Update on Potomac and Chesapeake Bay Nutrient Loads

Briefing to the
Water Resources Technical Committee October 9, 2009

Presented by:
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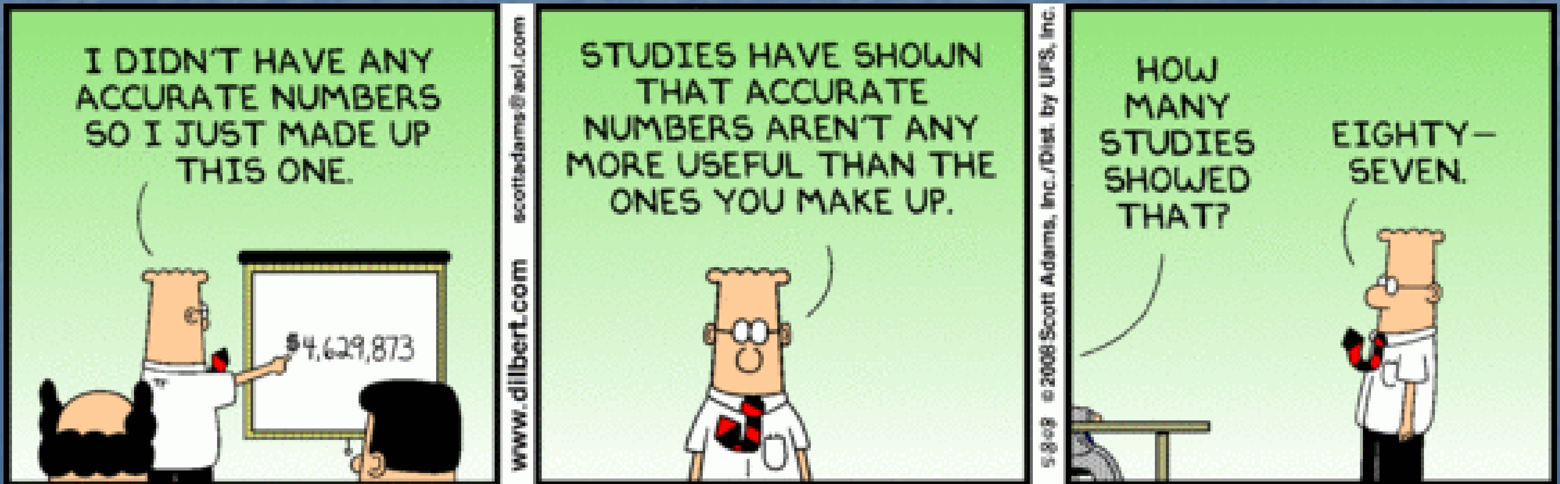
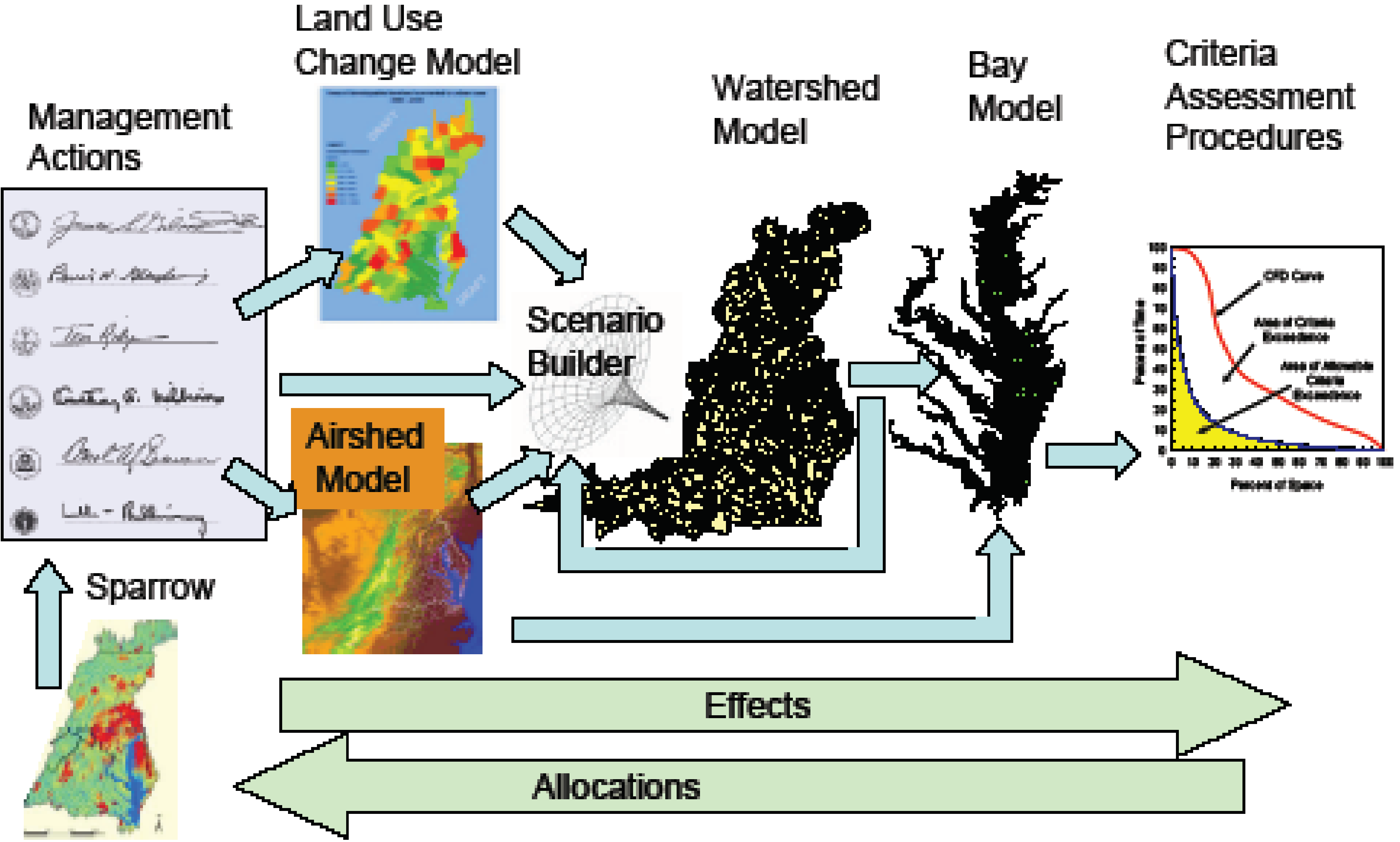
Metropolitan Washington
Council of Governments

Overview

- Review of Bay Program Modeling Tools
- Snapshot of Potomac and COG Region
  - Nitrogen Loads
  - Phosphorus Loads
  - Land Use
- Schedule for when final loads will be available



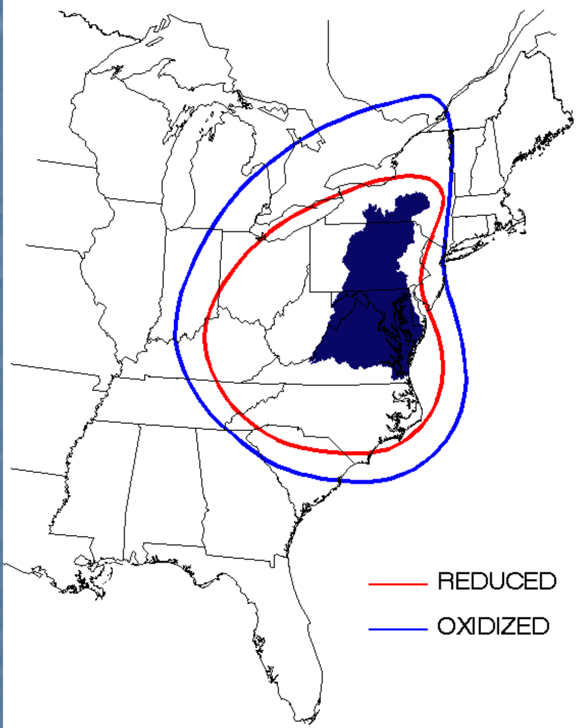
Chesapeake Bay Program Decision Support System



Key Improvements to the Chesapeake Bay Modeling Tools

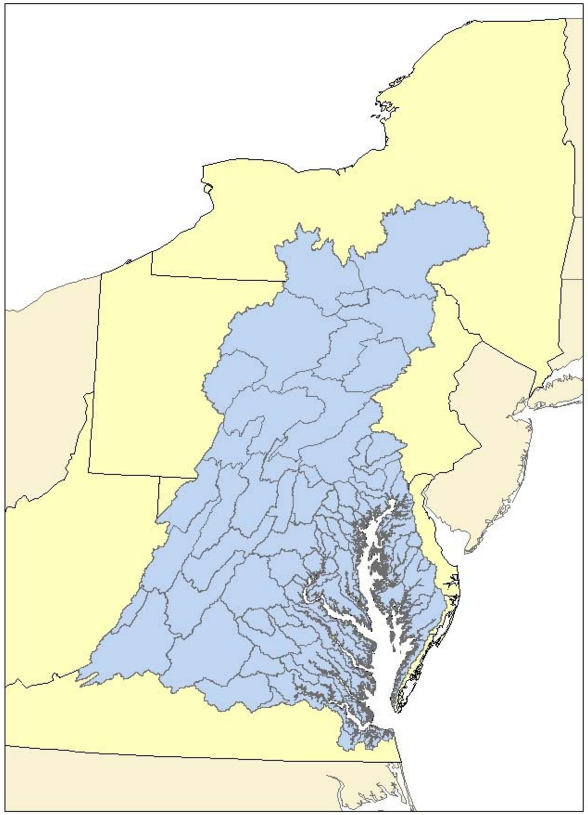
- Finer scale segmentation
  - 54,000 model cells in the WQSTM
  - 899 segments in the WSM
- More data and calibration stations
  - 35 air deposition monitoring stations
  - 296 WSM calibration stations
  - Improved calibration in quality and scale
- Better land use
  - More detailed
  - Changes from year to year
- Improved sediment information
  - Sediment types and physical processes affecting sediment loads incorporated.
  - Water quality responses to sediment control actions more accurately reflected.
  - Expert quantification of bank loads.
  - Time variable input based on erosion events.

Overview of the Assessment Tools:
Old Modeling Structure

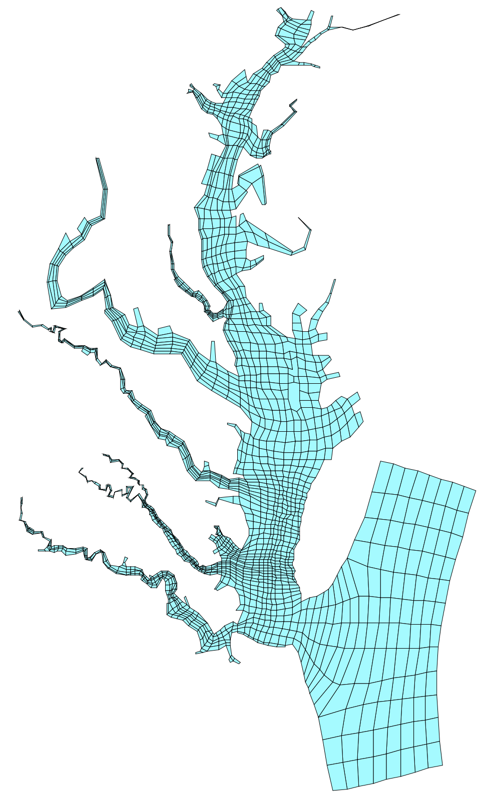


A **Regression Model** of 15 monitoring sites over 10 simulation years.

Changes in air quality management simulated with the **Regional Acid Deposition Model (RADM)** with a domain covering the Eastern states and limited grid capabilities

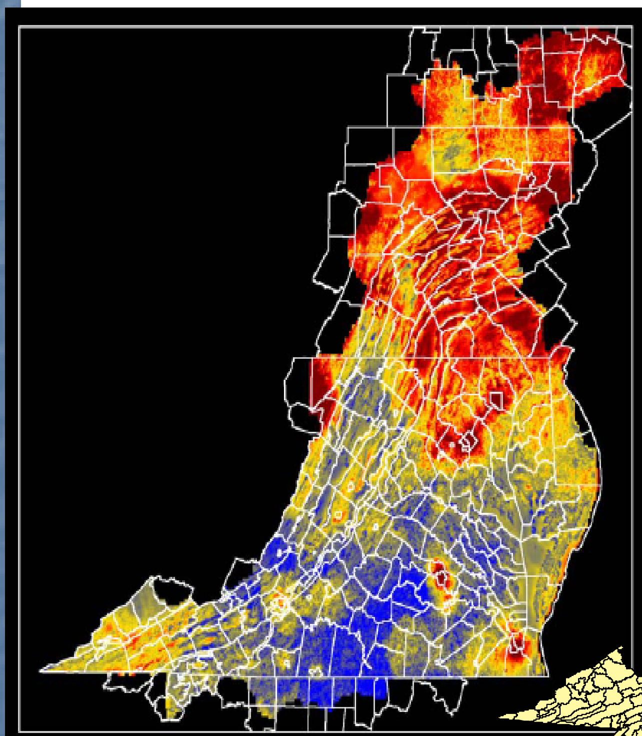


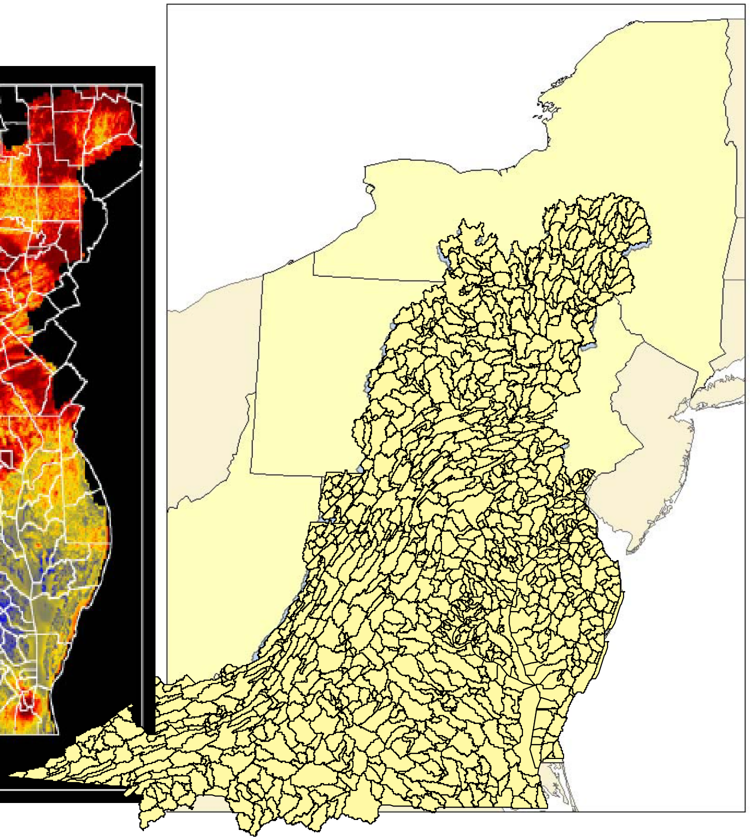
Watershed Model Phase 4.3
94 model segments, 9 land uses, 20 calibration sites, 10 simulation years, fixed annual land use

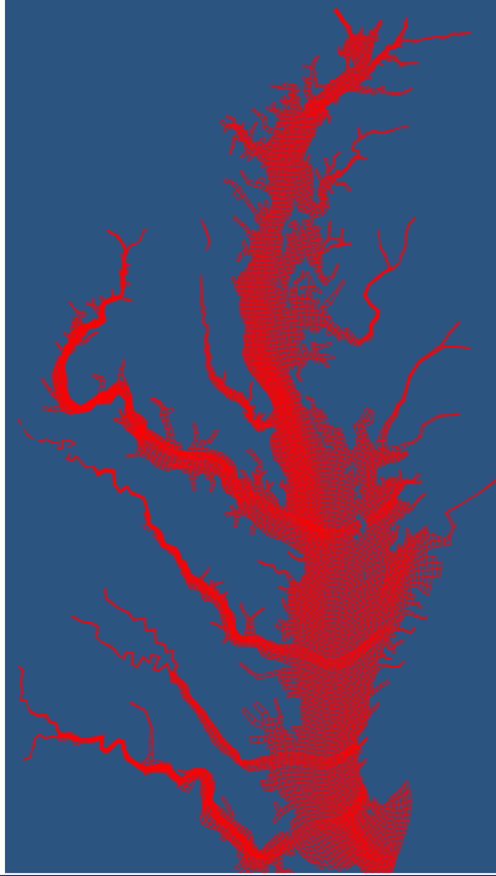


Chesapeake Bay Water Quality Model
Hydrodynamic Model, Sediment Benthic Model, and Submerged Aquatic Vegetation, 10 simulation years, 13,000 model cells

Overview of the Assessment Tools:
New Modeling Structure for TMDL Development





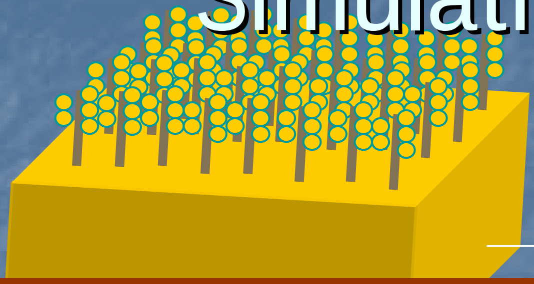


Nitrate and ammonia deposition from improved Daily Nitrate and Ammonium Concentration Models using 35 monitoring stations over 18 simulation years. Adjustments to deposition from Models-3/Community Multi-scale Air Quality (CMAQ) Modeling System

Phase 5 Watershed Model
Year-to-year changes in land use and BMPs; 899 segments; 24 land uses; 296 calibration stations; 18 simulation years; sophisticated calibration procedures; calibration demonstrably better in quality and scale

Chesapeake Bay Estuary Model
Detailed sediment input; Wave model for resuspension, Full sediment transport; Filter feeder simulation; Simulation of Potomac algal blooms; 54,000 model cells; 18 simulation years

The Mechanisms of Sediment Simulation are Improved in Phase 5



Edge of Field

BMP Factor

1. Sediment processes are simulated on the land surface resulting in an Edge-Of-Field sediment load. More land use types are simulated in Phase 5.

2. A time series of Best Management Practices (BMPs) is applied based on available data.

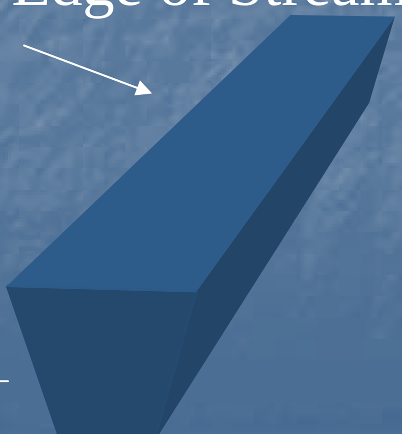
Land Acre Factor

3. A time series of land use acreage factors is applied.

4. A delivery factor based on the land use distance from the stream is applied (see below), resulting in the Edge-Of-Stream load.

Delivery Factor

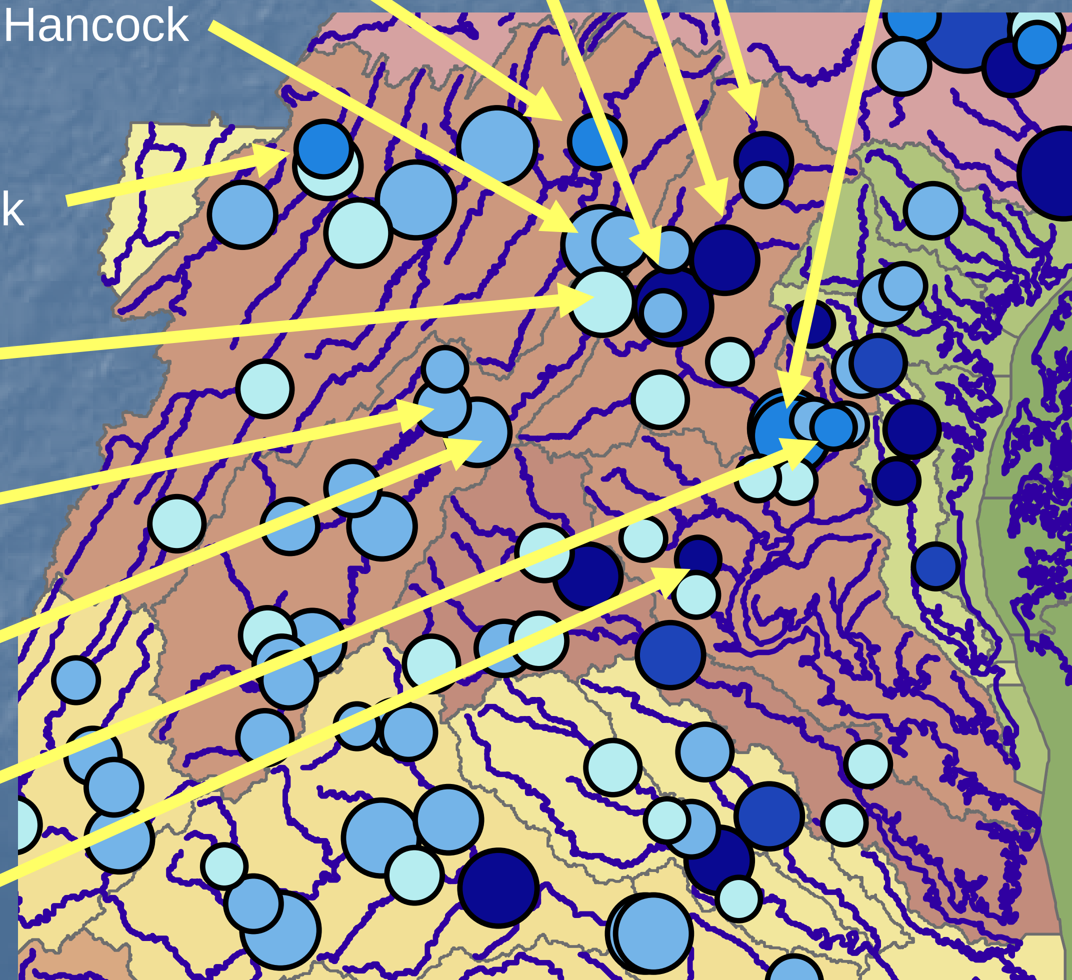
Edge of Stream



5. Processes of deposition and scour are simulated in the stream, resulting in concentrations that can be compared to observations.

In Stream Concentrations

Phase 4.3 had three Potomac calibration stations and none below the fall line. Phase 5 has 41 calibration stations with 13 below the fall line.



The Water Quality/Sediment Transport/Filter Feeder Model, Otherwise Known as the Bay Model, Will Improve Assessments of Tidal Sediment Loads

Bay Model refinements simulating sediment transport will improve assessments of:

- Shore erosion loads.
- Resuspended sediment loads.
- Sediment reductions due to the effect of filter feeders.
- Water Quality/Sediment Transport/Filter Feeder Model refinements contingent on funding.

CMAQ Airshed Model

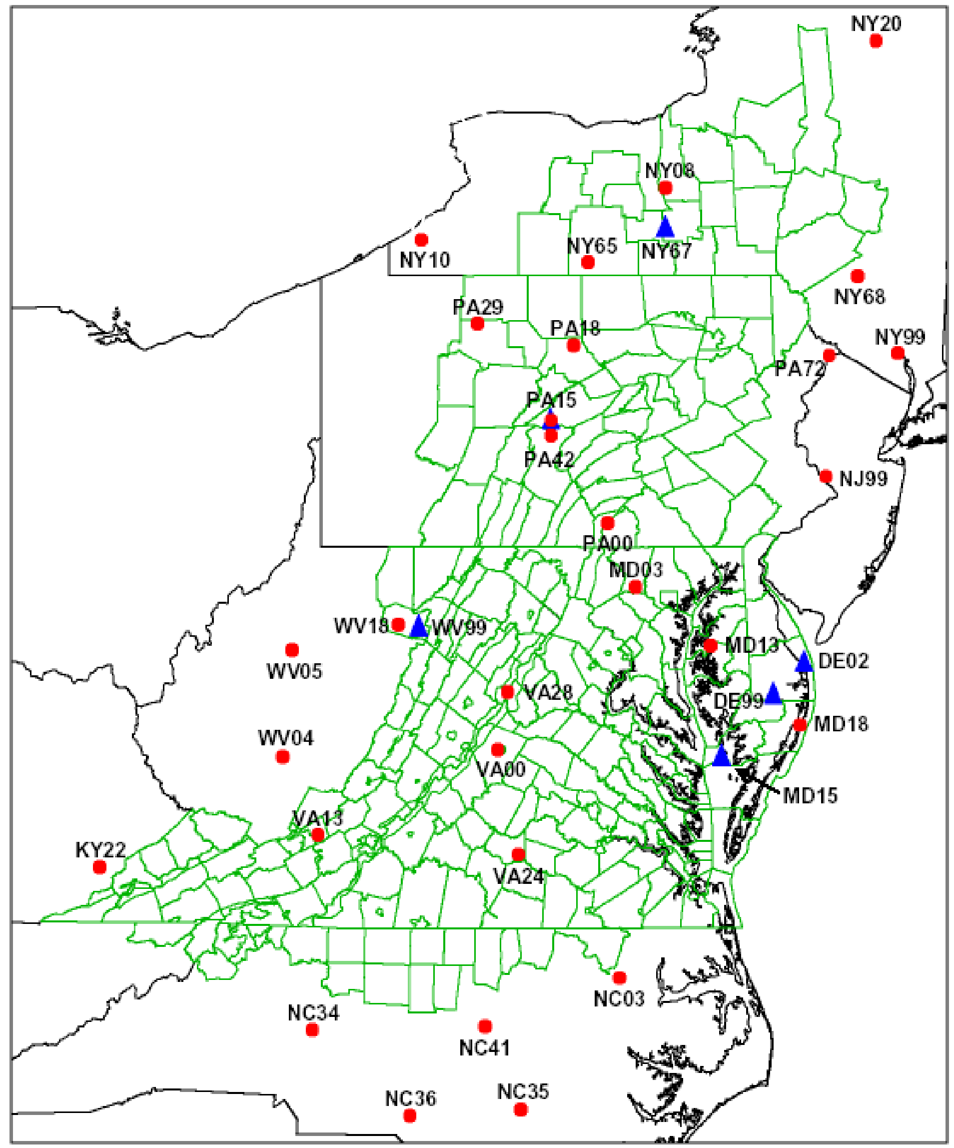
- Replaces Regional Acid Deposition Model (RADM).
- Provides estimates of nitrogen deposition resulting from changes in precursor emissions from utility, mobile, and industrial sources due to management actions or growth.
- Provides estimates of the influence of source loads from one region on deposition in other regions.

How the Atmospheric Deposition Simulation Works

We apply a regression model (J Lynch & J Grimm) to the monitoring station wetfall data to get spatially detailed daily ammonia and nitrate deposition.

For the detailed spatial scales of the Phase 5 we refined spatial and temporal variations in wet deposition.

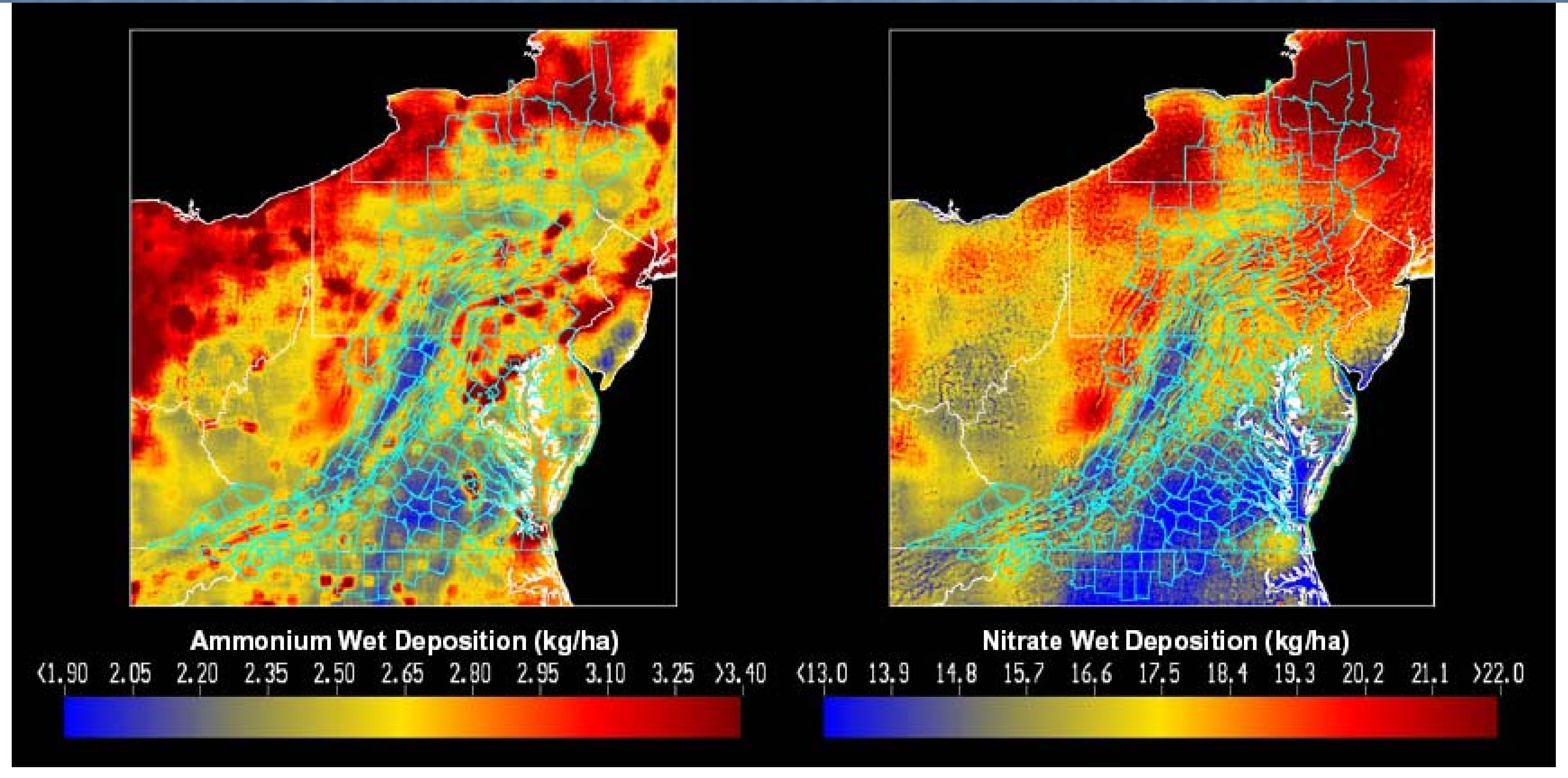
- **<u>Phase 4 Watershed Model</u>**
  - 15 NADP/NTN monitoring stations
  - 1984-1992
- **<u>Phase 5 Watershed Model</u>**
  - 29 NADP/NTN monitoring stations
  - 6 AirMoN monitoring stations
  - 1984-2001



Regression Model Estimated Atmospheric Deposition

NH_4^+ Wet Deposition (kg/ha)
Mean annual (1985-2001)

NO_3^- Wet Deposition (kg/ha)
Mean annual (1985-2001)



Estimates produced by applying daily ammonium and nitrate concentration model to grids of estimated daily precipitation from the National Weather Service Climate Prediction Center's U.S. Daily Precipitation Analyses.

Background and Documentation:

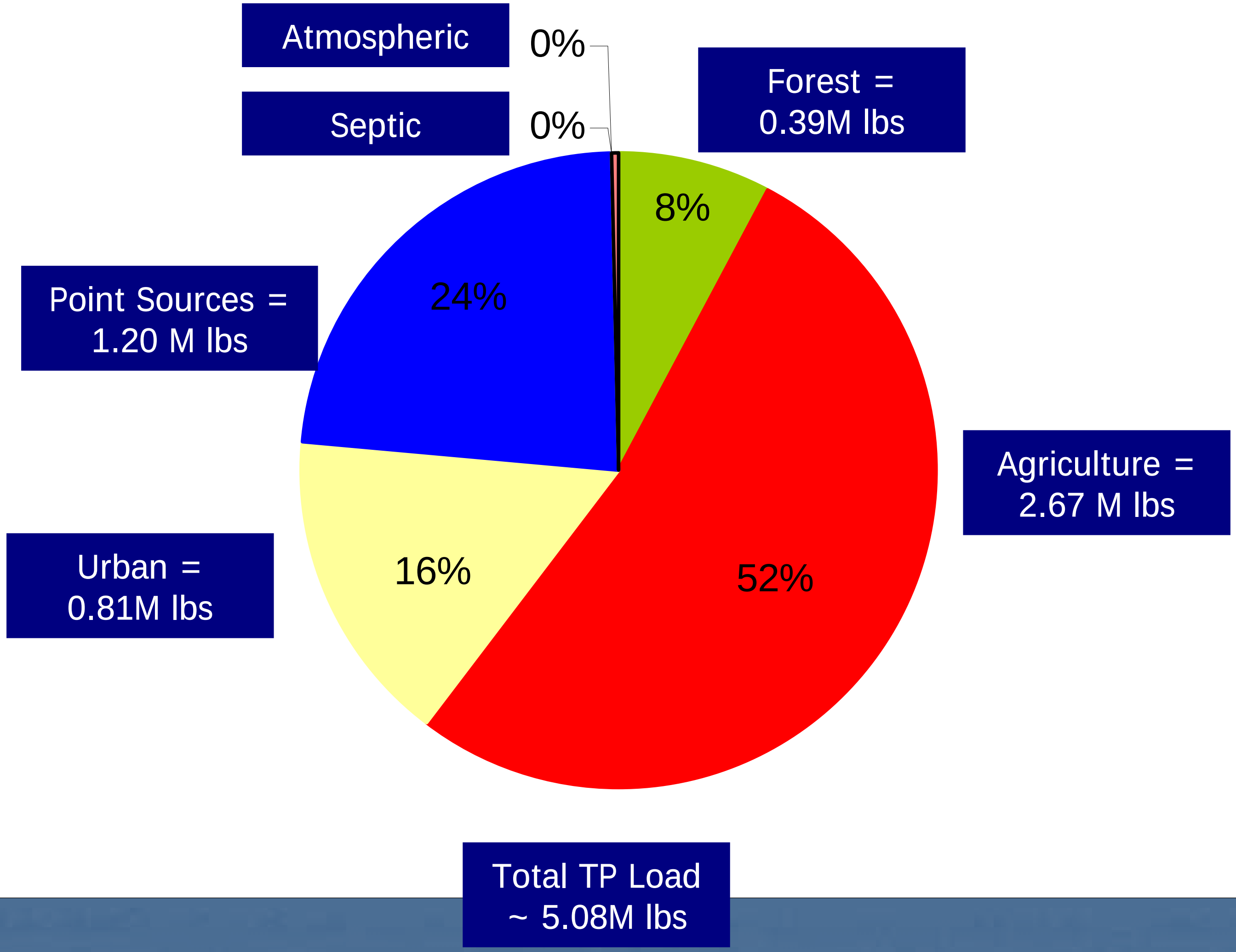
- http://www.chesapeakebay.net/modsc.htm
Under Publications tab is extensive documentation of all CBP models.

- http://www.chesapeakebay.net/modsc.htm
Under Current Projects and Info. tab are links to the community models of the watershed and estuary.

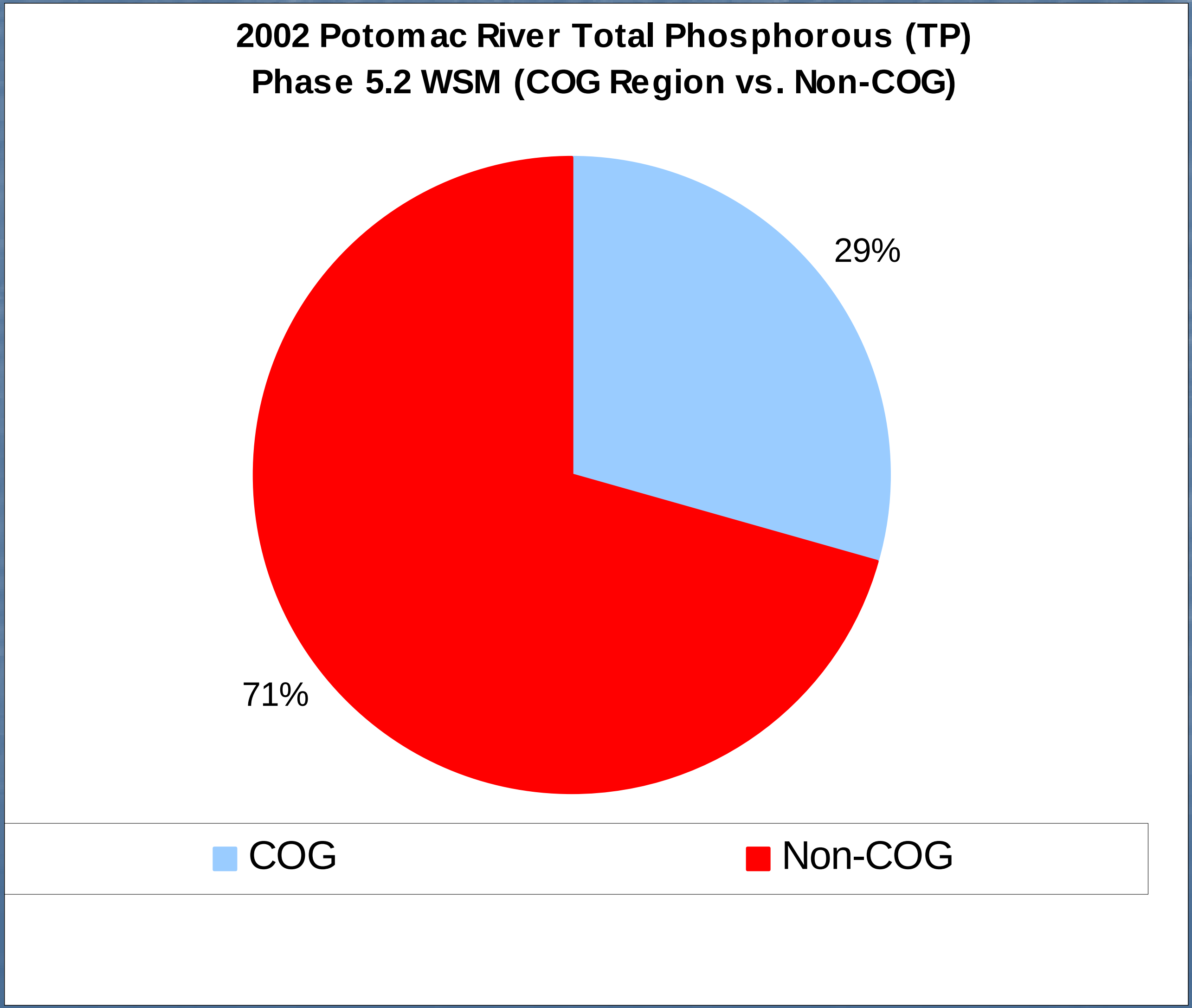
Remaining Schedule

- Phase 5.2 WSM
  - 2008 progress runs available next week.
  - Testing with Scenario Builder through October & November
  - Final Scenario Builder complete in December
  - Calibration complete January 1, 2010
- WQSTM Model
  - Calibration is optimal for Phase 5.2 WSM inputs
  - Pending Phase 5.3 WSM, calibration activities have ceased
  - Focus now is on scenarios

2002 Potomac Total Phosphorous Delivered Load
Phase 5.2 WSM – October 9, 2009



2002 Potomac Total Phosphorous Delivered Load Phase 5.2 WSM – October 9, 2009

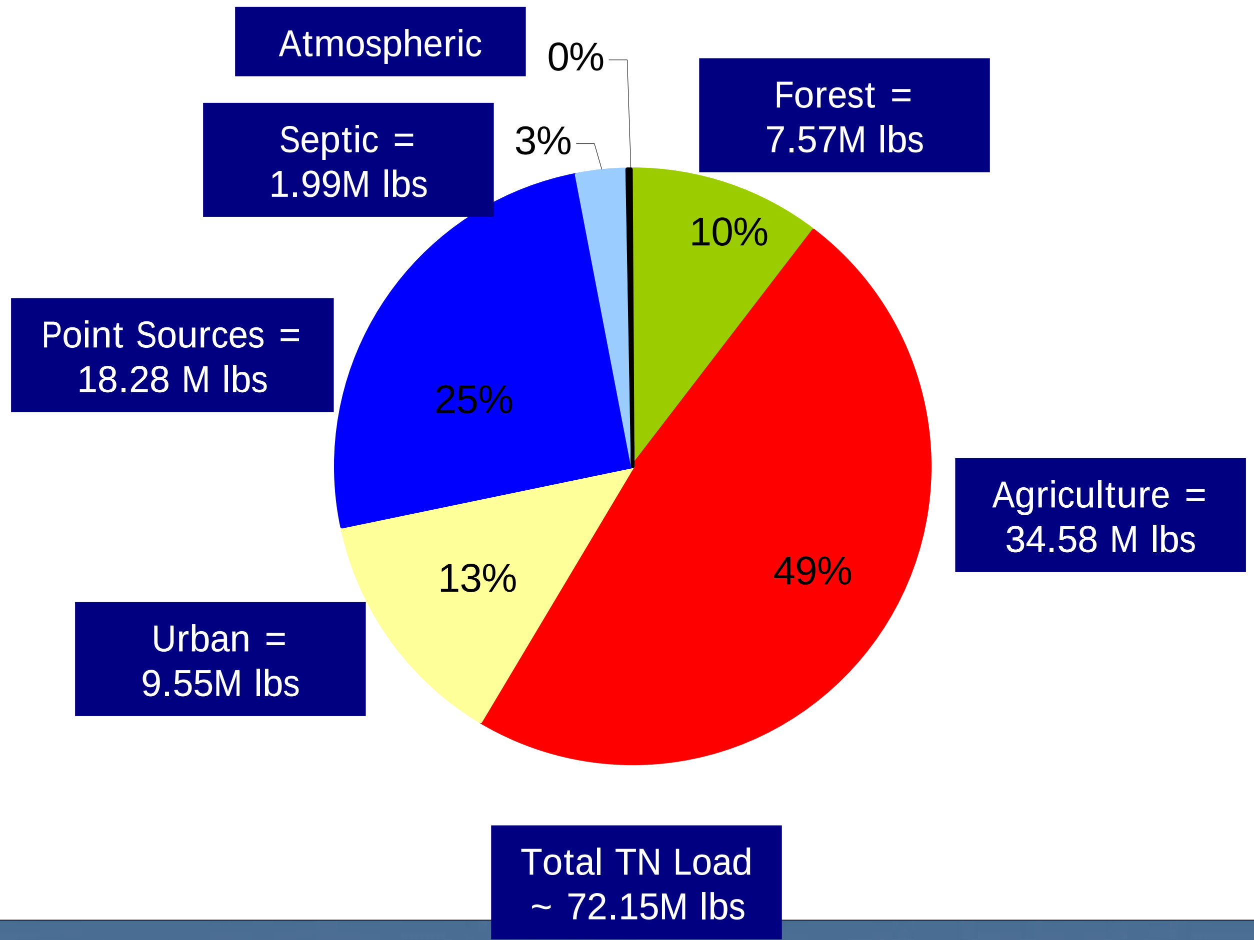


2002 COG Region Jurisdiction DRAFT Total Phosphorous Delivered Load Phase 5.2 WSM – October 9, 2009

(2008 data will be available at November WRTC meeting)

Jurisdiction	County	TP Load	Acre
DC	DISTRICT OF COLUMBIA	518,340	39,101
MD	FREDERICK	169,436	264,583
MD	FREDERICK	58,190	160,948
MD	MONTGOMERY	165,693	280,525
MD	PRINCE GEORGE'S	118,969	151,623
VA	ALEXANDRIA (CITY)	19,308	9,646
VA	ARLINGTON	27,478	16,800
VA	FAIRFAX	147,993	252,813
VA	FAIRFAX (CITY)	3,954	4,050
VA	FALLS CHURCH (CITY)	1,091	1,270
VA	LOUDOUN	185,439	332,838
VA	PRINCE WILLIAM	75601.8	216740
VA	MANASSAS (CITY)	2,777	6,410
VA	MANASSAS PARK (CITY)	712	1,619
Total	COG	1,494,981	1,738,966
Total	Non-COG	3,582,589	7,310,063
Total	All Potomac	5,077,570	9,049,029

2002 Potomac Total Nitrogen Delivered Load Phase 5.2 WSM – October 9, 2009



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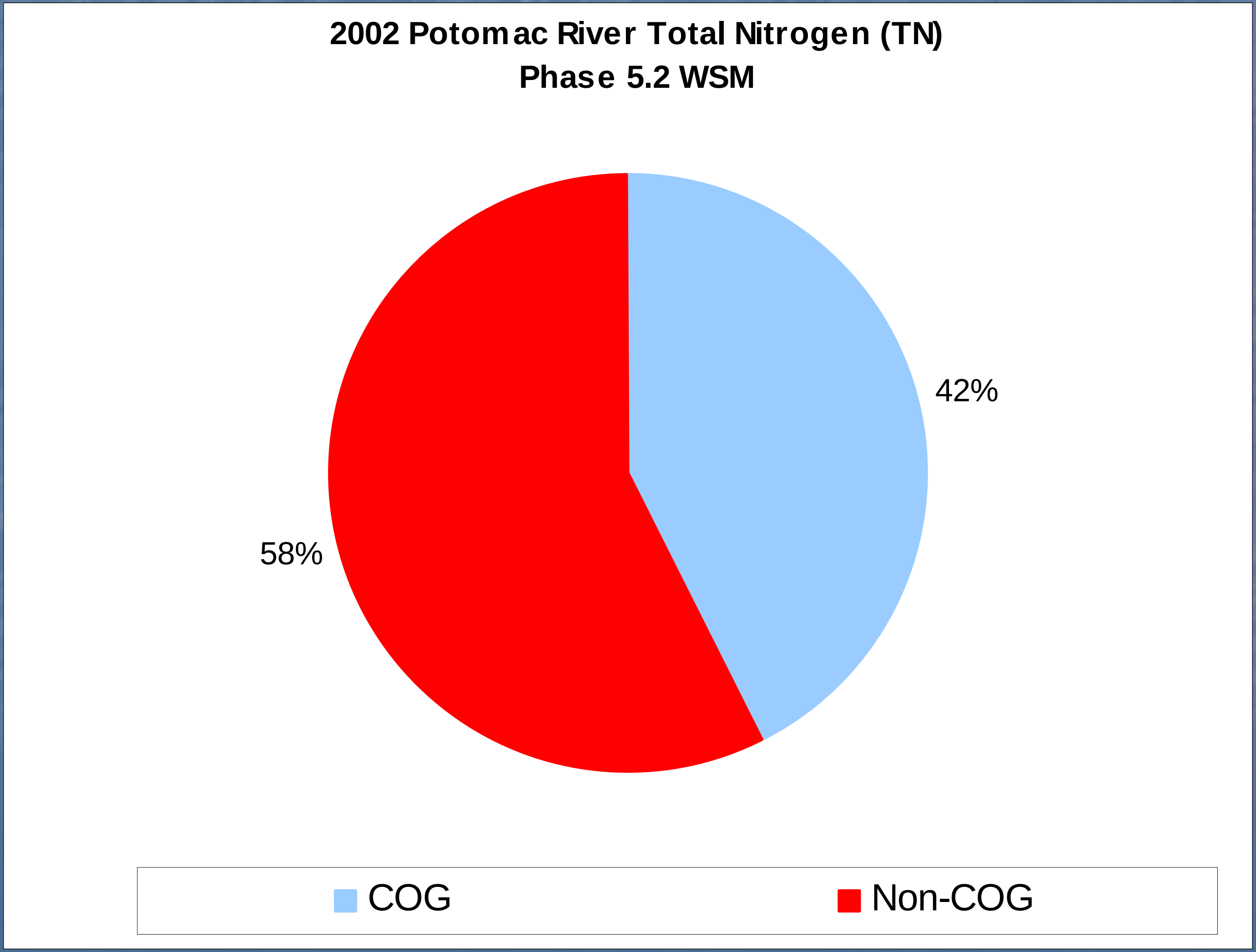

2002 COG Region Jurisdiction <u>DRAFT</u> Total Nitrogen Delivered Load Phase 5.2 WSM – October 9, 2009

Jurisdiction	County	TN Load	Acre
DC	DISTRICT OF COLUMBIA	5,357,068	39,101
MD	FREDERICK	3,826,934	264,583
MD	FREDERICK	1,334,666	160,948
MD	MONTGOMERY	4,648,760	280,525
MD	PRINCE GEORGE'S	2,570,484	151,623
VA	ALEXANDRIA (CITY)	2,784,250	9,646
VA	ARLINGTON	1,119,997	16,800
VA	FAIRFAX	4,542,662	252,813
VA	FAIRFAX (CITY)	26,092	4,050
VA	FALLS CHURCH (CITY)	11,237	1,270
VA	LOUDOUN	3,363,412	332,838
VA	PRINCE WILLIAM	1033193	216740
VA	MANASSAS (CITY)	15,943	6,410
VA	MANASSAS PARK (CITY)	4,064	1,619
Total	COG	30,638,763	1,738,966
Total	Non-COG	41,507,901	7,310,063
Total	All Potomac	72,146,664	9,049,029

Any questions?