New Information on Potomac Water Quality

Preliminary Findings and Next Steps for the Region

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Presentation Overview

- Summary of USGS data
- Some specific examples
  - Results for the Potomac
- What are the issues
- Next steps for COG

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New monitoring data from U.S. Geological Survey raises questions about our understanding of what's going on in Bay watershed, including Potomac basin

- USGS has monitoring data from 1985 – 2010 for a number of stations in the watershed, particularly the nine fall-line stations
- Have been using data to evaluate trends in concentration over time
- Now using data to evaluate trends in total loads over time
  - Load data is better match with Bay TMDL accounting system

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

> Estimating load trends above fall line

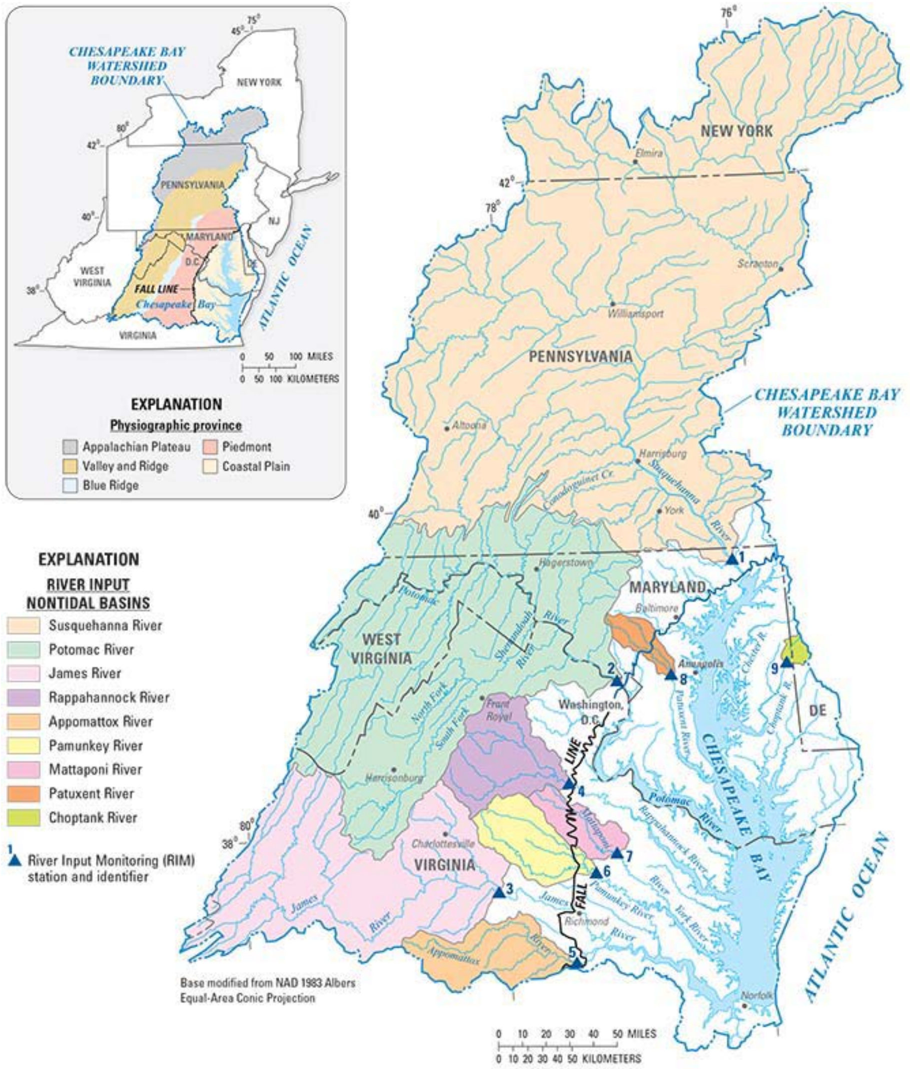

Figure 1. Location of the nine U.S. Geological Survey River Input Monitoring (RIM) stations at which the new load and trend computation method (Weighted Regression on Time, Discharge, and Season, or WRTDS) was applied: (1) Susquehanna River, (2) Potomac River, (3) James River, (4) Rappahannock River, (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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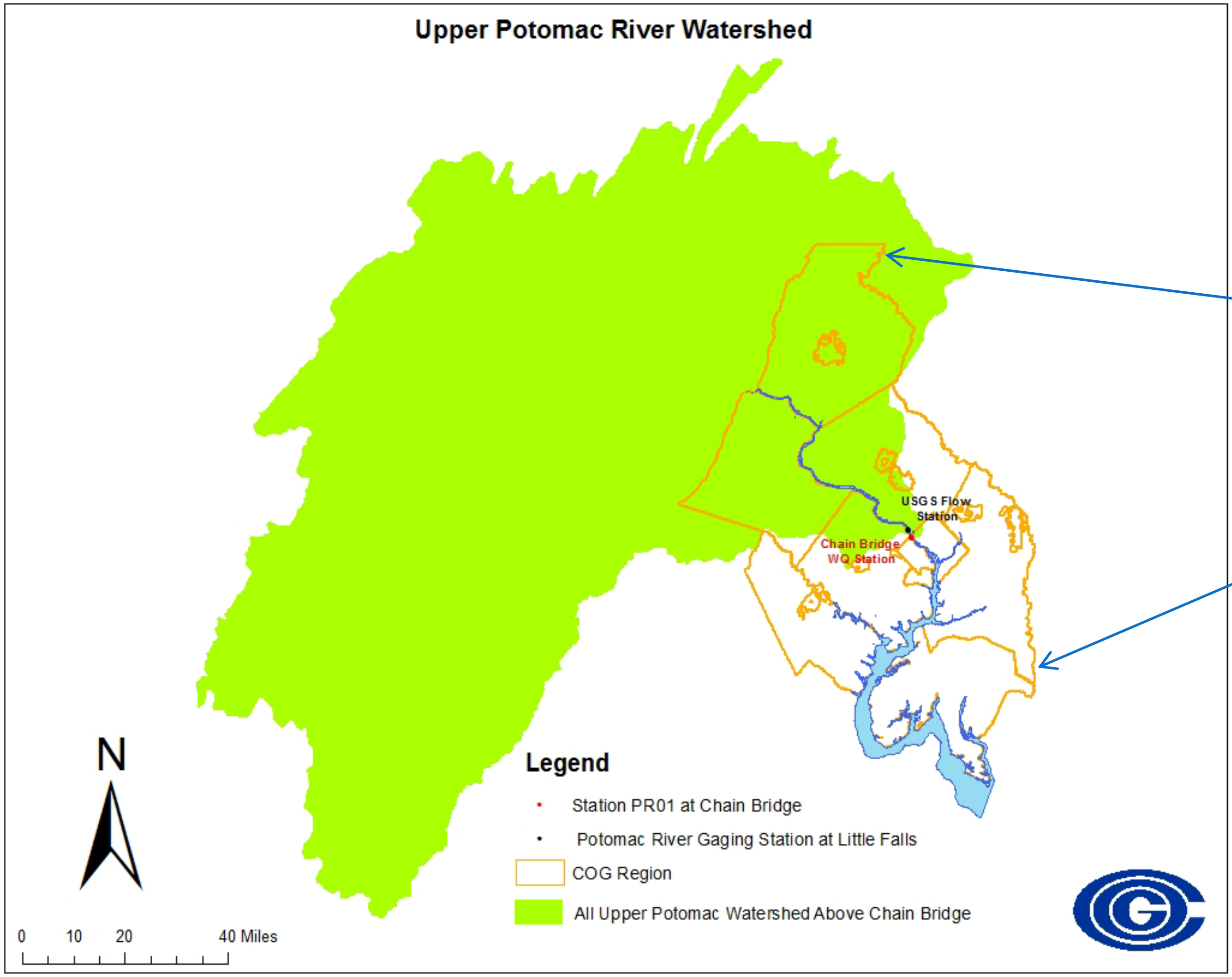

COG region accounts for about 25 percent of the acreage of the Potomac watershed above the fall line

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Summary of results

- For period of study, 1985 – 2010, many basin-wide loads (particularly for phosphorus and sediment) 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 2001-2010 period than for overall 1985-2010
- Nutrient types derived largely from wastewater discharges (nitrate, orthophosphate) do show improving trends for both 1985-2010 and 2001-2010 periods, consistent with management actions

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Bay-wide Issues Raised by USGS Work

- Discrepancy between monitoring and modeling results
  - Flow-adjusted load trends from monitoring should match CBP watershed model trends, but they don't
    - 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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Notes on Data

- Next set of slides (#9 – 14) all based on USGS 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
- Trend indications are broad-based for periods 1985-2010 and 2001-2010

* wastewater signal

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Color key, terminology for USGS slides

- Green is improving trend (decrease in loads)
- Yellow is neutral (no significant trend one way or the other)
- Pink is worsening trend (increase in loads)

- Note – Potomac results highlighted in red

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USGS Results for Trends in NO3 and TN

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

2000-2010 TN trends are basically flat

NO3 to TN comparison reflects impact of wastewater reductions

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USGS 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

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

Comparison of PO4 trends to TP trends reflects impact of ongoing wastewater reductions

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USGS 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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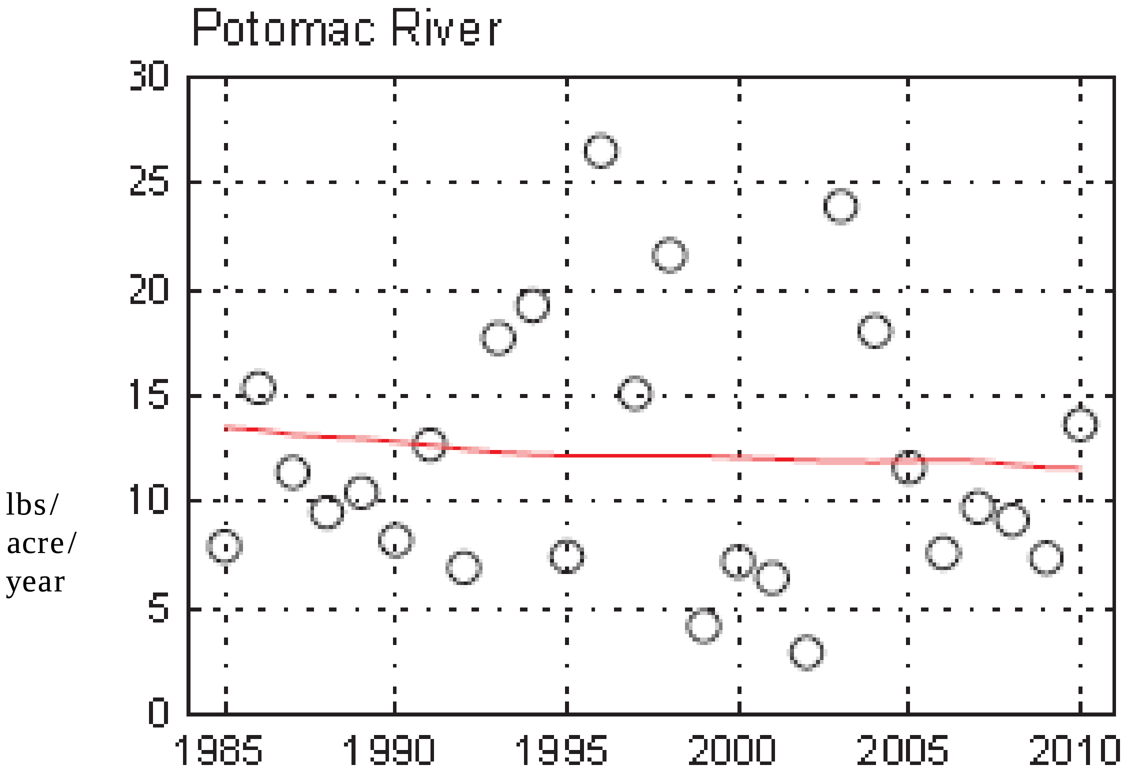
USGS Results for Potomac...a Closer Look

Results for total nitrogen yield



Flow adjusted trends for TN yield: 14.3% decrease from 1985 – 2010; 3.6 % decrease from 2001 - 2010

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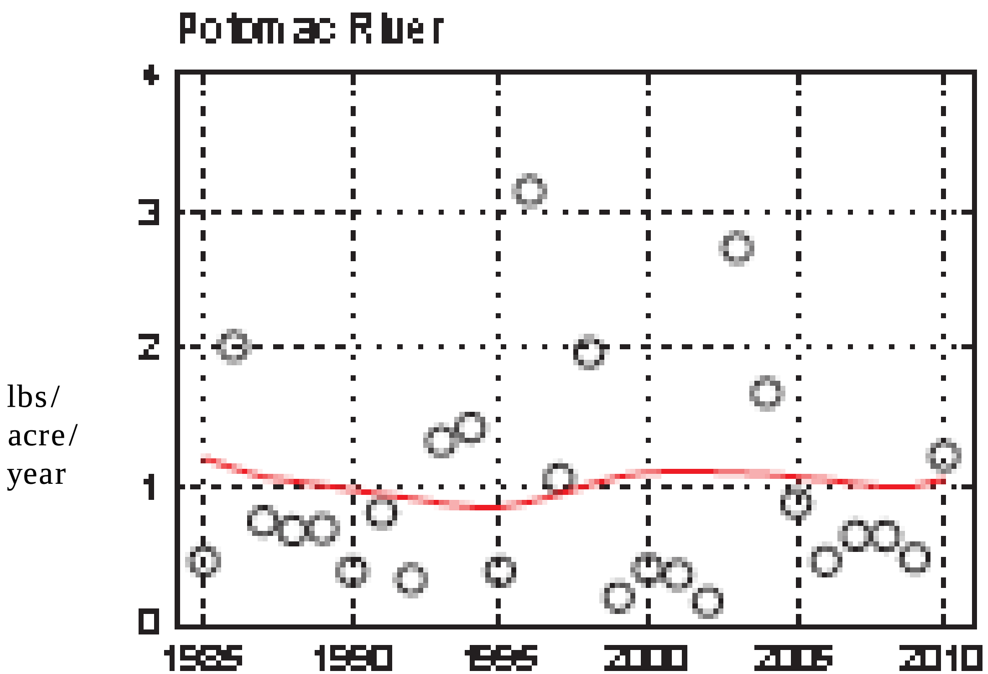
USGS Results for Potomac...a Closer Look

Results for total phosphorus



Flow adjusted trends for TP yield: 12.4% decrease from 1985 – 2010; 5 % decrease from 2001 - 2010

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Issues

- **Discrepancy between monitoring and modeling results**
  - Flow-adjusted load trends from monitoring should match CBP watershed model trends, but they don't
    - 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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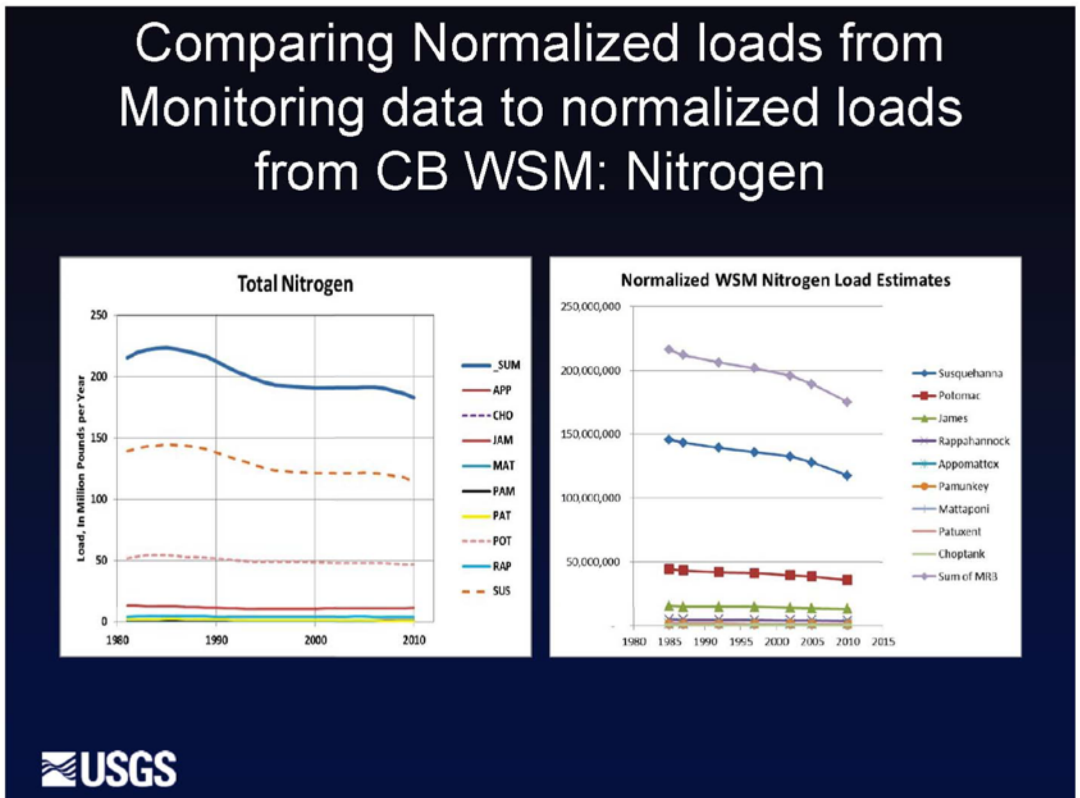
Monitoring vs. Modeling – Total Nitrogen



CB WSM = Chesapeake Bay Watershed Model

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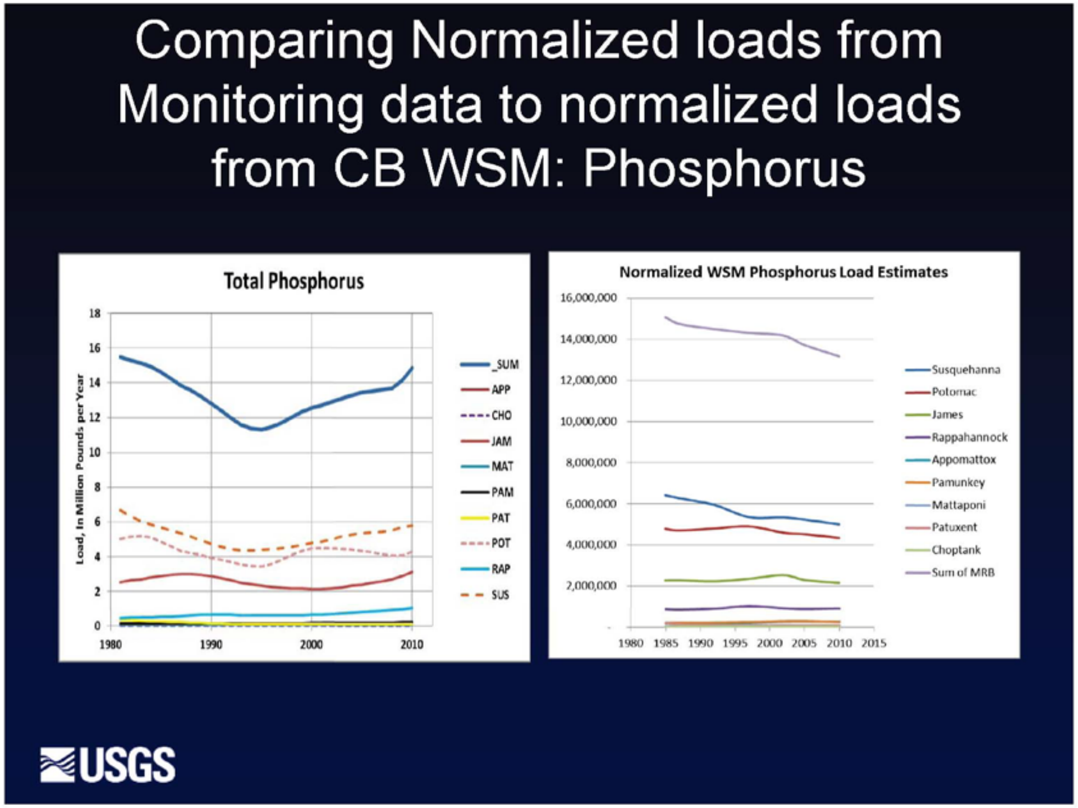
Monitoring vs. Modeling – Total Phosphorus



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- **What is driving increase in sediment (and attached phosphorus)?**
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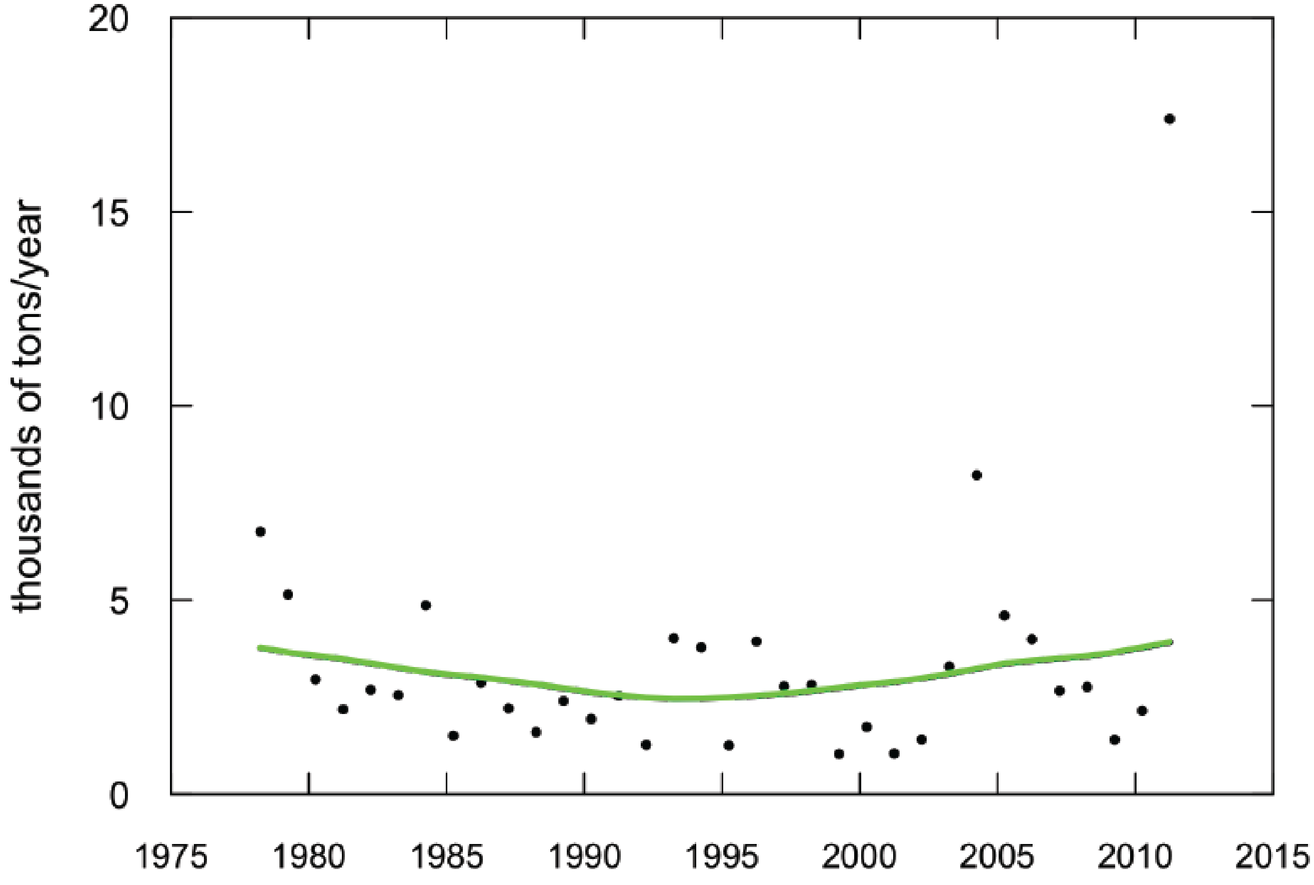
New USGS Susque-hanna data shows dam effect

Scouring of built-up sediment behind dams occurring more readily

Susquehanna River at Conowingo, MD Total Phosphorus loads with flow-normalized trend line



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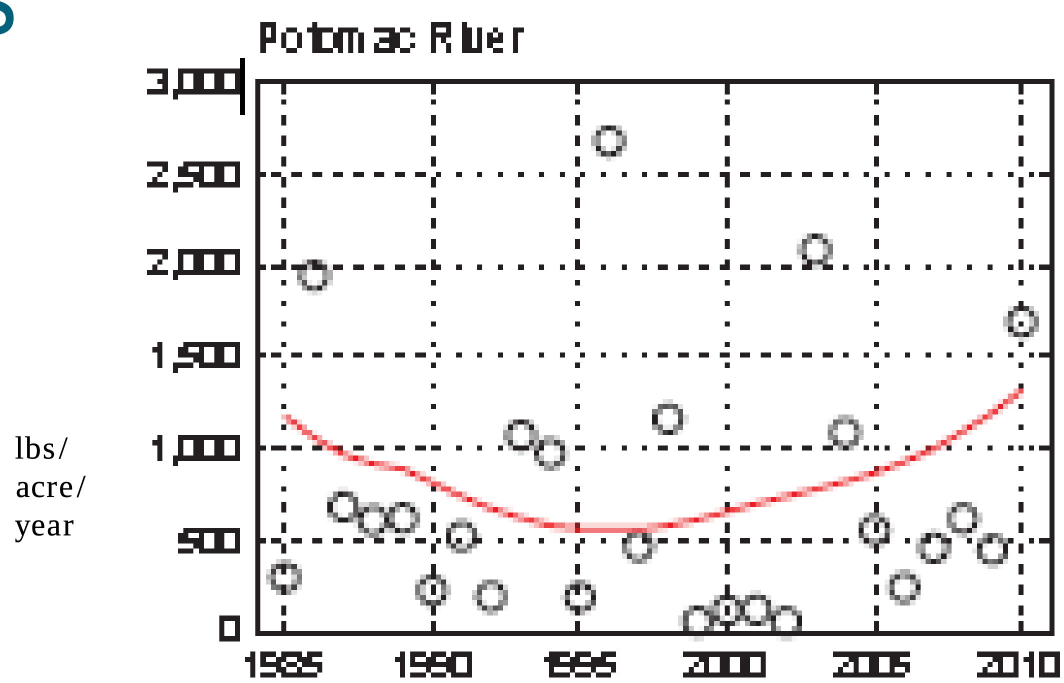
USGS Results for Potomac...a Closer Look

Results for total suspended solids yield



Flow adjusted trends for TSS yield: 12.2% increase from 1985 – 2010; 89.1 % increase from 2001-2010

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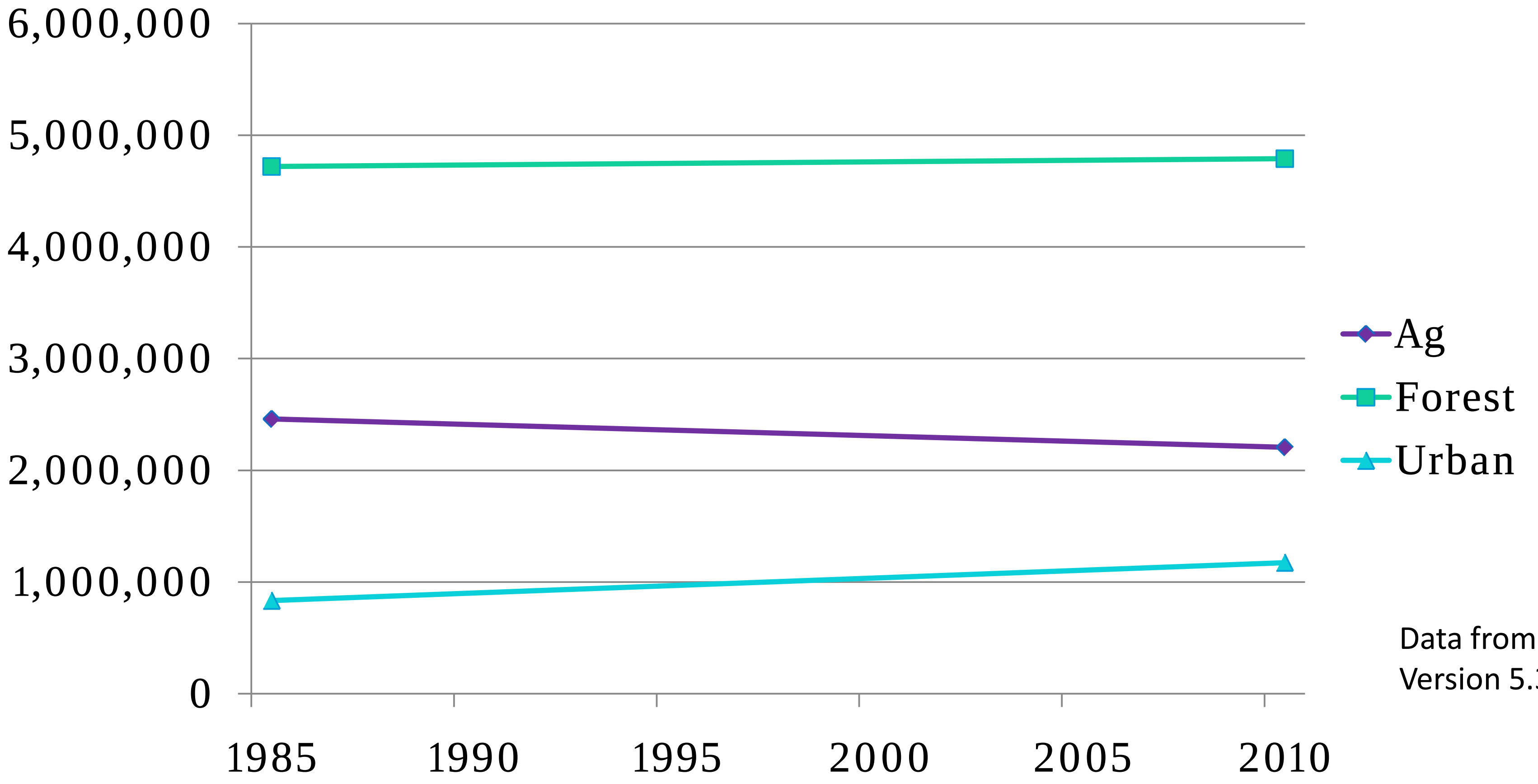
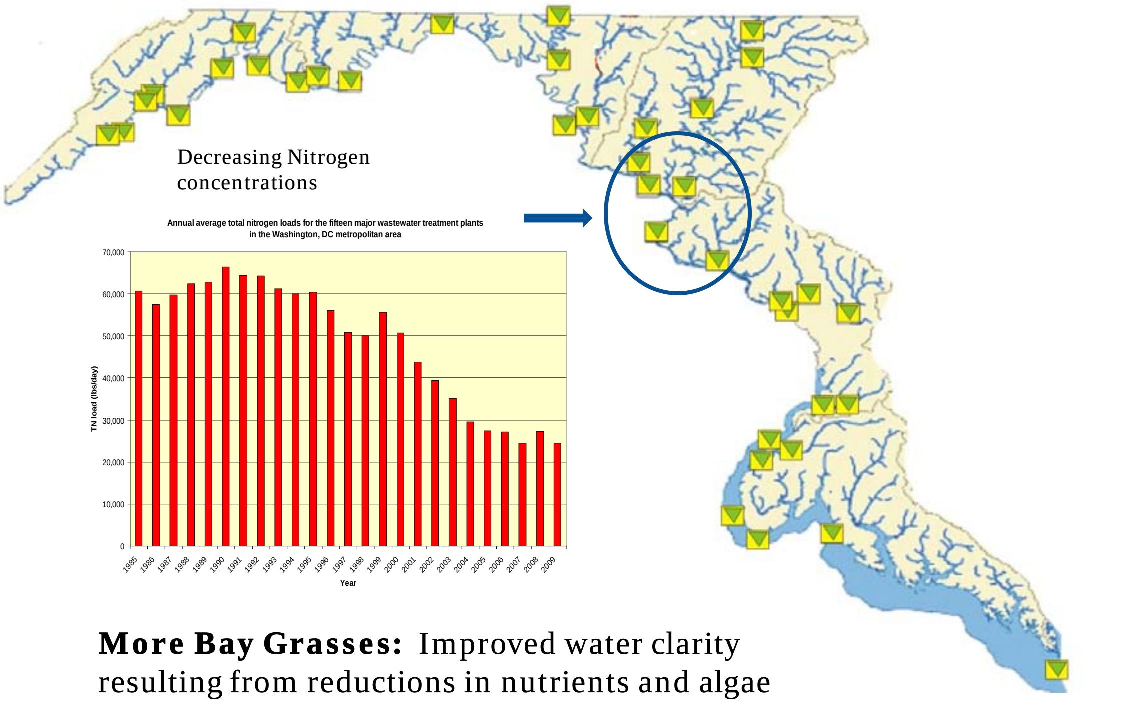
Land Use Acres, Potomac Above Fall Line



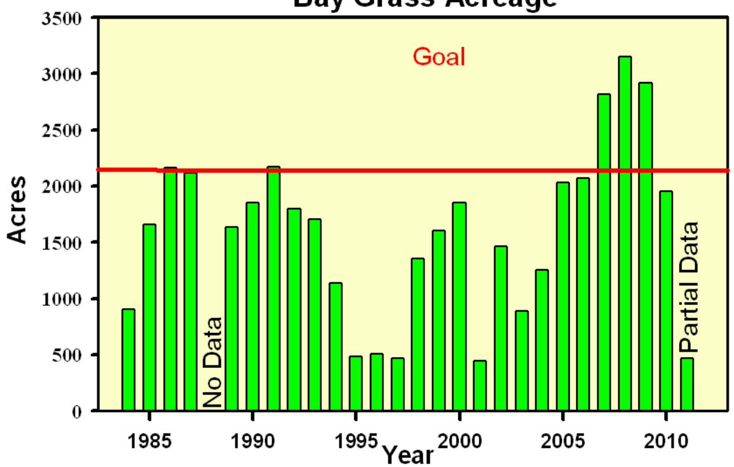
Data from WSM Version 5.3.2

Restoring the Bay: Potomac River responding to management efforts to reduce nutrients

Reduced Nutrient Loads and Concentrations: From 1985 - 2011, Maryland's water quality monitoring program has identified Potomac watershed wide long-term nitrogen reductions not only near the WWTP's but also throughout the Potomac tidal fresh and low salinity areas. Nitrogen reductions have resulted in clearer water and fewer serious algal blooms.



Potomac River Tidal Fresh (POTTF) Bay Grass Acreage



More Bay Grasses: Improved water clarity resulting from reductions in nutrients and algae have allowed a resurgence in Bay Grasses in the tidal fresh portion of the Potomac River since 2000. They are a key indicator of Chesapeake Bay health and protect shorelines from erosion, produce oxygen, filter polluted water and provide food and shelter for many Bay creatures. Bay grasses are also a prime habitat for Maryland's renowned Largemouth Bass fishery in the Potomac River.

Information courtesy of Maryland DNR

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Free Flowing 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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Bay-wide Preliminary Findings

Good news

- Nutrient reduction efforts by local government/utility wastewater plants are working
  - Point source load 'signals' show positive (decrease in loads) trends
  - Can document further with report on water quality improvements in upper Potomac estuary

More study needed

- Impact of reduction efforts on nonpoint sources is not clear
  - Negative (increase in loads) trends for phosphorus and sediment suggest something is not working
  - Urbanization may be culprit

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Next Steps

- USGS working with Bay Program to further investigate modeling and monitoring results
  - Potomac watershed to be a focus
- COG finalizing contract with Virginia Tech's Occoquan Watershed Monitoring Lab for additional Potomac water quality analysis
  - Participate in USGS-CBPO Potomac investigations
- Better document Potomac water quality in upper estuary through COG water quality fact sheet

Action: approve COG staff recommendatio0n to get COG Board approval to renew OWML Pot9omac monitoring contract and issue new contract for detailed analysis work

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WRTDS Results for TN Yields

(in pounds/ day/square mile)

Potomac shows early improvements leveling off

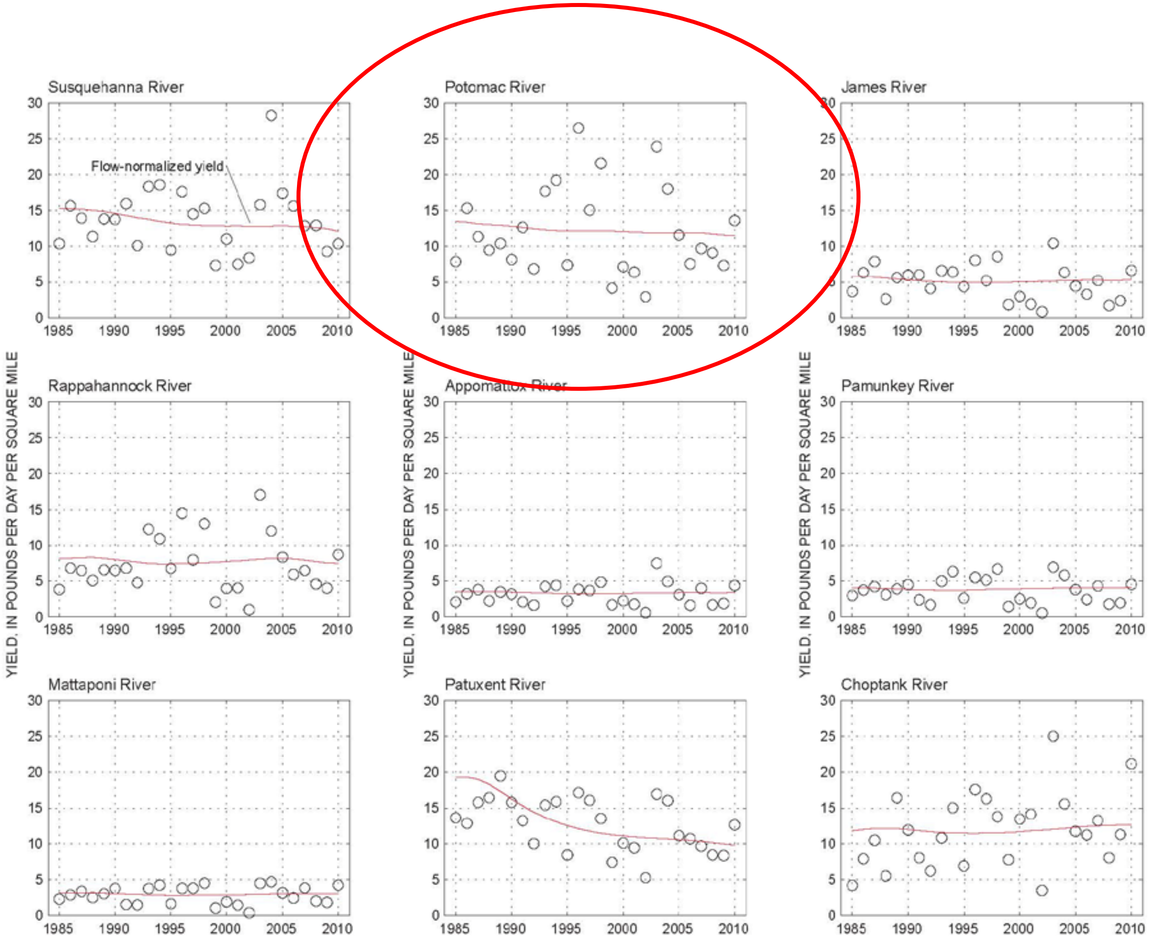

Figure 2. Estimated annual yields of total nitrogen at the nine U.S. Geological Survey River Input Monitoring (RIM) stations, Maryland and Virginia. (Trends in yield are computed on the basis of differences in flow-normalized yields over a given period of time; axes are scaled identically to permit comparisons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

http://chesapeake.usgs.gov

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WRTDS Results for TP Yield

(in pounds/ day/square mile)

Potomac shows early improving trend leveling off

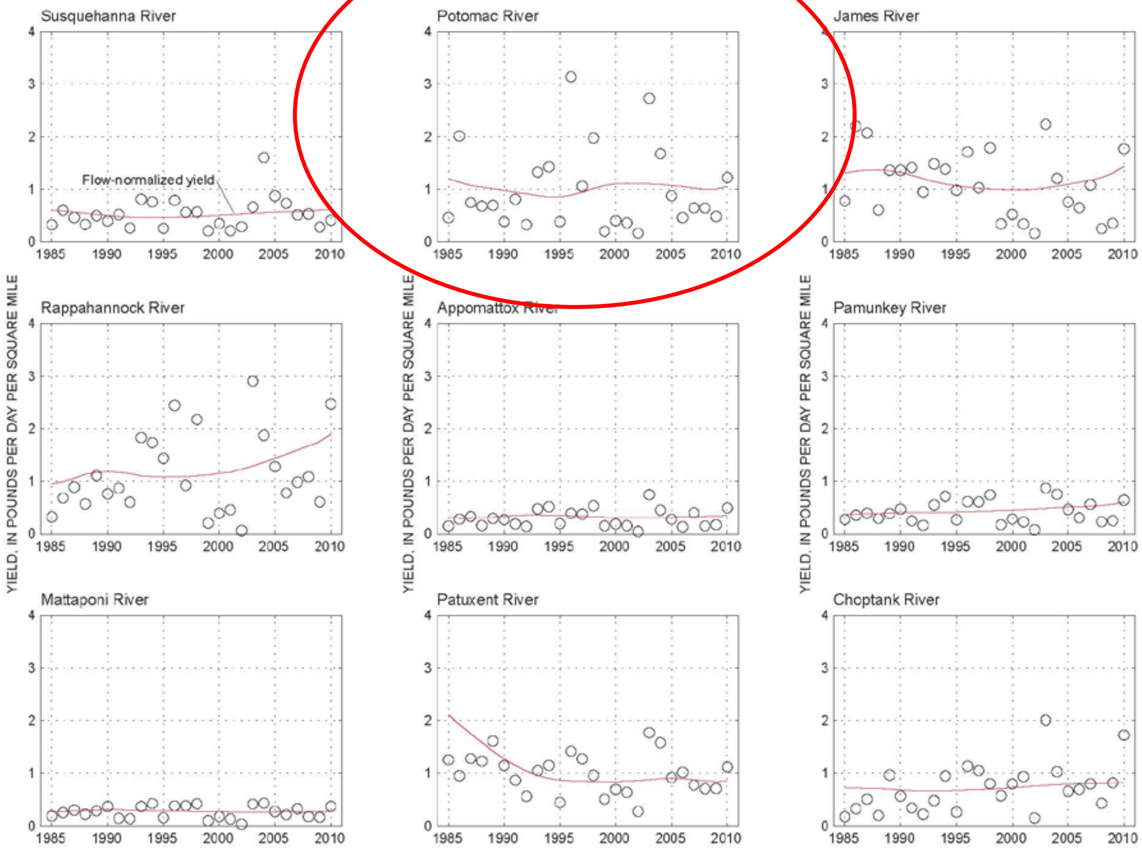

Figure 4. Estimated annual yields of total phosphorus at the nine U.S. Geological Survey River Input Monitoring (RIM) stations, Maryland and Virginia. (Trends in yield are computed on the basis of differences in flow-normalized yields over a given period of time; axes are scaled identically to permit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

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WRTDS Results for TSS Yield

(in pounds/ day/square mile)

Potomac shows early improving trend reversing

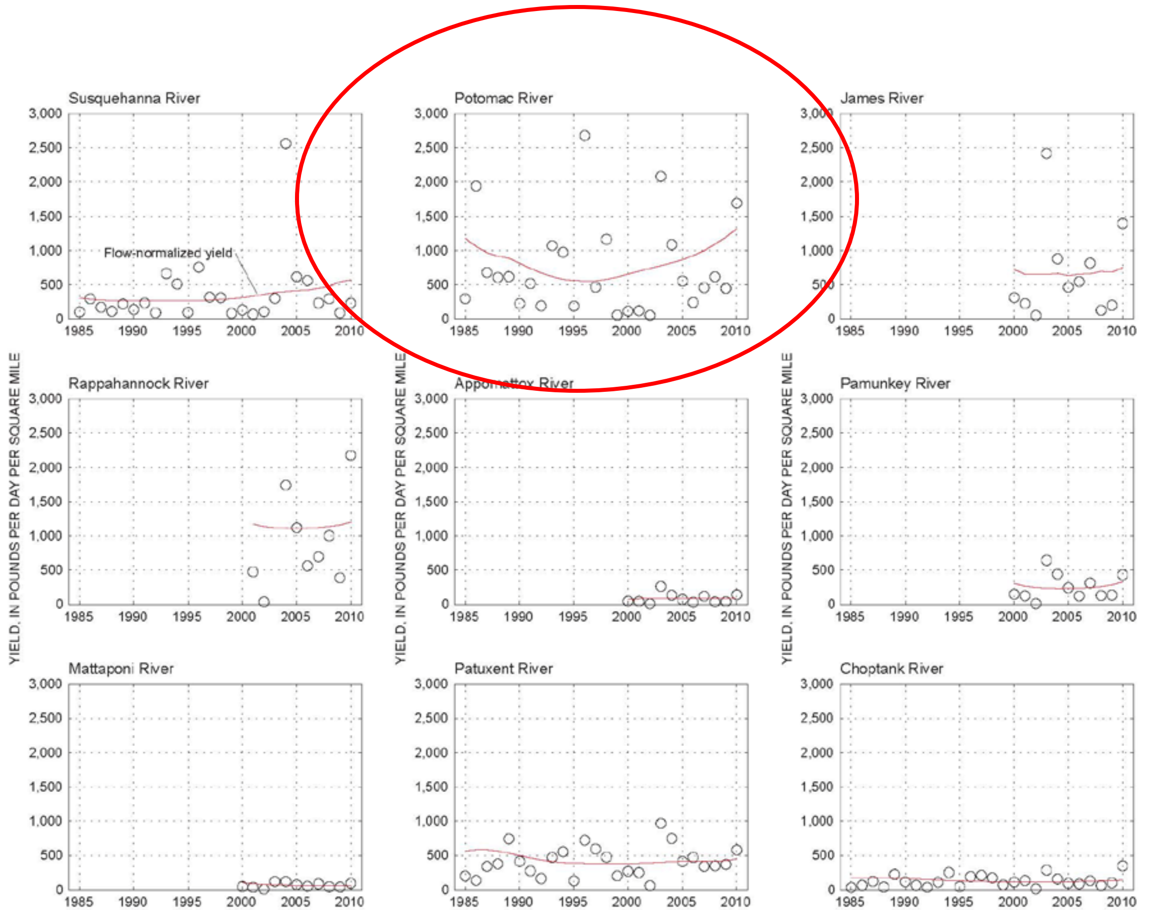

Figure 5. Estimated annual yields of suspended sediment at the nine U.S. Geological Survey River Input Monitoring (RIM) stations, Maryland and Virginia. (Trends in yield are computed on the basis of differences in flow-normalized yields over a given period of time; axes are scaled identically to permit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

http://chesapeake.usgs.gov/

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For More Information Redo

- USGS Chesapeake Page
- http://chesapeake.usgs.gov/
-
- Web summary for WRTDS
- http://chesapeake.usgs.gov/sciencesummary-enhancedstatistical.html
-
-
- 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/.)