Potomac Water Quality
Preliminary Findings and Next Steps for the Region

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Presentation Overview

- Issue framing slides (#3-4)
- USGS WRTDS data slides (#5-13)
  - Bay watershed-wide, but focus on Potomac
- Issue investigation slides (# 14 -19)
- **Preliminary Findings (#20)**
- **Elected Official Message Points (#21)**
- **Next Steps (#22-23)**

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New USGS data on flow-normalized loads (WRTDS) raises questions about our understanding of what's going on in Bay watershed (including Potomac)

- For period of study, 1985 – 2010, many loads (particularly TP and TSS) appear to be increasing, not decreasing
  - Contrary to watershed model estimates
  - Also different than some flow-adjusted <u>concentration</u> trends
- Worsening trends appear to be accelerating
  - Either less progress (TN) or increasingly higher load increases (TP, TSS) for 2000-2010 period than for overall 1985-2010
- Nutrient species related to wastewater discharges (nitrate, orthophosphate) do show improving trends for both 1985-2010 and 2000-2010 periods, consistent with management actions

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Bay-wide Issues

- Discrepancy between monitoring and modeling results
  - Flow-adjusted load trends from monitoring should match CBP watershed model trends
    - CBP watershed model shows decreases in TP, TSS loads where monitoring shows increases in loads
    - Effectiveness of BMPs / impact of lag times - ?
- What is driving increase in sediment (and attached phosphorus)?
  - Flow-adjusted trends should not be influenced by changing precipitation patterns

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New USGS method (WRTDS) has been applied to nine fall-line monitoring stations

> Estimating load trends above fall line

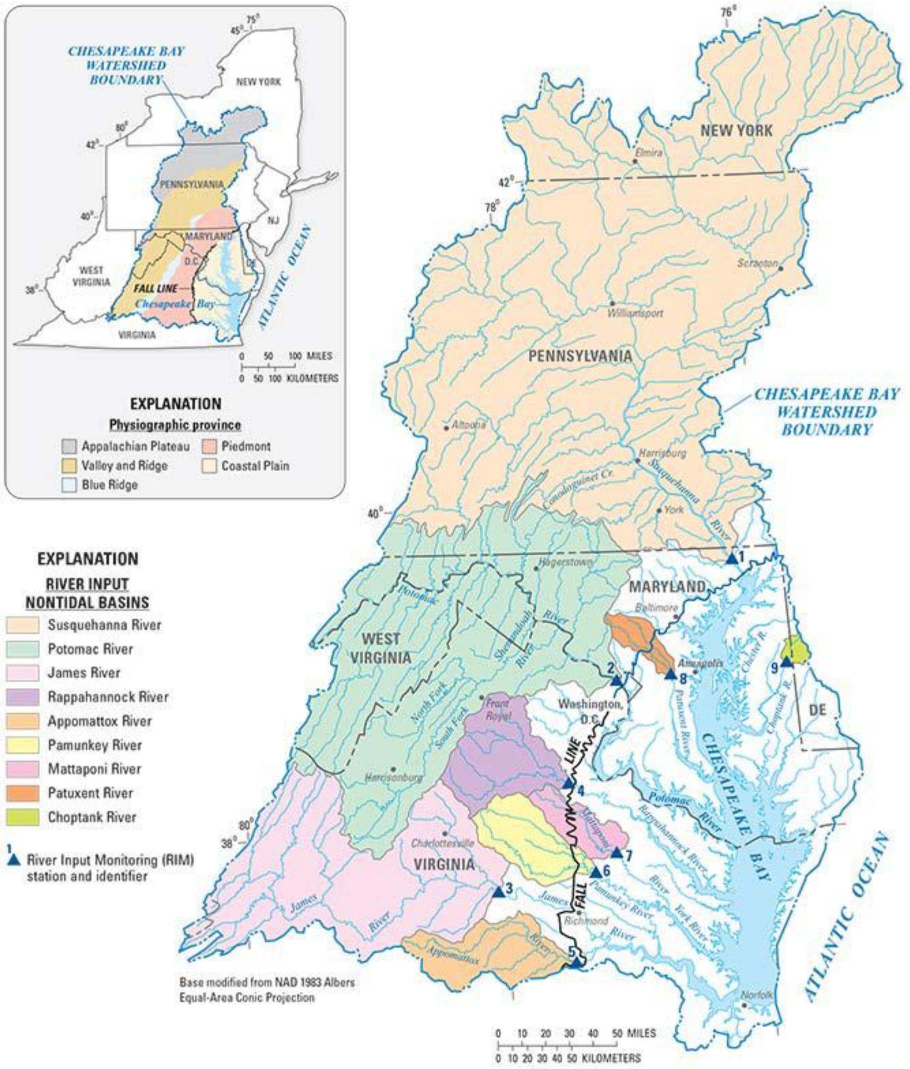

Figure 1. Location of the nine U.S. Geological Survey River Input Monitoring (RIM) stations at which the new load and trend computation method (Weighted Regression on Time, Discharge, and Season, or WRTDS) was applied: (1) Susquehanna River, (2) Potomac River, (3) James River, (4) Rappahannock River, (5) Appomattox River, (6) Pamunkey River, (7) Mattaponi River, (8) Patuxent River, and (9) Choptank River. (Modified from Moyer and others, 2012, fig. 1).

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WRTDS Results for Bay Watershed

1985-2010 flow adjusted trends

- Minimal changes in TN for 6/9 river basins
- Worsening trends (i.e. increase in load) for TP in 4/9 river basins; minimal change in 3/9 basins
- Worsening trends for TSS in 2/4 basins*; improving trends in 2/4 basins

2000 – 2010 flow adjusted trends

- Minimal changes in TN in 8/9 river basins
- Worsening trends for TP in 6/9 river basins; minimal change in 3/9 basins
- Worsening trends for TSS at 6/9 basins; minimal change in 2/9 basins

* None of the Virginia basins have sediment data going back to 1985

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Notes on Data

- Next set of slides (#6 – 11) all based on WRTDS flow-adjusted load trends for:
  - total nitrogen (TN), nitrate nitrogen (NO3)*,
  - total phosphorus (TP), orthophosphorus (PO4)*
  - total suspended solids (TSS)
- Results shown in 'yields' – load/acre/year, but yield trends are the same as plain load trends
- Includes all 9 Bay river basins, with Potomac results highlighted in red
- Trend indicators are broad-based (because WRTDS trends lack error bars)

* wastewater signal

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WRTC Meeting 3/7/13

WRTDS Results for Trends in NO3 and TN

2000-2010 TN trends are basically flat

Table 1. Changes in yields of nitrate and total nitrogen at the nine U.S. Geological Survey River Input Monitoring (RIM) stations during two time periods, long-term (1985–2010) and short-term (2001–10).

RIM STATION	LONG-TERM TREND IN YIELD (1985–2010)		SHORT-TERM TREND IN YIELD (2001–10)	
	NITRATE	TOTAL NITROGEN	NITRATE	TOTAL NITROGEN
SUSQUEHANNA	IMPROVING	IMPROVING	IMPROVING	MINIMAL CHANGE
POTOMAC	IMPROVING	IMPROVING	IMPROVING	MINIMAL CHANGE
JAMES	IMPROVING	MINIMAL CHANGE	MINIMAL CHANGE	MINIMAL CHANGE
RAPPAHANNOCK	IMPROVING	MINIMAL CHANGE	IMPROVING	MINIMAL CHANGE
APPOMATTOX	IMPROVING	MINIMAL CHANGE	MINIMAL CHANGE	MINIMAL CHANGE
PAMUNKEY	MINIMAL CHANGE	MINIMAL CHANGE	IMPROVING	MINIMAL CHANGE
MATTAPONI	MINIMAL CHANGE	MINIMAL CHANGE	MINIMAL CHANGE	MINIMAL CHANGE
PATUXENT	IMPROVING	IMPROVING	IMPROVING	IMPROVING
CHOPTANK	DEGRADING	MINIMAL CHANGE	MINIMAL CHANGE	MINIMAL CHANGE

NO3 to TN comparison reflects impact of wastewater reductions

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WRTDS Results for TN Yields

(in pounds/ day/square mile)

Potomac shows early improvements leveling off

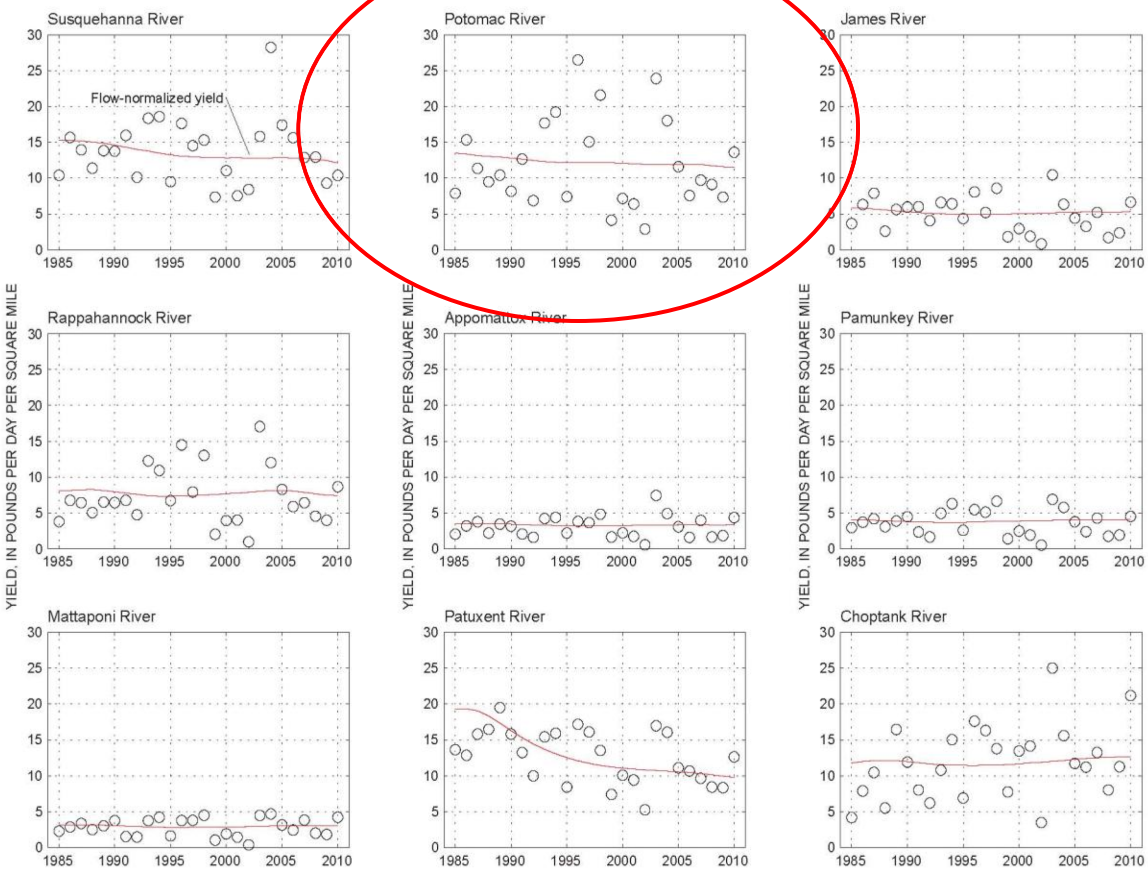

Figure 2. Estimated annual yields of total nitrogen at the nine U.S. Geological Survey River Input Monitoring (RIM) stations, Maryland and Virginia. (Trends in yield are computed on the basis of differences in flow-normalized yields over a given period of time; axes are scaled identically to permit comparisons of watershed yields over time. Modified from Moyer and others, 2012, fig. 18).

http://chesapeake.usgs.gov

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WRTDS Results for Trends in PO4, TP

Table 2. Changes in yields of orthophosphorus and total phosphorus at the nine U.S. Geological Survey River Input Monitoring (RIM) stations during two time periods, long-term (1985–2010) and short-term (2001–10).

RIM STATION	LONG-TERM TREND IN YIELD (1985–2010)		SHORT-TERM TREND IN YIELD (2001–10)	
	ORTHOPHOSPHORUS	TOTAL PHOSPHORUS	ORTHOPHOSPHORUS	TOTAL PHOSPHORUS
SUSQUEHANNA	IMPROVING	MINIMAL CHANGE	MINIMAL CHANGE	DEGRADING
POTOMAC	IMPROVING	IMPROVING	IMPROVING	MINIMAL CHANGE
JAMES	IMPROVING	MINIMAL CHANGE	IMPROVING	DEGRADING
RAPPAHANNOCK	IMPROVING	DEGRADING	MINIMAL CHANGE	DEGRADING
APPOMATTOX	IMPROVING	DEGRADING	IMPROVING	DEGRADING
PAMUNKEY	IMPROVING	DEGRADING	IMPROVING	DEGRADING
MATTAPONI	IMPROVING	MINIMAL CHANGE	IMPROVING	MINIMAL CHANGE
PATUXENT	IMPROVING	IMPROVING	IMPROVING	MINIMAL CHANGE
CHOPTANK	DEGRADING	DEGRADING	DEGRADING	DEGRADING

PO4 trends better than TP trends reflects impact of ongoing waste-water reductions

Comparison of Potomac TP 85-2010 to 2000-2010 trend shows improvement is slowing

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WRTDS Results for TP Yield

(in pounds/ day/square mile)

Potomac shows early improving trend leveling off

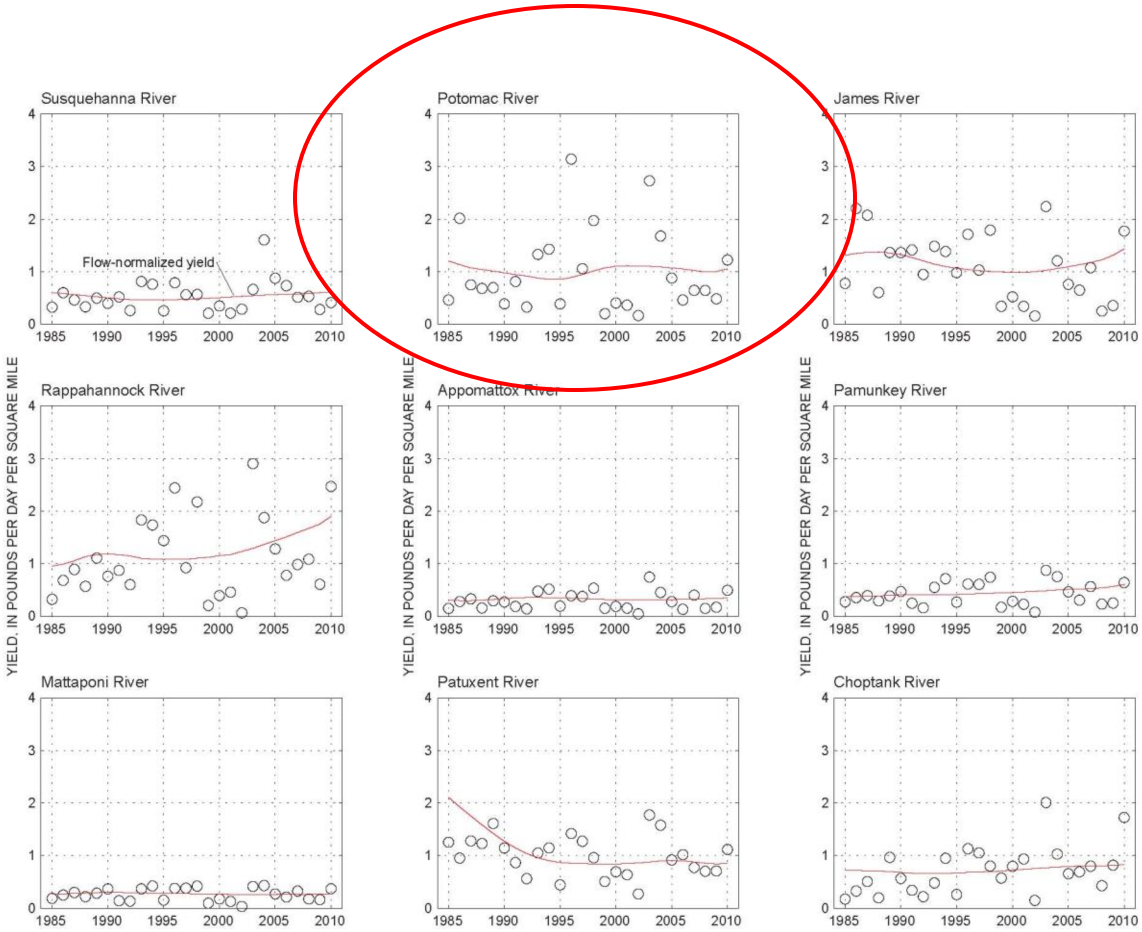

Figure 4. Estimated annual yields of total phosphorus at the nine U.S. Geological Survey River Input Monitoring (RIM) stations, Maryland and Virginia. (Trends in yield are computed on the basis of differences in flow-normalized yields over a given period of time; axes are scaled identically to permit comparisons of watershed yields over time. Modified from Moyer and others, 2012, fig. 20).

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WRTDS Results for Trends in TSS

Table 3. Changes in yields of suspended sediment at the nine U.S. Geological Survey River Input Monitoring (RIM) stations during two time periods, long-term (1985–2010) and short-term (2001–10). [NA, not available]

RIM STATION	LONG-TERM TREND IN YIELD (1985–2010)	SHORT-TERM TREND IN YIELD (2001–10)
SUSQUEHANNA	DEGRADING	DEGRADING
POTOMAC	DEGRADING	DEGRADING
JAMES	NA	DEGRADING
RAPPAHANNOCK	NA	MINIMAL CHANGE
APPOMATTOX	NA	MINIMAL CHANGE
PAMUNKEY	NA	DEGRADING
MATTAPONI	NA	IMPROVING
PATUXENT	IMPROVING	DEGRADING
CHOPTANK	IMPROVING	DEGRADING

Almost all basin trends (including Potomac) are negative and accelerating negatively

Note: Data not available for long-term trends at Virginia stations

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WRTDS Results for TSS Yield

(in pounds/ day/square mile)

Potomac shows early improving trend reversing

Figure 5. Estimated annual yields of suspended sediment at the nine U.S. Geological Survey River Input Monitoring (RIM) stations, Maryland and Virginia. (Trends in yield are computed on the basis of differences in flow-normalized yields over a given period of time; axes are scaled identically to permit comparisons of watershed yields over time. Modified from Moyer and others, 2012, fig. 22).

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Issues

- **Discrepancy between monitoring and modeling results**
  - Flow-adjusted load trends from monitoring should match CBP watershed model trends
    - CBP watershed model shows decreases in TP, TSS loads where monitoring shows increases in loads
    - Effectiveness of BMPs / impact of lag times - ?
- What is driving increase in sediment (and attached phosphorus)?
  - Trend should not be due to changing precipitation patterns

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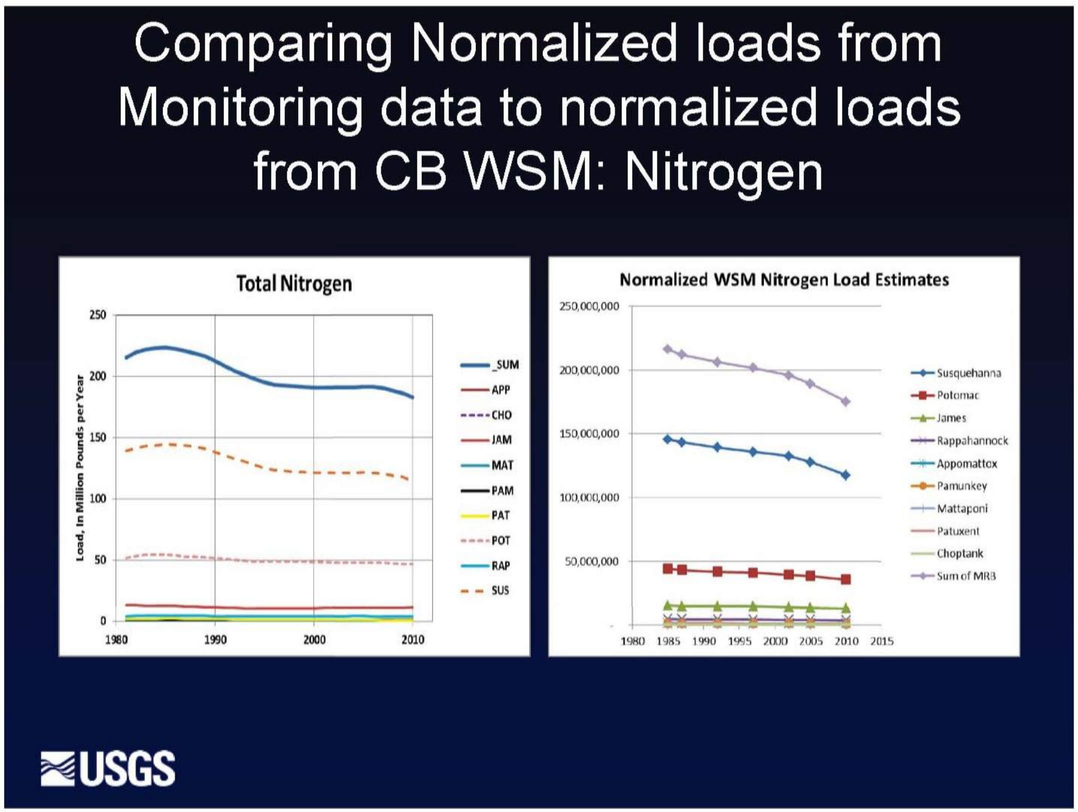
Monitoring vs. Modeling – Total Nitrogen



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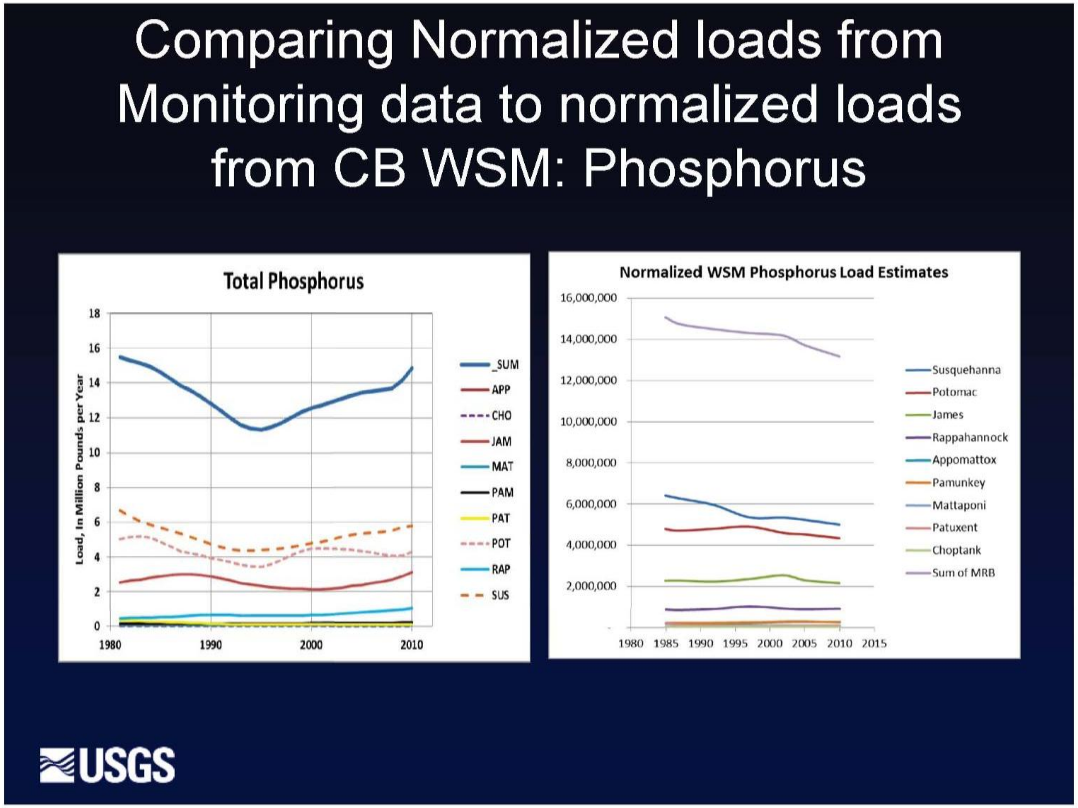
Monitoring vs. Modeling – Total Phosphorus



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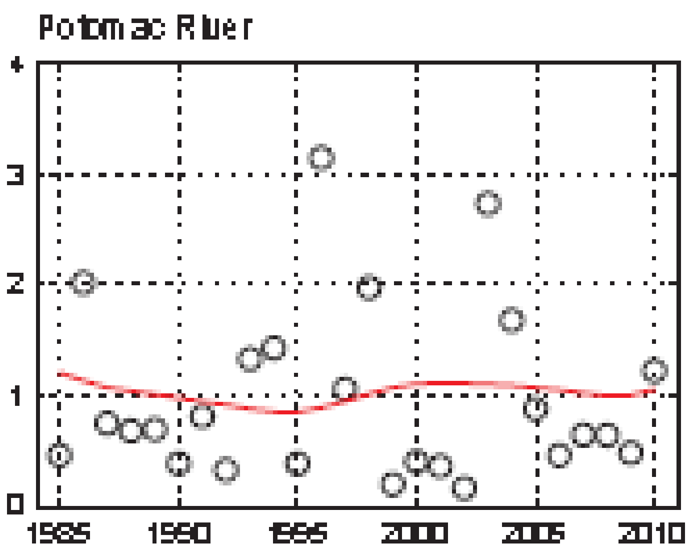
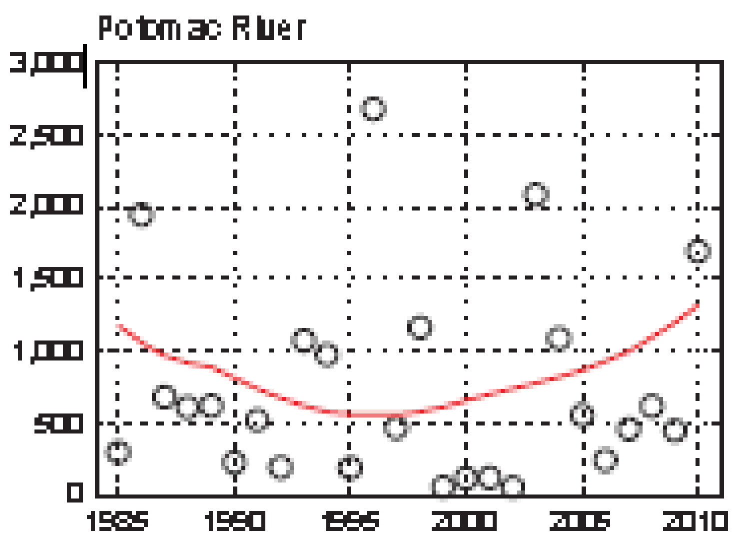
WRTDS Results for Potomac…a Closer Look



Flow adjusted trends for TP yield: 12.4% decrease from 1985 – 2010; 5 % decrease from 2000 - 2010



Flow adjusted trends for TSS yield: 12.2% increase from 1985 – 2010; 89.1 % increase from 2000-2010

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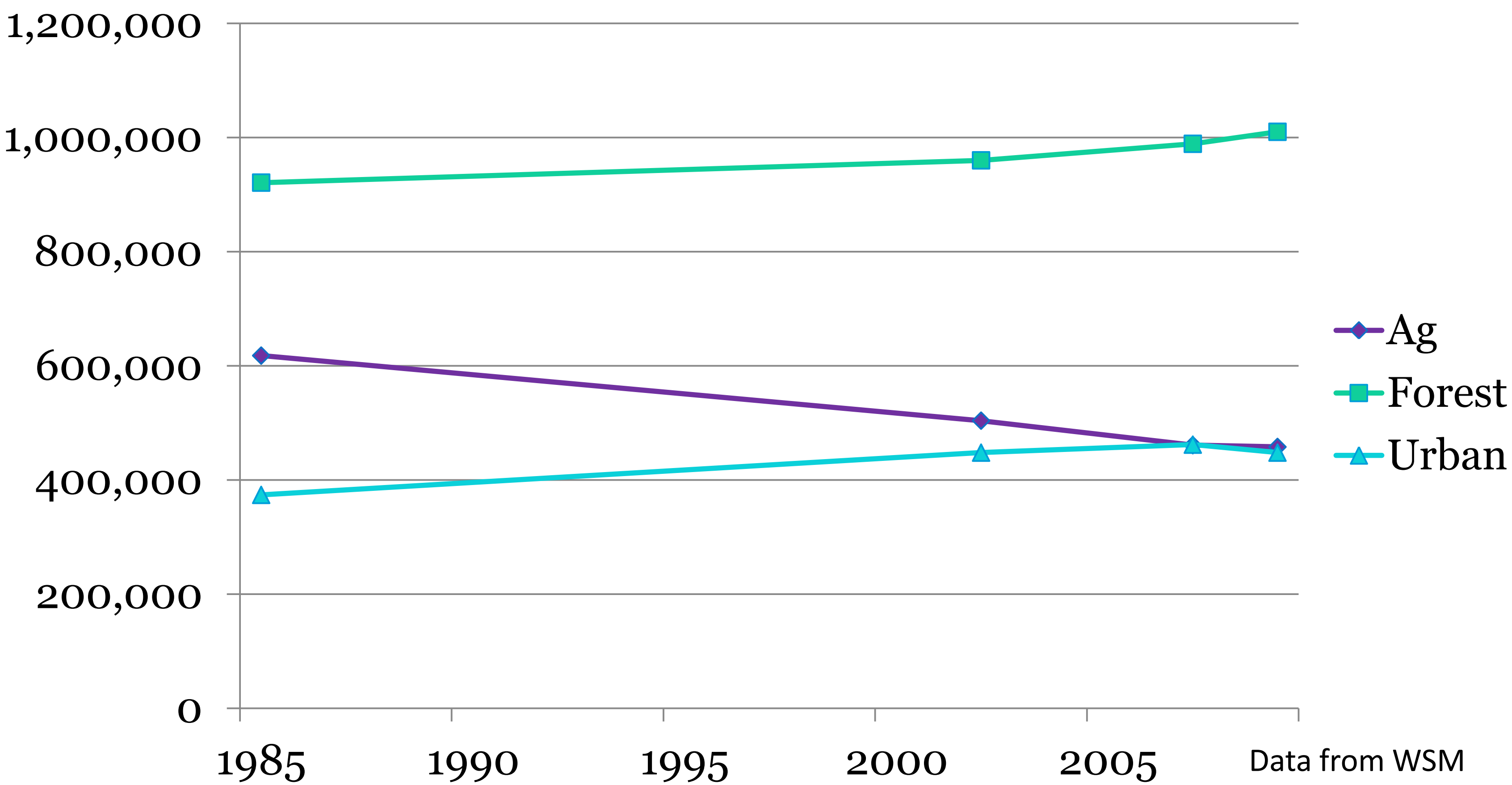
Land Use Acres, Potomac Above Fall Line



Data from WSM Version 5.3

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Upstream Potomac Water Quality - Preliminary Findings

- Wastewater nutrient upgrades from AFL plants account for much of the progress seen in fall-line monitoring results to date
  - Note --most of the region’s WWTPs discharge below fall line
- Same worsening trend for TSS and declining progress in TP as observed elsewhere in Bay watershed
  - Would not appear to be the result of changes in ag land use or production
  - Impact of urbanization on increasing flows, scouring of legacy sediments

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Message to Elected Officials

Emphasize Good News

- Nutrient reduction efforts by local government/utility wastewater plants are working
  - Account for most of the progress seen in fall-line monitoring results and upper Potomac estuary water quality
  - Will document further with report on water quality improvements in upper Potomac estuary

Note More Work Needed (Sound Science)

- Verify USGS results with more detailed COG data
- Investigate reasons for negative or worsening trends for TP and TSS

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Next Steps by Bay Program

- USGS working with Bay Program modeling team to investigate modeling and monitoring results
  - Potomac watershed to be a focus (9 USGS water quality monitoring stations upriver from fall line)
  - Looking for data to isolate possible source and geographic signals
  - Seeking partners – opportunity for COG

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Next Steps by COG

- Presentation of preliminary findings to CBPC March 22
- Issue detailed Potomac water quality fact sheet later in 2013
- COG finalizing contract with OWML for additional Potomac water quality analysis
  - Develop load profile for the Potomac using OWML's Chain Bridge data
  - Check accuracy of USGS flow-adjusted loads for the Potomac
  - Provide seasonal trend estimates for nutrient species important to upper estuary water quality
  - Participate in USGS-CBPO Potomac investigations

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For More Information

- USGS Chesapeake Page
- http://chesapeake.usgs.gov/
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- Web summary for WRTDS
- http://chesapeake.usgs.gov/sciencesummary-enhancedstatistical.html
-
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- Moyer, Douglas, Hirsch, Robert, and Hyer, Kenneth, 2012, Comparison of two regression-based approaches for determining nutrient and sediment fluxes and trends in the Chesapeake Bay watershed: U.S. Geological Survey Scientific Investigations Report 2012-5244, 118 p. (Also available online at http://pubs.usgs.gov/sir/2012/5244/.)