Nitrogen and Phosphorus Pollution Series: State and Local Policies to Restrict the Use of Lawn Fertilizers

Watershed Academy Webcast

Wednesday, September 21, 2011

1:00–3:00 PM Eastern

Instructors:
Anne Weinberg , Environmental Protection Specialist, US EPA, Office of Wetlands, Oceans and Watersheds
Ron Struss, Research Scientist, Minnesota Department of Agriculture
Bevin Buchheister, Maryland Director, Chesapeake Bay Commission
Dr. John Lehman, Professor of Ecology and Evolutionary Biology, University of Michigan

1

Guide to Our Webcasts

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2

Topics for Today's Webcast

- Overview on the need to implement better turf management including reducing the use of lawn fertilizers
- Minnesota's Fertilizer Law
- Chesapeake Bay State's Fertilizer laws
- Case study of reductions in river phosphorus following implementation of a municipal ordinance in Ann Arbor, Michigan

Massive Algal Bloom in the St. James River, Florida

Photo by Bill Yates

3

Overview: Better Turf Management & Reducing the Use of Lawn Fertilizers

Anne Weinberg, Environmental Protection Specialist,
U.S. EPA Office of Wetlands, Oceans, and Watersheds

4

What is Nitrogen (N) and Phosphorus (P) Pollution?

- "Nutrient pollution," is the result of excess nitrogen (N) and phosphorus (P) entering waters
- It can cause harmful algal blooms that produce toxins harmful to both humans and animals, and deplete oxygen needed for fish and shellfish survival, and smother vegetation and discolor the water
- N and P pollution threatens waters used for drinking, fishing, swimming, and other recreational purposes

Photo Courtesy of Ohio EPA

5

National Scope of Nitrogen and Phosphorus Pollution

- Almost 16,000 waters are impaired by nutrient-related pollution and every state has been impacted in some way by nutrient pollution and the problem is growing
  - 101,461 miles of rivers and streams
  - 2.5 million acres of lakes and reservoirs
  - 833 square miles of bays and estuaries – they exhibit eutrophication and many have harmful algal blooms
- EPA's Wadeable Streams Assessment shows that:
  - over 47% of streams have medium-to-high levels of P and
  - over 53% have medium-to-high levels of N
- Nutrient impacts reflect doubling of U.S. population over past 50 years
  - Increased construction, wastewater and food production

6

Severity of N & P Pollution

- USGS' Nutrients in the Nation's Streams and Groundwater (September 2010) report found that:
  - 50% of U.S. streams have medium to high levels of nitrogen and phosphorus
  - 78% of assessed coastal waters exhibit eutrophication
  - Nitrate drinking water violations have doubled in eight years
- N and P pollution can increase drinking water treatment costs, hurt the tourism industry, reduce people's property values, and cause illnesses

Photo by Bill Yates

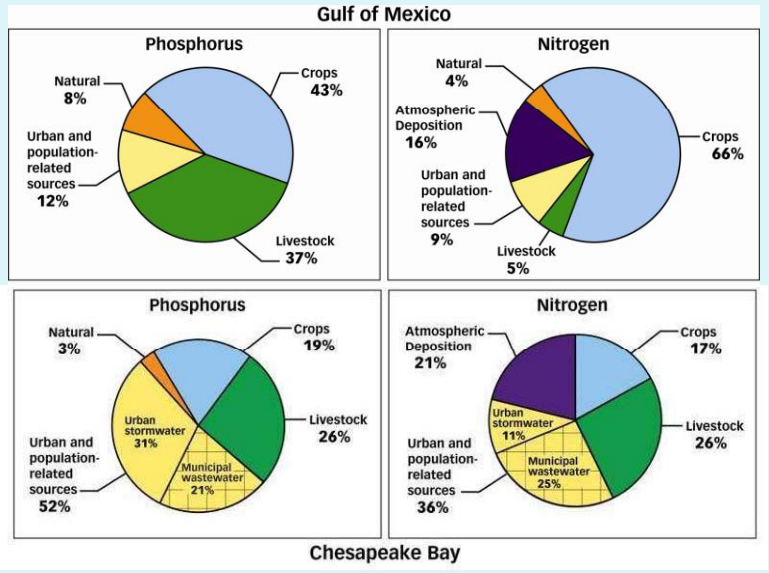
7

Primary Sources of Nitrogen and Phosphorus Pollution

- Row crop agriculture
- Agricultural livestock
- Lawn fertilizer
- Urban and suburban stormwater runoff
- Municipal wastewater treatment systems including onsite systems
- Atmospheric deposition

8

Relative Contributions of N & P for the Chesapeake Bay and the Gulf of Mexico



9

A Few Key Facts About Stormwater

- **Urban Stormwater**
  - 80% of the U.S. population live on 10% of the land with urban population heavily impacting coastal areas
  - 50% of the existing urban landscape will be redeveloped by 2030
  - An additional 30% of needed built environment for 2030 does not exist
  - Urban stormwater is a major source of nutrient pollution in heavily populated areas and is expected to increase dramatically with accelerating population

10

A Few Key Facts About Turf

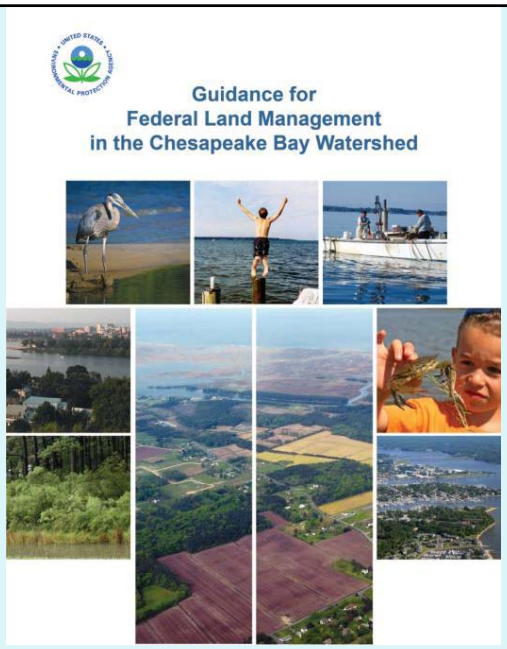
- Turf grasses cover an estimated 50 million acres across the U.S. (an area about the size of the New England states) (Milesi et. al, 2005)
  - 75% of turf is in residential lawns
  - 15% of turf is in low maintenance parks
  - 10% of turf is in athletic fields and golf courses
- The rate at which fertilizer is applied to home lawns and commercial and institutional landscaping varies - depending on the level of maintenance (high or low input) and who is maintaining it.
- One study estimates that home lawns account for 70% of turf area in the Chesapeake Bay watershed, half of which is maintained as high-input turf. The remaining 30% of total turf area is public turf, of which 1/3 is estimated to be maintained as high-input turf. (Schueler, 2000)

11

States Laws to Restrict the Use of Lawn Fertilizers

- MN's Phosphorus Turf Fertilizer Restrictions (2002, updated in 2004)
- ME's Protection and Improvement of Waters (2007)
- WI's Turf Fertilizer Restrictions Law (2009)
- MI's Public Act 299 (2010)
- IL's Lawn Care Products Application and Notice Act (2010)
- NY's Dishwasher Detergent and Nutrient Runoff Law (2010)
- FL's Fertilizer Statutes (2010)
- MD's Fertilizer Use Act of 2011 (2011)
- VA's Fertilizer Act (2011) (takes effect in 2014)
- NJ's Fertilizer Law (2011)
- VT's Turf Fertilizer Law (2011)

12



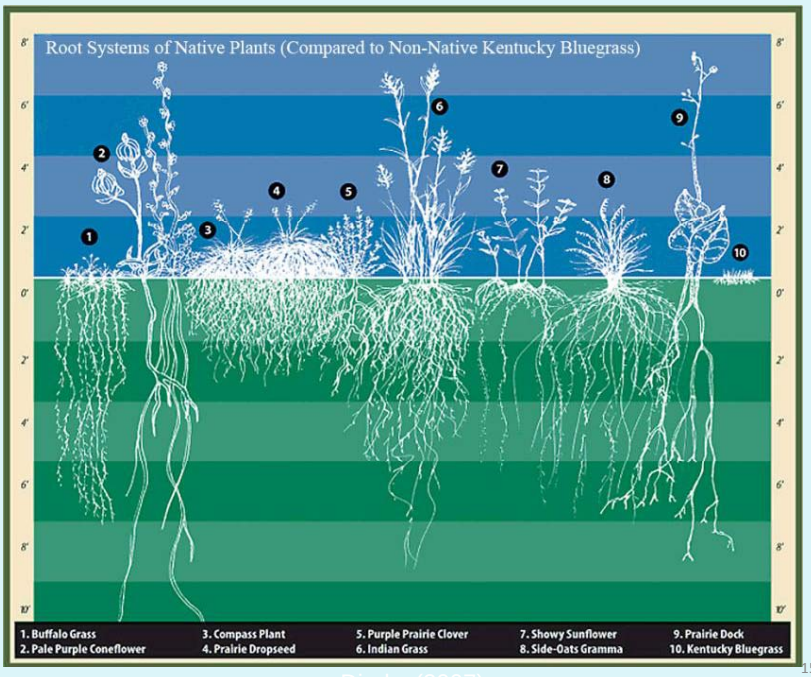
Document no. EPA 841-R-10-002, May 12, 2010
http://www.epa.gov/nps/chesbay502/downloads.html

13

General Turfgrass Best Cultural Practices

- Mulch clippings back into the grass
- Aerate compacted sites annually
- Apply nutrients, in spring, fall or both, when roots are actively growing. Avoid feeding during periods of drought or when the ground is frozen.
- Use proper fertilizer spreaders that have been calibrated
- Apply fertilizer only to lawn areas - sweep any material from paved impervious surfaces back into lawns.
- Avoid fertilization before heavy rainfalls.
- Mow at heights of 3 inches and higher.
- Where possible, use native landscapes which promote higher infiltration rates and greater root depths.

14



Dierks (2007)

15

Conclusions

- N and P pollution are of a pervasive nature and have detrimental effects on our all of our nation's waterbodies
- We have done a series of Webcasts on different aspects of N and P pollution.
- Today's webcast focuses on state and local policies to restrict the use of lawn fertilizer.
- We look forward to discussing a variety of other topics related to the challenges of nutrient pollution.

16

Minnesota's Phosphorus Lawn Fertilizer Law

Minnesota Dept of Agriculture
Carol Durden
Collie Graddick
Bruce Montgomery
Ron Struss

University of Minnesota
Dr. Brian Horgan
Dr. Carl Rosen

Chisago County, Minnesota
Jerry Spetzman

MPCA photo

17

18

Lawn fertilizer; a source of phosphorus

- Typically lawn fertilizer contains N-P-K, nitrogen, phosphorus, and potassium
- It is nitrogen that “greens up” lawns.
- Phosphorus (P) content is expressed as phosphate (P_2O_5). (P_2O_5 X 43% = P)
- Maintenance lawn fertilizers have 3% P_2O_5, starter lawn fertilizers have 20% - 40% P_2O_5
- A “zero in the middle” indicates a phosphorus-free fertilizer
- Need for phosphorus-free lawn fertilizer noted in 1979 study

MPCA photo

19

Phosphorus needed; not necessarily bad

- A major “life building block” (C, H, O, N, P, S)
- Fertilization should be based on plant need, ideally indicated by soil or tissue testing
- Aquatic systems require 1,000 times less P than terrestrial systems – that is where problems start

graysgardens.com

MPCA photo

20

It started local . . .

City of Shorewood, MN

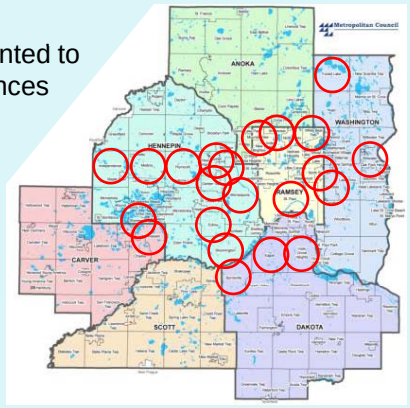
Jose Ruiz photo

Year	Action
1985	First city passes "low P" (3% P_2O_5 or less) ordinance. Several cities followed suit with "low P" ordinances over next ten years.
1996	First city passes "zero P" ordinance for commercial applicators.
2000	First cities pass "zero P" ordinance for both commercial and private applicators. Served as model for state legislation.
2000 - 2001	MN Department of Agriculture twice sponsored legislation for state restrictions on phosphorus lawn fertilizer use. Bills did not pass but raised awareness of issue by legislators, policy makers, and public.
2001 - 2002	Broad coalition formed to promote state legislation. MN Department of Agriculture active in bringing groups together and refining legislation.
2002	**Phosphorus Lawn Fertilizer Law passes**. Restricts use to "zero P" in Twin Cities counties; "low P" elsewhere. Restrictions started 2004.
2004	Subsequent legislation took "zero P" restriction state-wide in 2005.

21

Factors in passage of the 2002 law

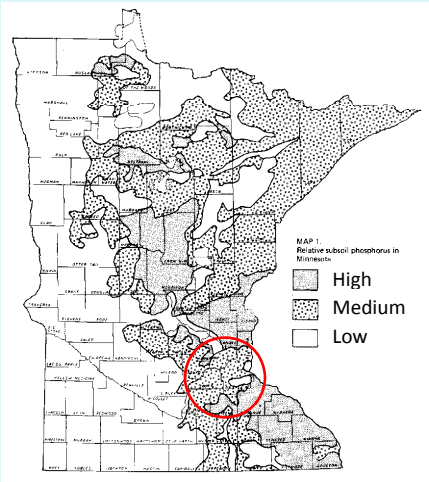
- Coalition of city, landscape industry, and environmental interests
  - Cities and landscape industry wanted to avoid "patchwork" of local ordinances
  - Cities and environmental groups wanted to protect lakes
  - Most commercial lawn care companies had stopped using P
- Commitment of MN Dept of Agriculture to effort
  - Position of Dept of Agriculture important to legislative agriculture committees



22

Factors in passage of the 2002 law

- Science based.
  - 1972-76 soil test survey showed 70 – 80% of Twin City lawns have soil P levels in “very high” range
  - Subsequent 1991-94 soil test survey supported findings
  - Based on “fertilize according to plant need” university recommendation long used by agriculture
  - Subsequent expansion of law in 2004 to include entire state not supported by data

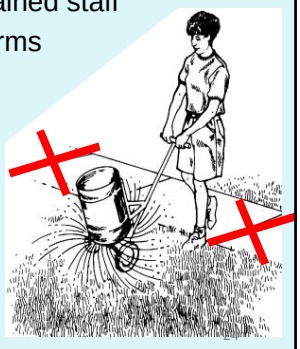


Relative subsoil phosphorus in MN

23

A restriction, not a ban …

- Law allows the use of phosphorus lawn fertilizer but only when these situations exists:
  - A soil test or plant tissue test shows a need for P
  - A new lawn is being established by seeding or laying sod
  - P fertilizer is applied on a golf course by trained staff
  - P fertilizer is applied on commercial sod farms
- Law requires all fertilizer to be cleaned off impervious surfaces (whether containing P or not)



University of Wisconsin Extension

The Minnesota law…

- Does not restrict the sale of P lawn fertilizer (display of product, need to show soil test, etc.)
- Does not exempt organic fertilizers
- Defines "zero P" to be 0.67% P_2O_5 or less
- Enforcement is delegated to local units of government
- Requires consumer education, research evaluation and reporting

25

The Minnesota law…

- Preempts regulation of all fertilizers by local units of government
  (Local ordinances regulating the sale of P lawn fertilizer were grandfathered.)
- Did not provide funding
- Did not promise clear lakes

Education promoted "package approach":

- Use "zero P"
- Sweep up clippings
- Rake up leaves
- Pick up poop
- Control erosion

26

How did it work?

- Implementation went smoothly!
  - Legislative process provided awareness
  - Local ordinances started the process
  - Two-year lead time was provided
- "Self-fulfilling" implementation:
  - Stores knew customers needed zero-P
  - Stores stocked zero-P
  - Customers bought and used zero-P
- Team approach to public education
- Even with lead time, questions on using left-over P lawn fertilizer arose

MPCA photo

27

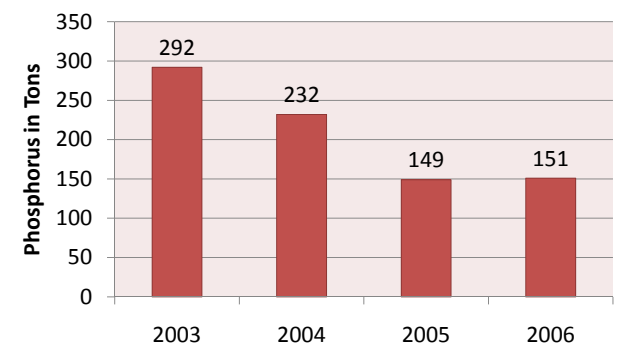
Spring 2002

28

Five Year Evaluation Report - 2007

1. "Zero P" fertilizer widely available
2. 82% of lawn fertilizer sold in 2006 was "zero P"
3. Phosphorus sold decreased 48% from 2003 to 2006

Tons of phosphorus contained in sold lawn fertilizer

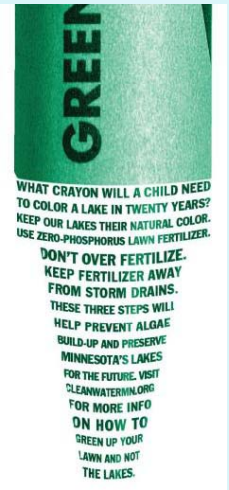


29

Five Year Evaluation Report - 2007

4. Law provided a "teachable moment"
5. Cost of "zero P" fertilizer same as "low P"
6. No reports of law being enforced by local governments (warnings made, no fines)

Note:
Enforcement was not a priority for the law; the priorities were 1) public education, and 2) making "zero-P" fertilizer widely available.



cleanwaterMN.org

30

Five Year Evaluation Report - 2007

7. Companies were successfully manufacturing and marketing "zero P" lawn fertilizer
8. No changes in water quality documented
9. Research needed to:
   a) quantify water quality benefits
   b) avoid possible loss of turf health
10. Minnesota only state regulating phosphorus lawn fertilizer

MDA photo

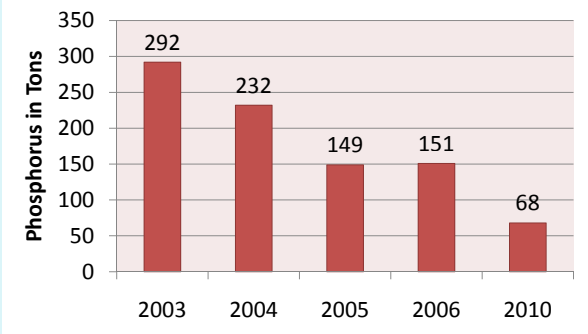
(Evaluation report available at: www.mda.state.mn.us/phoslaw)

31

2010 Update on Sales Data

- 91% of lawn fertilizer sold in 2010 was "zero P"; up from 82% in 2006
- Phosphorus sold decreased 77% from 2003 to 2010

Tons of phosphorus contained in sold lawn fertilizer



32

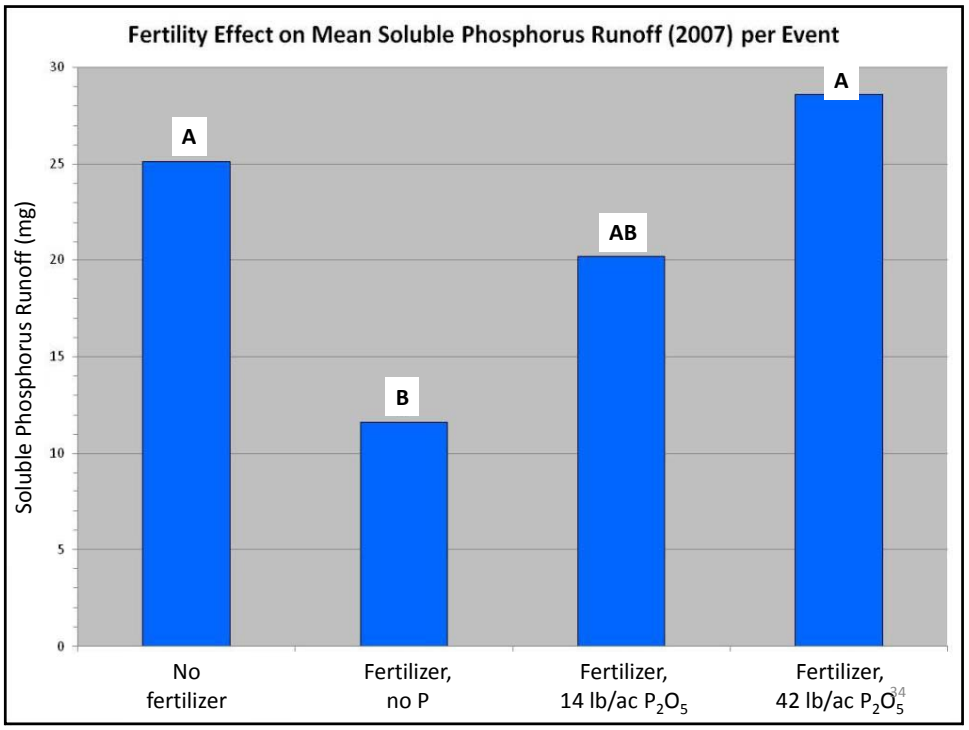
University of Minnesota turfgrass runoff study

Objective: Evaluate the effect of grass clipping management and fertilizer inputs on P runoff from home lawns

Runoff collected during winter thaw.

Contact: Drs. Brian Horgan and Carl Rosen, University of Minnesota

33



34

University of Minnesota turfgrass runoff study

- Phosphorus in water runoff, the soil, and grass plant tissue increased linearly with increasing P fertilizer application rate
- 86% of phosphorus runoff occurred when soil was frozen
- 78% of water runoff occurred when soil was frozen
- 72% of runoff P was water soluble reactive phosphorus – the form most available to plants (algae)
- P runoff can be reduced without affecting turf quality by not applying P fertilizer when soil test P levels are high
- However, these results should not be extrapolated to infer that no fertilizer of any type should be applied!
- Properly fertilized turf can reduce P runoff

35

Midwest P Lawn Fertilizer Laws Compared

(Year law passed / Year "zero-P" restriction implemented)

36

Midwest P Lawn Fertilizer Laws Compared

Aspect	Illinois	Michigan	Minnesota	Wisconsin
Year passed / enacted:	2010 / 2010	2010 / 2012	2002 / 2004	2009 / 2010
Administered by:	Dept of Ag	Dept of Ag	Dept of Ag	Dept of Ag
Applicators affected:	For hire	All	All	All
Exempted applicators:	Golf courses; Sod farms	Golf courses; Sod farms	Golf courses; Sod farms	Sod farms
When P lawn fertilizer can be applied:	Deficiency; Est. new turf; Lawn repair	Deficiency; Est. new turf	Deficiency; Est. turf	Deficiency; Est. turf
Exemption for types of manure or sewage sludge:	Yes	Yes	No	Yes
Application to paved surfaces: (All types of lawn fertilizer)	Prohibited, Clean up	Clean up	Prohibited, Clean up	Prohibited, Clean up

37

Midwest P Lawn Fertilizer Laws Compared

Aspect	Illinois	Michigan	Minnesota	Wisconsin
Setbacks from water: (All types of lawn fertilizer)	3 ft to 15 ft setback	3 ft to 15 ft setback	None	None
Restrictions on frozen and saturated soils: (All types of lawn fertilizer)	Not on frozen or saturated	Not on frozen or saturated	No restrictions	Not on frozen
Restrictions on P lawn fertilizer sales:	No restrictions	No restrictions	No restrictions	No display; No sale if ill intent known
Enforcement:	Dept of Ag; Atty General	Dept of Ag; Atty General	Local units of gov't	Dept of Ag
Penalty amounts:	$250 - $1,000	$50 - $1,000	Varies by local unit	$50 - $500
State needs to provide consumer information:	No requirement	Required	Required	No requirement

38

Conclusions

- Minnesota's phosphorus lawn fertilizer law developed over a series of events starting in 1970's
- The law has been largely "self implementing" through education and altering type of product offered for sale
- The law has effectively reduced amount of phosphorus sold in lawn fertilizers
- Industry has adapted nicely; zero-P becoming norm nationally
- No changes in water quality due to MN law documented

MPCA photo

39

Recommendations

- Know phosphorus status in your state's lawns. If levels are low, passing zero-P law is not advised
- Engage state ag agency, turf industry, and university specialists early in the process
- Give manufacturers adequate lead time to clear out stock
- Allow homeowners to use up old stock to avoid "weed & feed" from becoming hazardous waste
- Require all lawn fertilizer to be cleaned up (not just P fertilizer)
- Don't promise a "silver bullet"

MDA photo

40

Questions?

For more information:

Ron Struss
Minnesota Department of Agriculture
651-201-5259
ron.struss@state.mn.us

MINNESOTA DEPARTMENT OF AGRICULTURE
PESTICIDE AND FERTILIZER MANAGEMENT

41

Maryland Fertilizer Use Act of 2011

Bevin Ann Buchheister, MD Director
Chesapeake Bay Commission
September 2011

42

Who is the CHESAPEAKE BAY COMMISSION*?*

- ✓**Tri-State Legislative Commission**
  - **Maryland**
  - **Pennsylvania**
  - **Virginia**
- ✓**Congressional Liaison**
- ✓**21 Members**
  - **15 General Assembly Members**
  - **3 Governors**
  - **3 Citizens**

43

BACKGROUND: The Challenge

1960s

2011

The Chesapeake Bay Restoration A Short History - Key Events

•1960s-70s	Visible decline in Bay resources
•1976-1982	EPA conducts 5-year Bay study
•1980	Chesapeake Bay Commission established
•1983	**First Bay Agreement** - Bay Program created
•1987	**Second Bay Agreement** – WQ Goals
•1992	Amendments to Agreement – Tributary Strategies
•2000	**Third Bay Agreement** – Precursor to TMDL
•2008	Water Quality Impairments Acknowledged
•2010	Chesapeake Bay **TMDL** established

44

CHESAPEAKE BAY PROGRAM *Leadership*

Governor of MD

Governor of VA

Governor of PA

Executive Council

Chesapeake Bay Program

EPA Administrator

Chair of Chesapeake Bay Commission

Mayor of DC

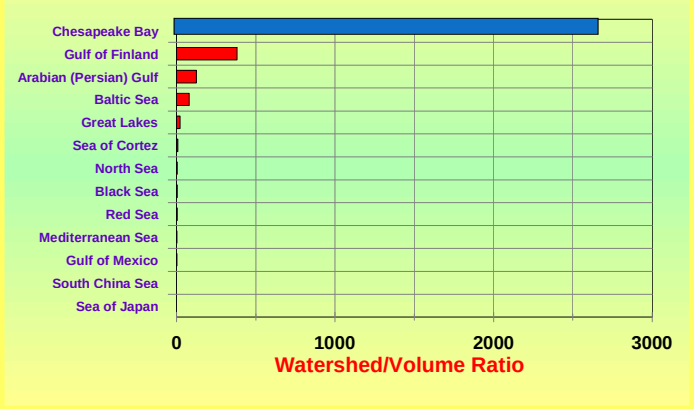
45

BACKGROUND:

Its flushing is HIGHLY restricted!

46

BACKGROUND: Practices on the land greatly affect water quality



47

Today's Bay is Impaired

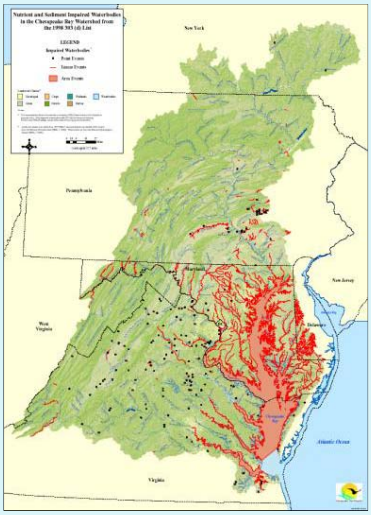
Baywide TMDL

Nitrogen

191.57 million lbs/year

Phosphorus

14.55 million lbs/ year



48

TMDL Reductions

- *Nitrogen Reductions Needed:
  - Md.- 10.33 million lbs. by 2020
  - Pa.- 30 million lbs. by 2025
  - Va.- 12.33 million lbs. by 2025
- *Phosphorus Reductions Needed:
  - Md.- .58 million lbs. by 2020
  - Pa.- 1.2 million lbs. by 2025
  - Va. - 1.73 million lbs. by 2025
  - *reduction numbers were revised by EPA in Aug. 2011

49

Total Maximum Daily Load

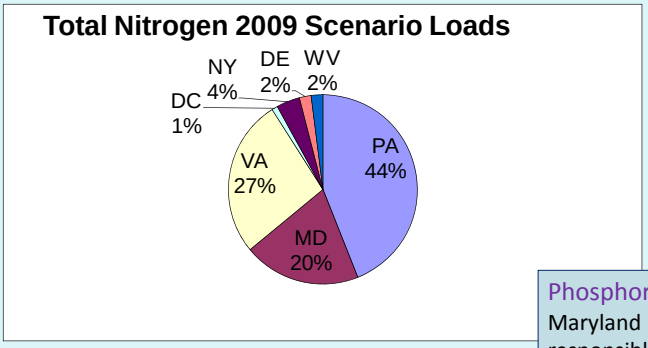
TMDL requires States to have practices and programs in place to meet water quality goals by the year 2025.

Watershed Implementation Plans, WIP, developed by States to meet TMDL.

- Md., Pa. and Va. cite urban/suburban nutrient management as one of the many reduction strategies.

50

NITROGEN LOAD BY STATE



Phosphorus: Maryland is responsible for 22% of the Total Phosphorus Chesapeake Bay TMDL Load

51

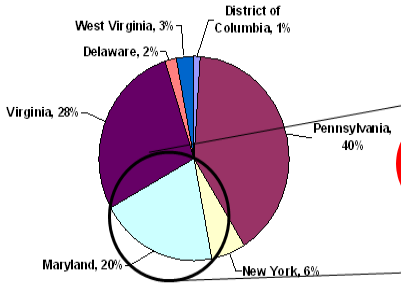
2011 LEGISLATIVE OPPORTUNTITY:

Turf Care Across the Watershed

Relative Responsibility for Loads to the Bay

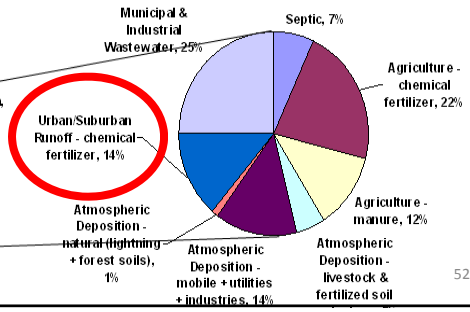
by Jurisdiction

Nitrogen



Nitrogen

Maryland



52

The Process

1. Chesapeake Bay Commission members request draft of fertilizer legislation.

2. CBC convenes Stakeholder Group to get input from the beginning.

   - professional applicators, fertilizer manufacturers, golf course association, turf specialist from land grant university, environmental groups, poultry industry, homebuilders, Departments of Agriculture and Natural Resources, and the Attorney General's Office

3. Science driven process. Bill addresses both content and behavioral changes at the residential and commercial scale. Pre-empts local laws.

4. Link to Maryland Fertilizer Use Act of 2011
http://mlis.state.md.us/2011rs/chapters_noln/Ch_485_hb0573E.pdf

53

Content and Use Restrictions

NITROGEN

- Water soluble nitrogen is no more than 0.7 lbs per 1,000 sq ft. per application.
- Total nitrogen is no more than 0.9 lbs per 1,000 square/ft per application.
- Bags sold must have at least 20% slow release nitrogen.
- Professional applicators do not have a slow release requirement.

54

Content and Use Restrictions

PHOSPHORUS

- No phosphorus except when specifically labeled and used for:
  - *Providing nutrients as determined by a soil test*
  - *Establishing vegetation*
  - *Repairing turf*

  Except
    - A natural organic or organic product containing phosphorus may be sold to commercial applicators for use on soils that test medium or low for phosphorus. Cannot apply on soils that test "optimum to excessive."
    - In 2013 commercial applicators may only apply natural organics and organics that meet the low phosphorus standard of .25 lbs P/1,000 sq. ft. per application with an annual maximum of .5 lbs P/1,000 sq. feet.

55

Content and Use Restrictions

- **Application Dates:**
  - Consumers- from March 1 to November 15.
  - Commercial- from March 1 to November 15. And November 16 to December 1 using *only* water soluble N (no slow release) at the reduced rate of 0.5 lbs/1000 square feet or less.
- **Enhanced Efficiency Controlled Release Products:**
  - Annual application cannot exceed 2.5 lbs., with a 0.7 lbs N/1000 square feet monthly release rate.
  - Application cannot exceed 80% of UMD recommended rate.
  - Application must be discontinued from November 15 - March 1 of each calendar year.

56

Use and Labeling Restrictions

- No fertilizer application to frozen ground or impervious surfaces.
- No application within 15 feet of water body/or within 10 feet if using a drop spreader, rotary spreader with deflector or targeted spray liquid.
- Restrictions apply to processed sewage solids.
- No fertilizer product may be labeled for use as a de-icer.
- Labels must contain the following statement:
  - "*Do not apply near water, storm drains or drainage ditches. Do not apply if heavy rain is expected. Apply this product only to your lawn and sweep any product that lands on the driveway, sidewalk, or street, back onto your lawn.*"

57

Training, Education and Reporting

Commercial Applicators

- Required to have Fertilizer Application Certification or be under direct supervision of certified applicator.
  - Subject to civil fines from incorrect application; 1,000 first offense, 2,000 second offense
- Dept. of Agriculture will offer training, approve other training courses and publish list of certified applicators on their website.
- State law pre-empts local laws.

Consumers

Public Education Program to disseminate information on: nutrient pollution, proper use of fertilizer, soil testing, interpreting label instructions and use and calibration of equipment.

Reporting Requirement

Annual reporting of retails sales by sector: lawn & turf, golf course & athletic field, gardening, greenhouse & nurseries.

58

ESTIMATED POLLUTION REDUCTION

PHOSPHORUS:

- 3% reduction from 2009 of the phosphorus load from all sources combined which equates to
- 15% reduction of urban phosphorus runoff compared to 2009 urban loads which equates to
- 20% of the phosphorus reduction MD needs to achieve its statewide TMDL.

Nitrogen reduction is still being calculated.

The biggest reductions will likely come from the buffer areas, education on sweeping fertilizer from impervious surfaces, ban for use as de-icer and restricted application dates.

59

Efforts in Virginia and Pennsylvania

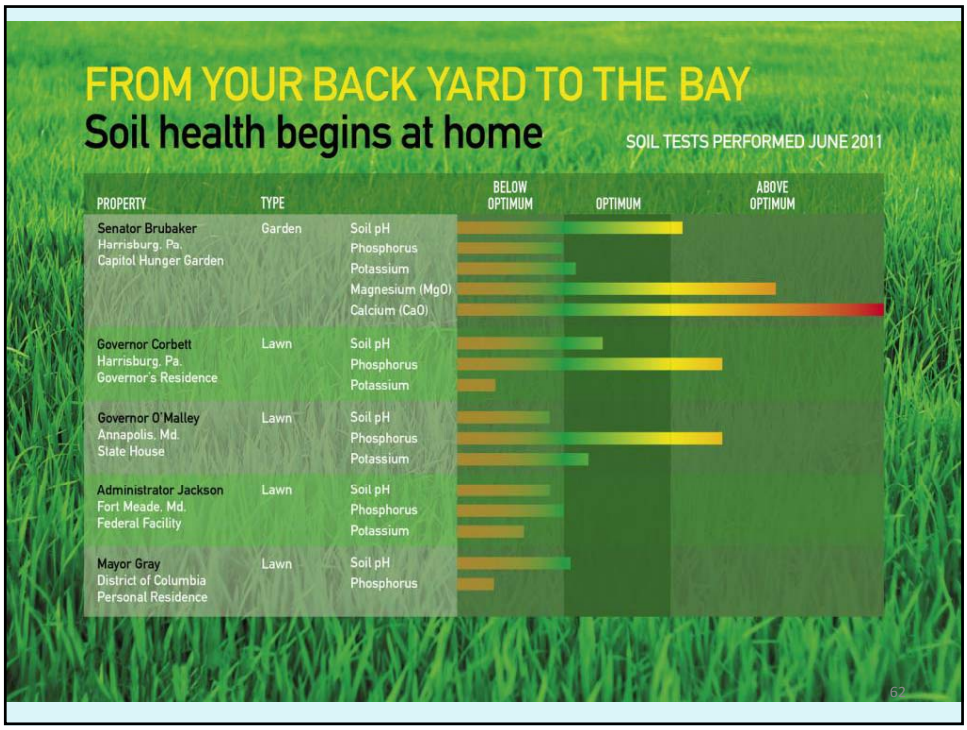
- **Virginia**- HB 1831 passed in 2011 - bans phosphorus from lawn maintenance fertilizer in Va. beginning December 31, 2013.
  - Bans nitrogen in de-icer.
  - Study Group to determine correct amount of slow release nitrogen in lawn fertilizer.
  - Contact Kathryn.Paxton@vdacs.gov
- **Pennsylvania**- Sen. Mike Brubaker, Chair of the Chesapeake Bay Commission introduced SB 1191.
- http://www.legis.state.pa.us/cfdocs/billinfo/billinfo.cfm?syear=2011&sind=0&body=S&type=B&BN=1191

60

Actions To Reduce Runoff of Nutrients and Sediment from Lawns

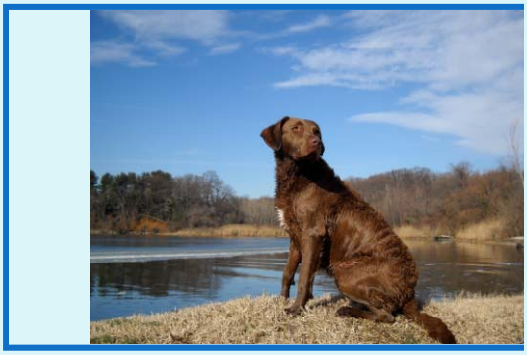
1. If you choose grass make sure to keep it healthy.
2. Test soil for pH and correct deficiencies before fertilizing.
3. Fertilize responsibly- rates, times, methods

61



62

QUESTIONS ?



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63

Reduced River Phosphorus Following Implementation of a Lawn Fertilizer Ordinance

Prof. John T. Lehman
University of Michigan
Ann Arbor, MI 48109-1048 USA

Case Study of Ann Arbor, Michigan and the Huron River

64

You have to perturb a system to understand it.

65

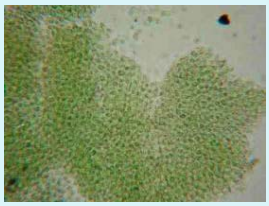
66

Cyanobacteria

"bluegreen"

Aphanizomenon

Microcystis



http://www-cyanosite.bio.purdue.edu

68

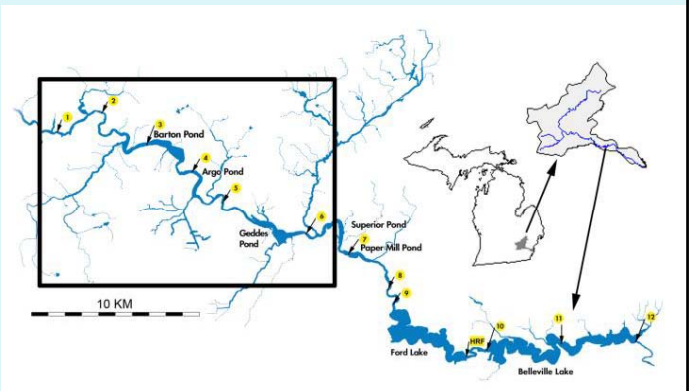
Cyanobacteria

- Inedible by lake organisms
- Surface scums
- Foul odors
- Fish kills
- Some species release toxins

69

The regulatory problem:

Reduce point source and non-point source P loading to the Huron River above the lakes (TMDL)



70

Experiment:

Ann Arbor restricts the use of lawn fertilizer containing phosphate.

A watershed model predicts full compliance could reduce river P by 22%.

If real, can a change of such magnitude be detected? How hard will it be to detect?

71

A baseline data set existed for the Huron River, 2003-2005 (pre-ordinance)

Baseline data included multiple sites weekly or twice weekly.

Phosphorus as well as other variables were measured.

Individual measurements had precision of 5% or less.

72

Theory:

A 25% change in Huron River TP should be detectable within one or two years by taking weekly samples from May to September.

(Ferris and Lehman 2008, *Lake and Reservoir Management*, Vol. 24: 273-281).

73

Theory:

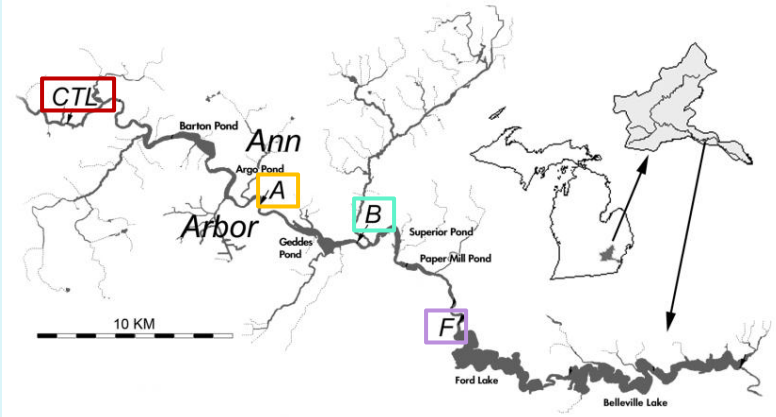
Pre-experiment 'natural variability' in the Huron River makes it easier to detect changes in Total P (TP) and Total Dissolved P (DP) than soluble reactive P (SRP).

That is, SRP is more variable than DP or TP in this system.

74

Test:

Design the study. Select sampling sites, target variables, and non-target variables.



75

Sampling Sites:

CTL- 'control' site upstream of Ann Arbor jurisdiction

A- first experimental site with 29 km^2 of drainage attributable to Ann Arbor

B- second experimental site with 94 km^2 of drainage attributable to Ann Arbor

F- downstream of AAWWTP outfall

76

Target Variables (the *a priori* expectation is that these should decrease):

TP- Total P, both particulate and dissolved.

DP- Dissolved P, both organic and inorganic.

SRP- mainly dissolved or colloidal inorganic P.

77

Non-Target Variables (no *a priori* expectation for change):

Nitrate- a mineral nutrient.

CDOM- colored dissolved organic matter, mainly organic nitrogen and carbon.

SRSi- silica, a mineral nutrient for some algae.

78

Experimental Years = May to Sep 2008 to 2010

Sample weekly

Laboratory analytical error- less than 5%

Statistical tests- by month, 2008-2010 versus 2003-2005

79

Results-

No systematic changes in non-target variables.

No decreases in P at CTL site.

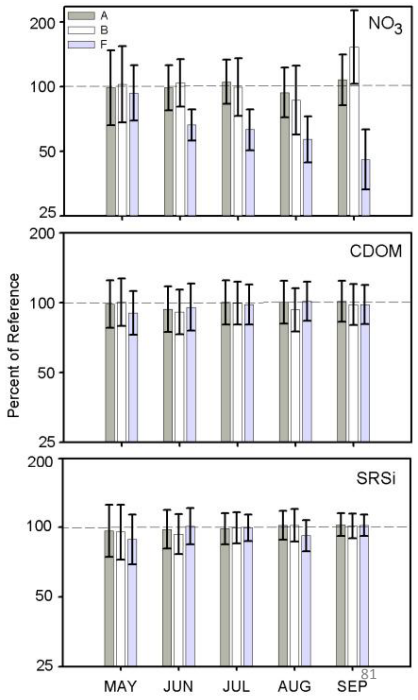
No decreases in point source P effluent from AAWWTP.

Yes- decreases in TP and DP at experimental sites.

80

Results-

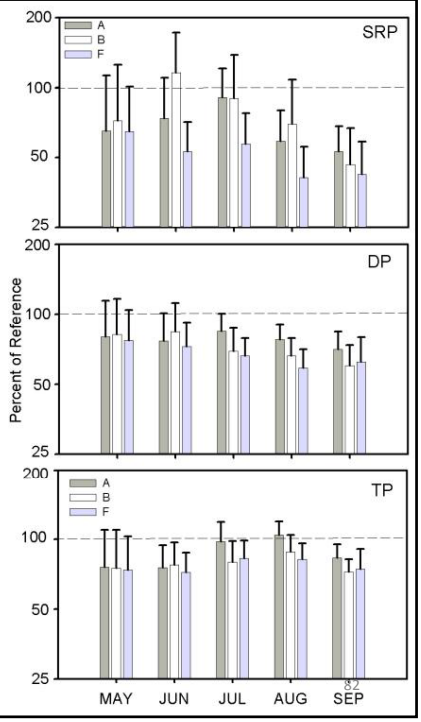
Non-target variables



81

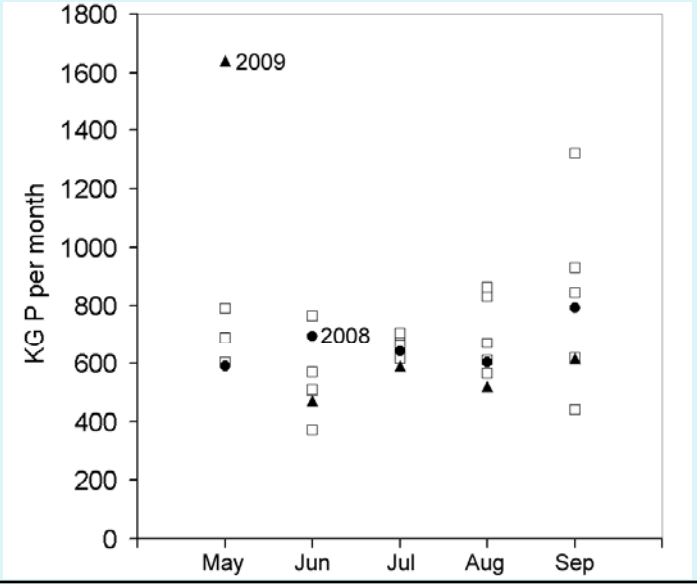
Results-

P variables



82

Reductions at Station F cannot be attributed to WWTP effluent



83

Conclusion

- The average reductions in SRP compared to reference conditions from June to September at three sites affected by the ordinance ranged from 24 to 52 percent.
- Average reductions in DP ranged from 23 to 35 percent.
- Average reductions in TP ranged from 11 to 23 percent.

84

Conclusion

- Causal inference is not clean – fertilizer ordinance was just one of several nonpoint source management efforts
- To duplicate this study elsewhere you need a good baseline or reference data set to document pre-existing condition

85

For more information and the data themselves, visit

http://www.umich.edu/~hrstudy

86

For comparison with other sites:

From May-Sept of 2003-2005, 94 km^2 drainage area exported P to the Huron River at the following average rates:

SRP	0.12 g/ha/d
DP	0.38 g/ha/d
TP	1.41 g/ha/d

This is equivalent to 0.5 kg TP/ha/yr

87

Questions?

August 2002

August 2008

88

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89

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http://water.epa.gov/learn/training/wacademy/upload/2011_9_21_certificate.pdf

You can type in each of the attendee's names and print the certificates.

90