on how, when and what type of N allowed in lawn fertilizer
- Applies to both commercial applicators and DIY-ers
- Handled as a post-process BMP

Maryland State N Credit	
Turf Management Category	Annual Nitrogen Reduction Rate
Commercially-applied lawns	9 % reduction of pervious load
Do-it-yourselfers	4.5 % reduction of pervious load

Panel Recommendation:
Verification Procedures for State-wide Credits

After 2015, all automatic state credits will end. Any continuation of statewide credits should be based on state fertilizer sales data quantifying P fertilizer applications

- Determine the P content of non-farm fertilizer sales for at least two consecutive years
- Adjusting for any non-Bay watershed acreage represented by the data, compute average fertilizer input per pervious acre

"The Panel acknowledges that most current state non-farm fertilizer sales statistics are not detailed enough to characterize urban nutrient content, but feel that such data is critical to verify the substantial reductions provided"

Nutrient Management Plan Recommendations

Rationale for Setting the UNM Rates

Panel assumptions:

• 80% of the pervious land in the Bay watershed is in a low-risk category for potential nutrient loss; 20% is in a high-risk category

• 5% of applied N fertilizer is exported in high risk category; 1% is exported in low risk category.

• No P fertilizer applied for either high or low risk

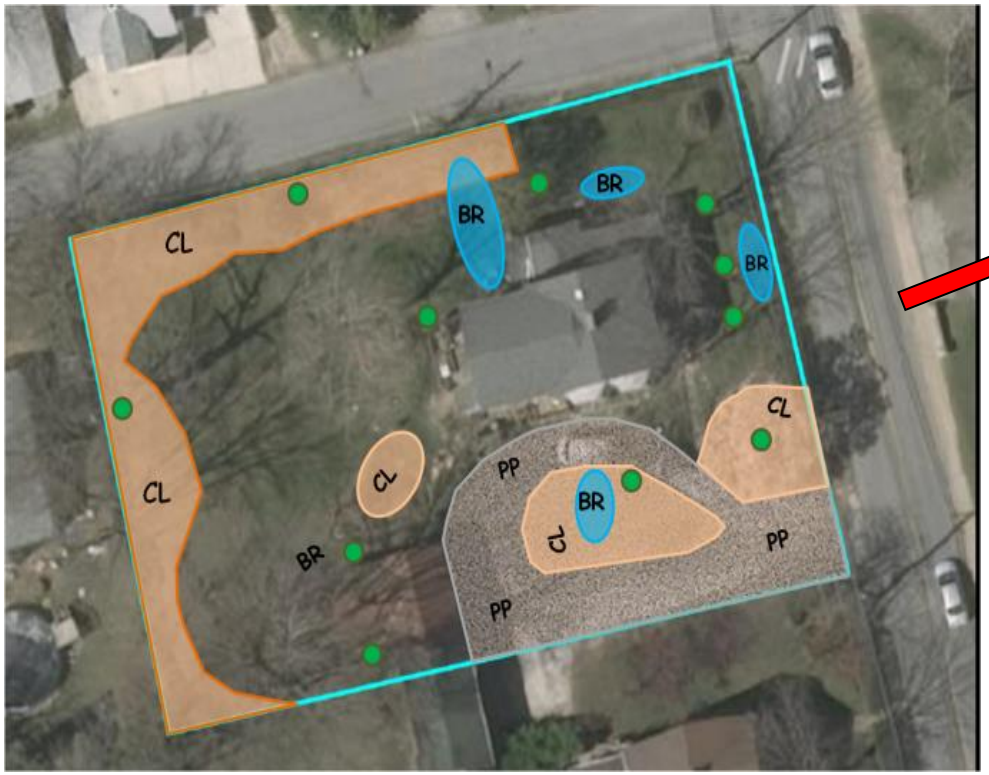
•Current CBWM pervious fertilizer application rates and export sensitivities used as the baseline for estimating reductions.

•A portion of the total N/P load from pervious land is not subject to any reduction by UNM practices—defined as twice the average load from forest land in CBWM. Correspondingly UNM practices can reduce export from pervious land to which no fertilizer is applied.

•A lower maximum removal rate is assigned for P since reductions in P fertilizer application are already addressed by the state-wide P reduction credit for pervious land.

Two independent mass balance checks were conducted to determine if the rates were reasonable and consistent w/ current watershed model – see Appendix A of Urban Nutrient Management Expert Panel report

Fundamental Reporting Unit: Acres in UNM Plan



	UNM Plan for 9200 Bradford Pear Lane: 0.5 acres	
1	Get Expert Lawn Advice	✓
2	Maintain Dense Cover on Turf	✓
3	Choose NOT to fertilize	✓
4	Recycle Lawn Clippings and Compost Fallen Leaves	✓
5	Correct Fertilizer Timing	N/A
6	Use Slow Release Fertilizer	N/A
7	Set Mower Height at 3 inches	✓
8	No off-target fertilization	N/A
9	Fertilizer free buffer zones around water features	✓
10	Increase soil porosity and infiltration	✓

Panel Recommendation: Nitrogen Reduction Credits for Qualifying UNM Plans

Turf Nitrogen Management Category	Annual Nitrogen Reduction Rate[1]
Low Risk Lawns	**6 % reduction of pervious load**
Hi Risk Lawns	**20% reduction of pervious load**
Blended Rate [2]	**9% reduction of pervious load**

[1] regardless of fertilization regime (including non-fertilized lawns
[2] state-wide credit, assuming 80% of lawn acreage falls into the low category and 20% is high risk

While rates were based on best professional judgment, they are reinforced by a CBWM loading mass balance analysis

Panel Recommendation: Phosphorus Reduction Credits for Qualifying UNM Plans

Turf Management Category	Annual TP Reduction Rate [1]
Low Risk Lawns	**3 % reduction of pervious load**
Hi Risk Lawns	**10 % reduction of pervious load**
Blended Rate[2]	**4.5% reduction of pervious land**

[1] regardless of fertilization regime (including non-fertilized lawns
[2] state-wide credit, assuming 80% of lawn acreage falls into the low category and 20% is high risk

UNM Plan Verification

- Maximum duration of a UNM plan is 3 years
- Can be renewed based on affirmation from the owner or applicator that they are either (a) maintaining the plan or (b) or have modified the plan based on further professional feedback/tests
- If a UNM plan cannot be reconfirmed after 3 years, it will be considered lapsed, and the treated acreage should be deducted from the UNM planning agency database.
- Turf areas greater than one acre in size may require an on-site visit to assess turf condition and nutrient export risk.

Issues

- High-risk/low-risk determination more art than science
- Capacity – how many plans can actually be written and verified using current resources
- Verification of state credits – will states have fertilizer sales data to continue to confirm statewide reduction credits
- Full nutrient management credit for non-fertilized lawns is counter-intuitive; model would work better with differential loading for fertilized/unfertilized pervious land
- Almost all data examined by panel was for lawn turf

Research Recommendations

- Studies that compare water quality impacts of lawns w/ and w/o UNM plans
- Studies that examine nutrient export from unfertilized turf
- Surveys of homeowner fertilizer behavior; more data on DIY-ers
- Studies on loading response of pervious land types other than lawns, e.g. road right-of-ways

Suggested Watershed Model Refinements

- For pervious urban class -- establish fertilized and unfertilized turf sub-classes in Phase 6.x
  - Develop differential loading estimates for fertilized and unfertilized turf
  - Quantify and map fertilized and unfertilized turf areas in model
- Develop sufficient N fertilizer sales and application data to develop revised fertilizer input for fertilized-turf pervious land class
- Evaluate whether some Hi Risk and Low Risk areas for lawn fertilization application can be mapped in the model's land use