Monitoring “201”: Monitoring and the stories it tells

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On behalf of many investigators and partners
Chesapeake Bay Commission
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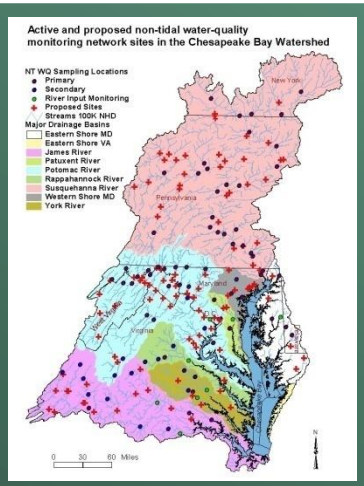
Monitoring: we will discuss…

- How conducted
  - Water-quality emphasis
- Use in Decision Making
  - Assessing progress
  - Effects of practices
- Potential CBC issues
  - Midpoint Assessment

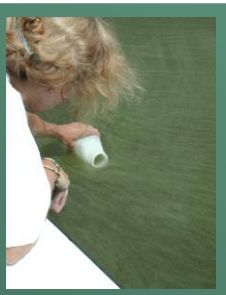
Selected Chesapeake Monitoring Networks



Watershed Monitoring

Shallow Water Habitat

Bay Water Quality Monitoring



Living Resources Monitoring

Watershed Monitoring Network

Are practices reducing nutrients and sediment

MOU signed in 2004

Presently: 117sites

Nutrient and sediment concentration data

Stream flow

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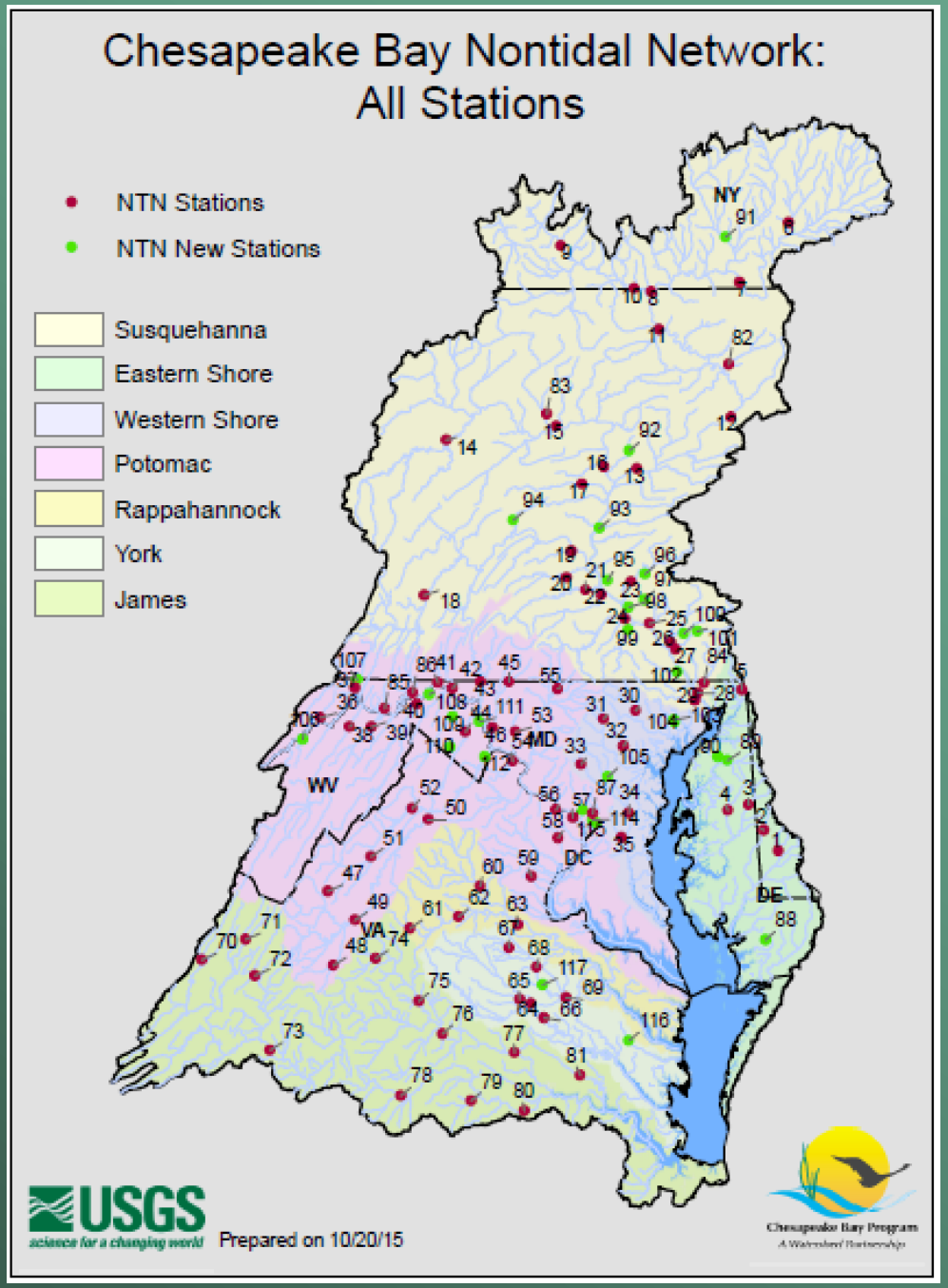

Sample Collection: Wading, Bridges, Cableways

Storms are Important

- Most of the sediment and P delivered
- More intense collection

Rappahannock River @ Fredricksburg, VA

Automatic and Continuous Samples

Sample Processing and Laboratory Analysis

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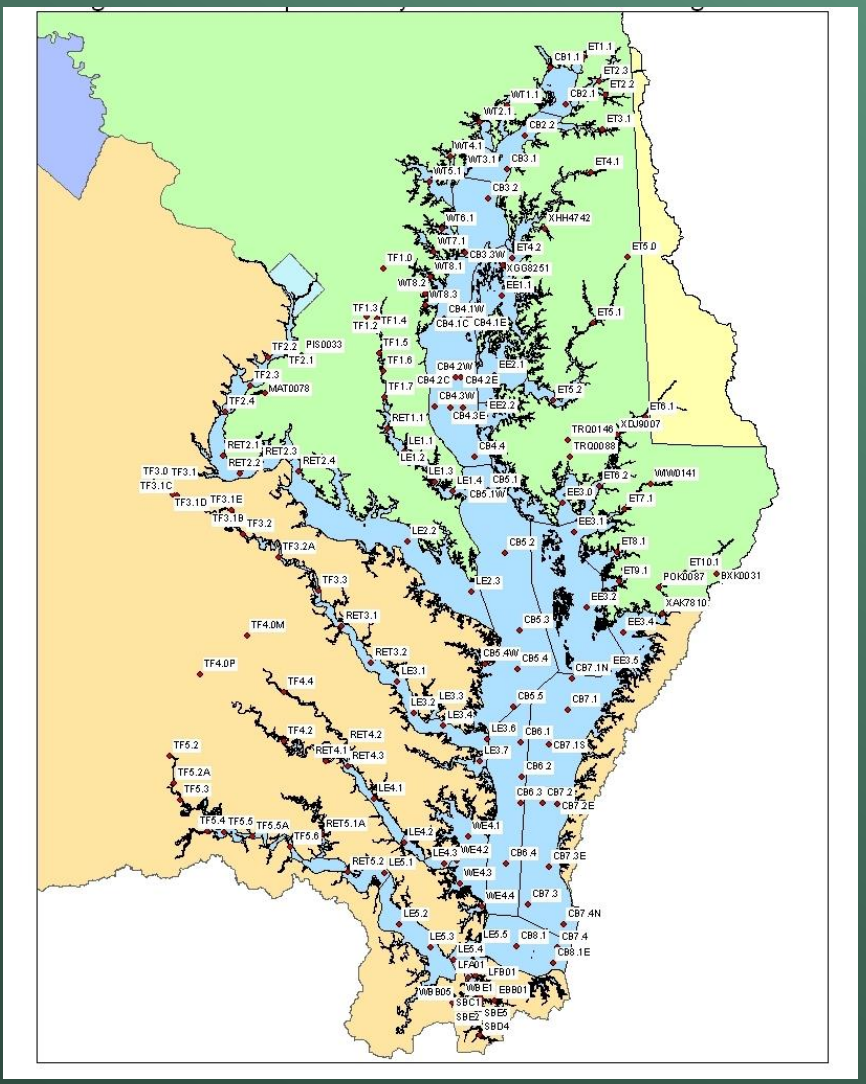
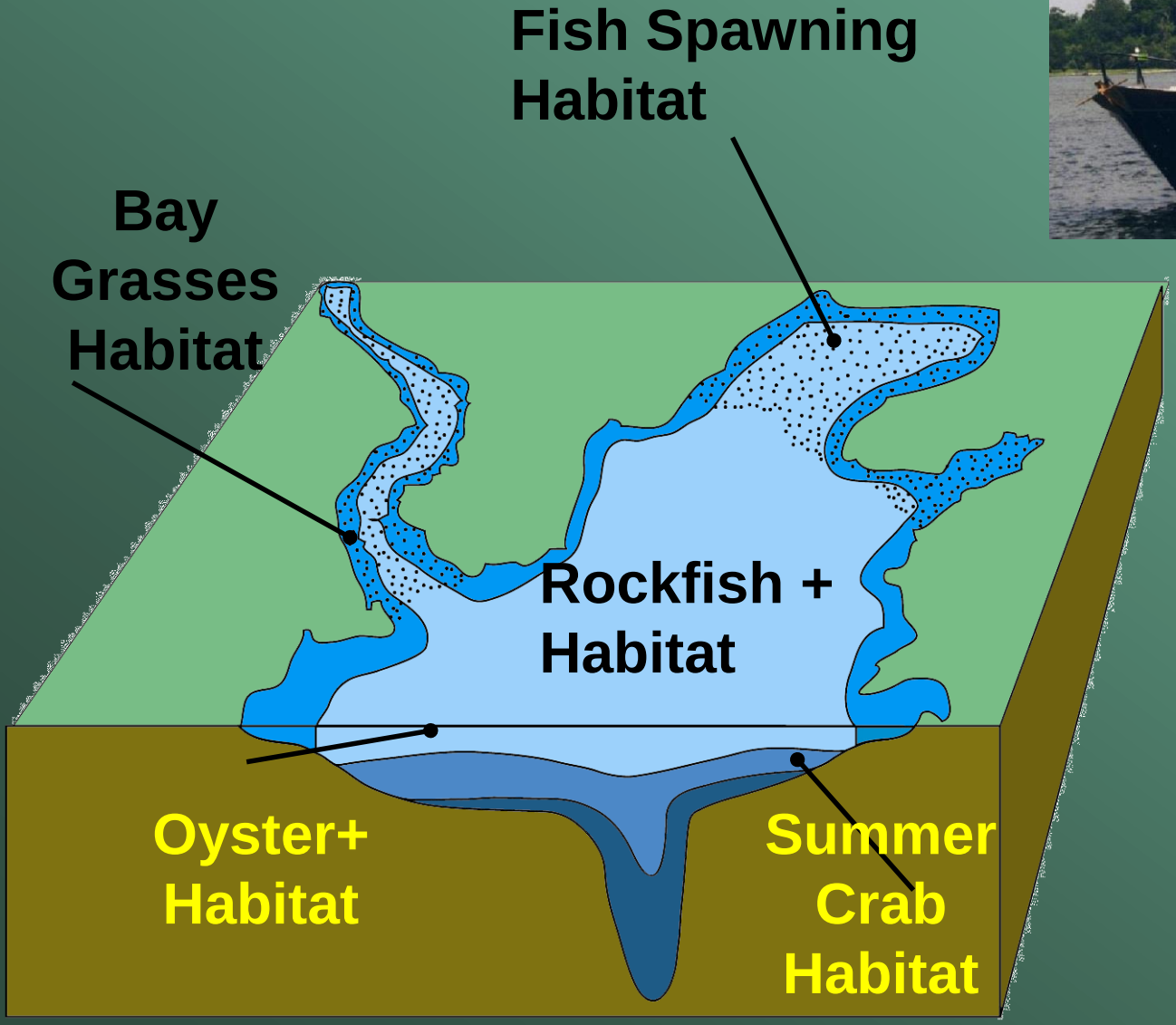
Tidal Water Quality Monitoring Program



- Main Bay and tidal waters
  - 161 sites
  - Biweekly to monthly
  - 26 parameters
  - 1985-present
- Provides:
  - Attainment of standards
  - Conditions for fish and SAV

Sample collection



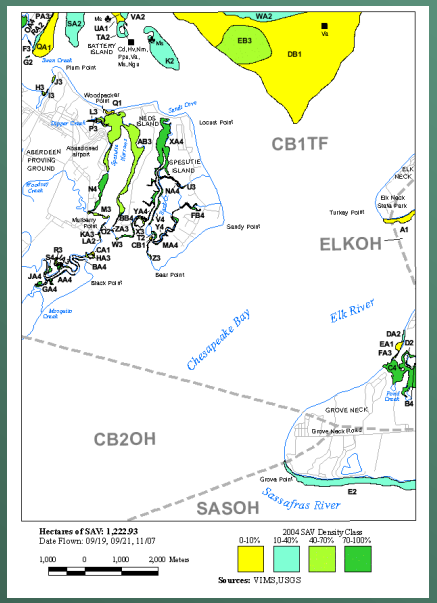
Continuous Monitoring

- CBIBS
  - NOAA “smart buoys”
  - 10 locations
  - Update observations every 10 minutes.
  - Captain John Smith National Historic Trail.
- MD and VA shallow water
- Habitat and fishery conditions

Submerged Aquatic Vegetation

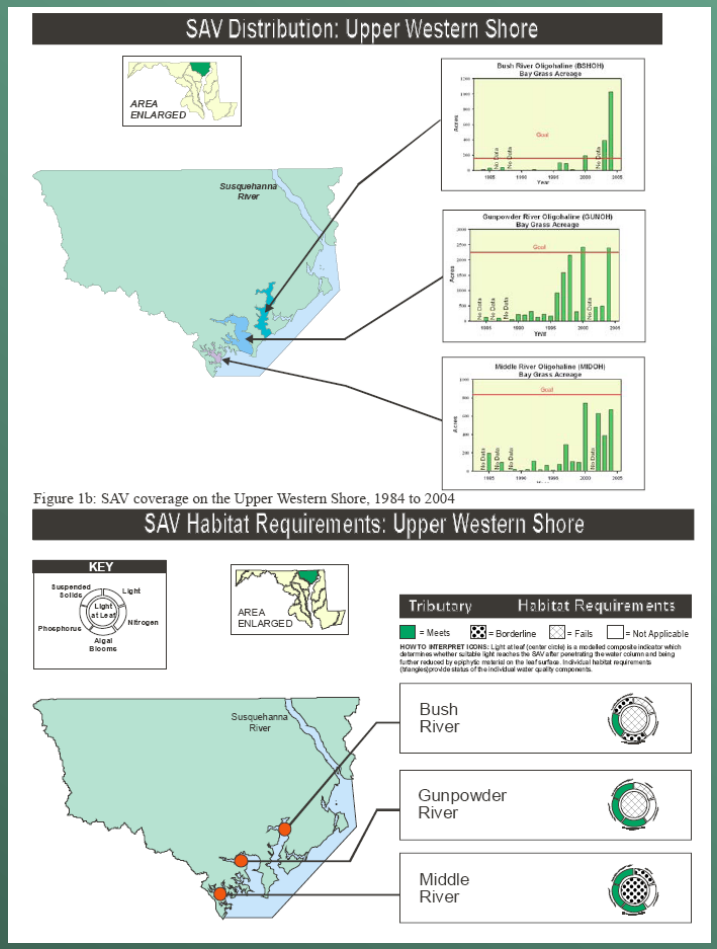
Aerial mapping

Field sampling



GIS coverage mapping of SAV beds

91,000 acres in 2015



Quality Takes Time and Effort

- Chesapeake Bay Program requirements
  - Field protocols
  - Laboratory methods
  - Data examination
  - Quality control checks
  - Stored in databases
  - 3-6 months
- Data finally ready to use!

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What we will discuss

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- Use in Decision Making
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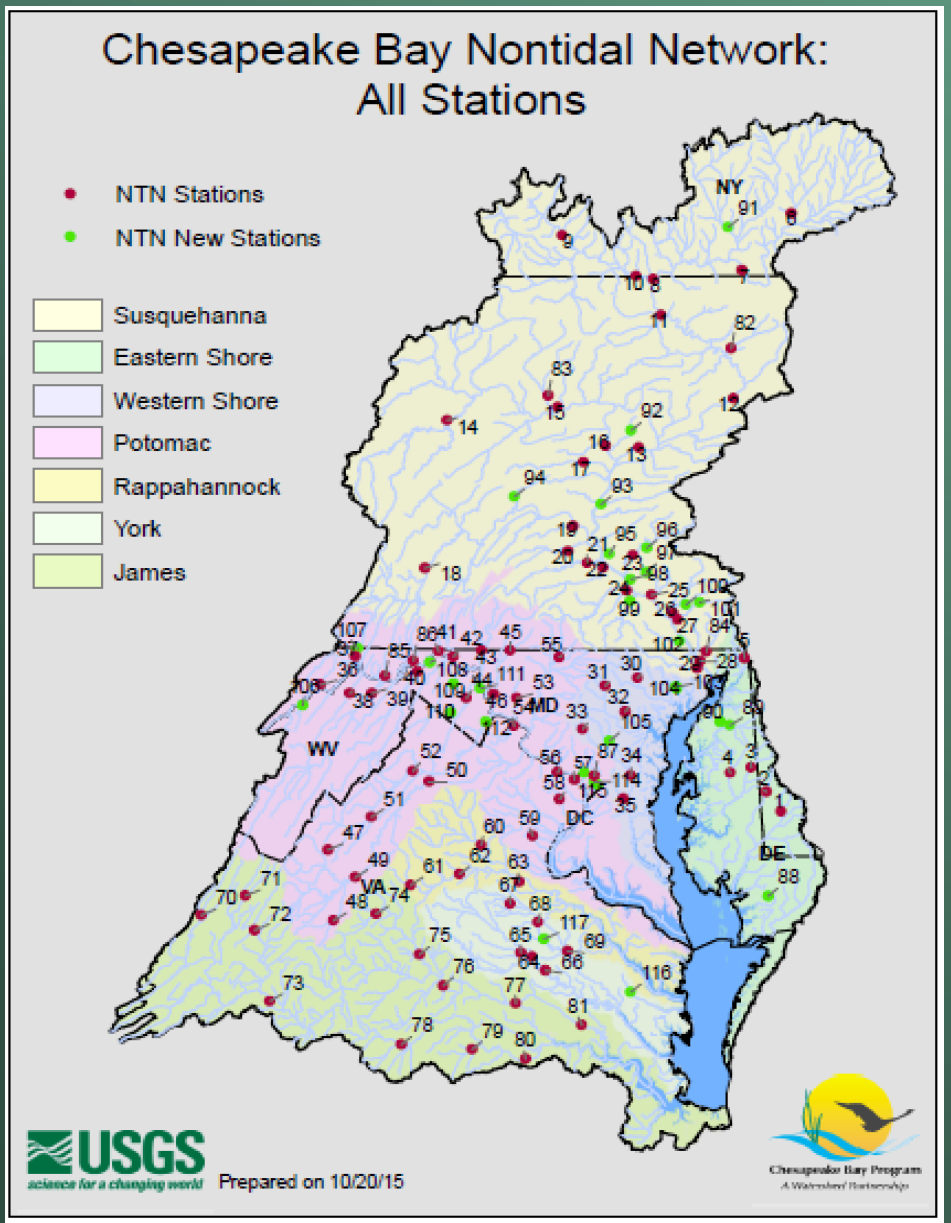
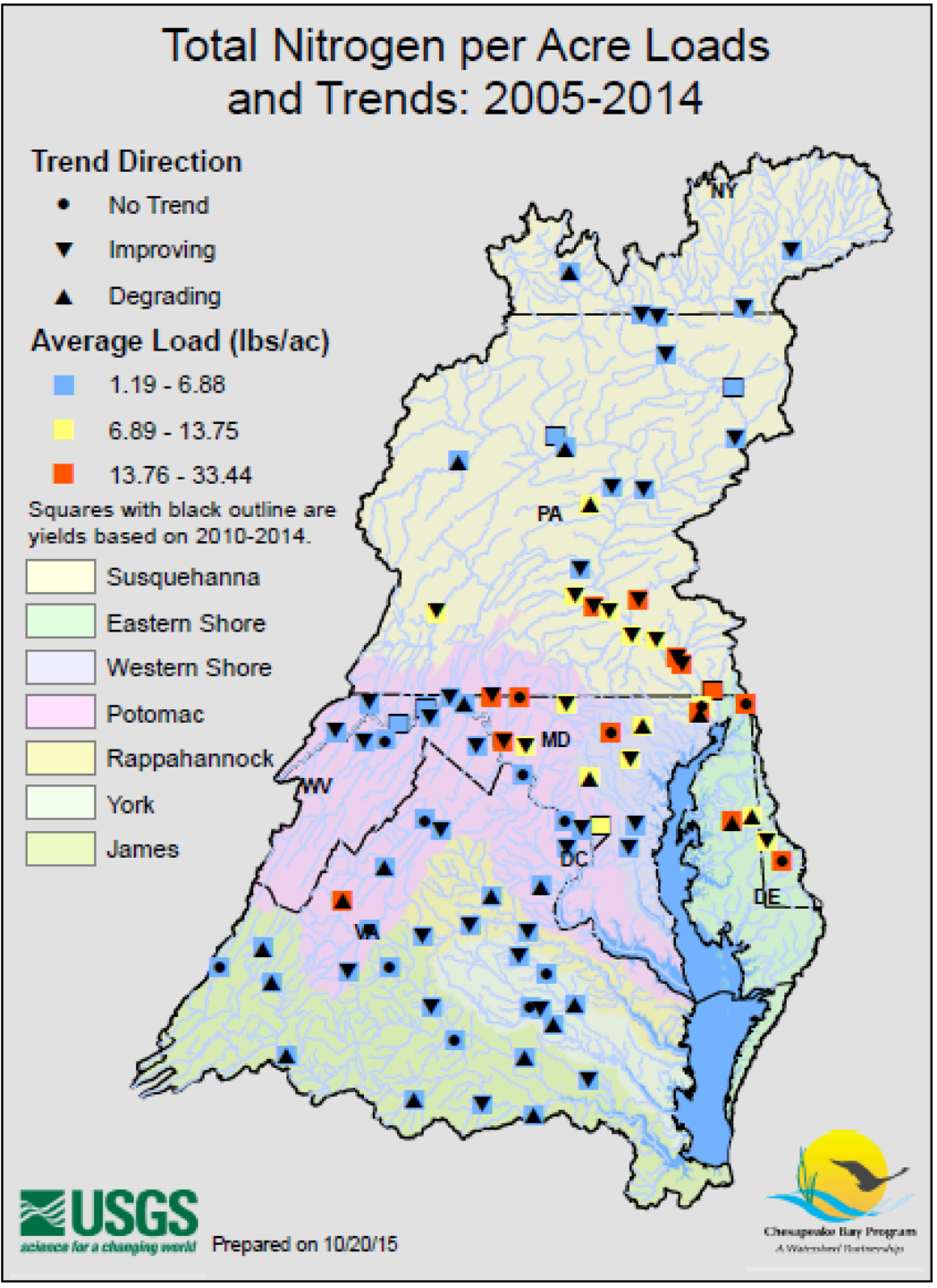
  - Effects of practices
- Potential CBC issues
  - Midpoint Assessment

Assess water-quality progress



- Practices
  - Model projections
- Watershed
  - Nutrients and sediment
- Tidal waters
  - DO, Clarity, and Chl
  - Standards
- Inform WIPs

Source: USGS, 2016



Nitrogen

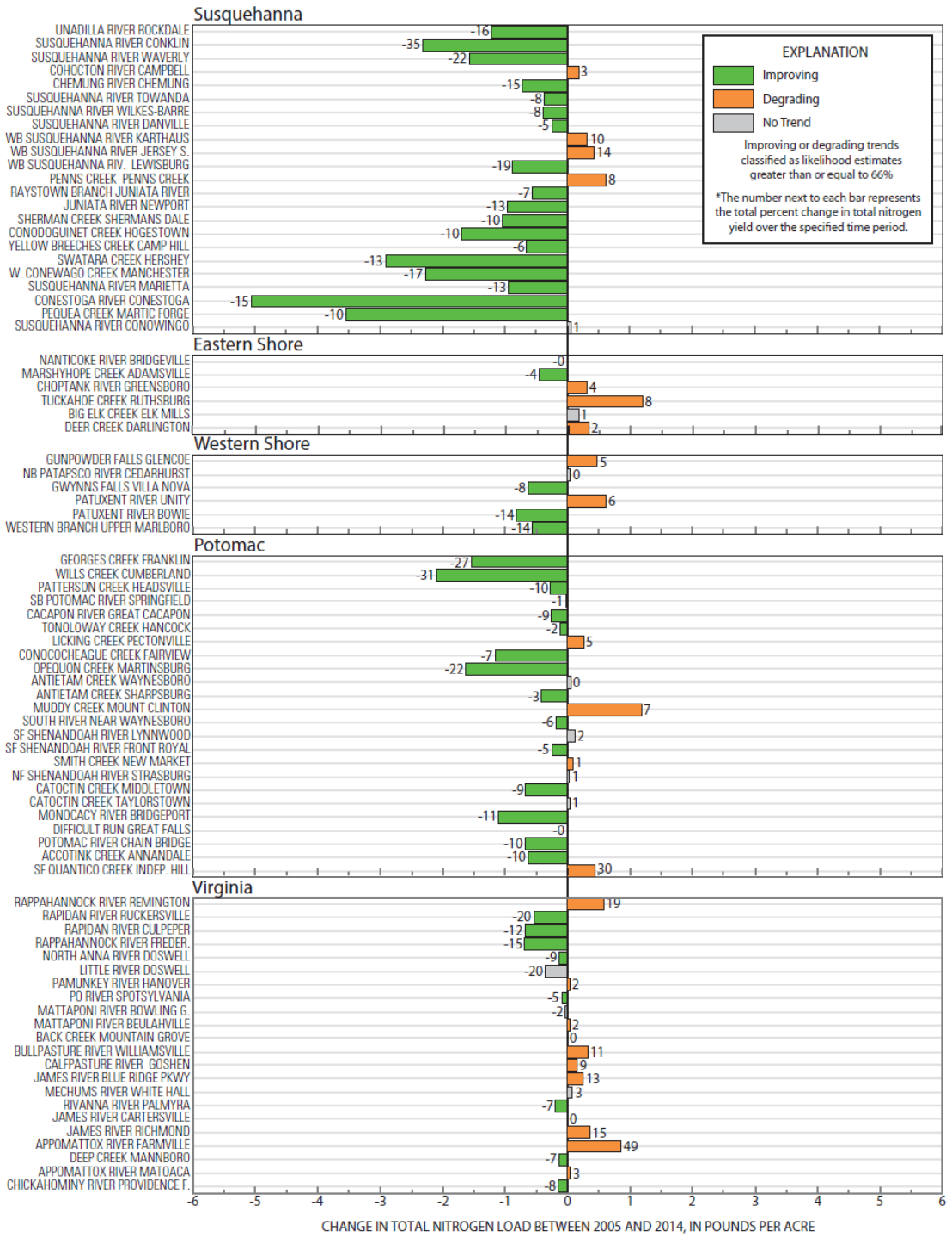
River loads

- Large range
- Lbs per acre

Influenced by:

- Land use
- Practices

Source: USGS, 2016



Nitrogen Change (2005-2014)

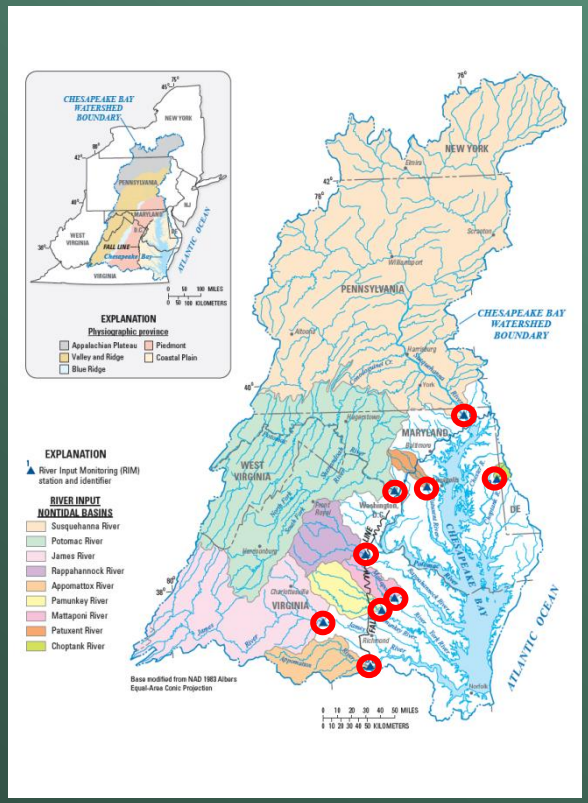
-Trends

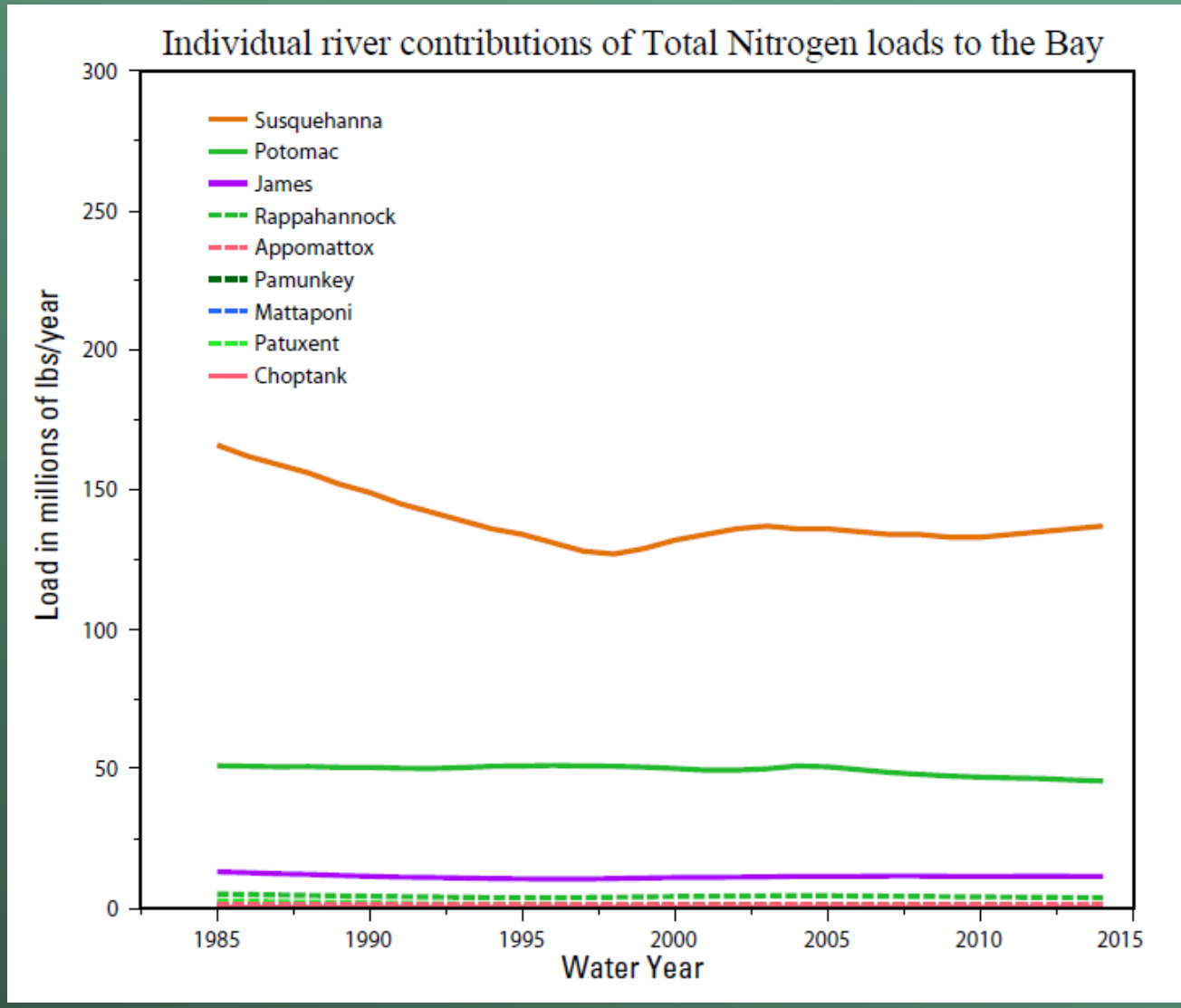
- Improving:54%
- Degrading:27%
- No Trend: 19%

-Factors

- Agriculture
- Urban lands
- WWTP
- Atmospheric
- Practices

Changes in nitrogen to the tidal waters





Source: USGS, 2016

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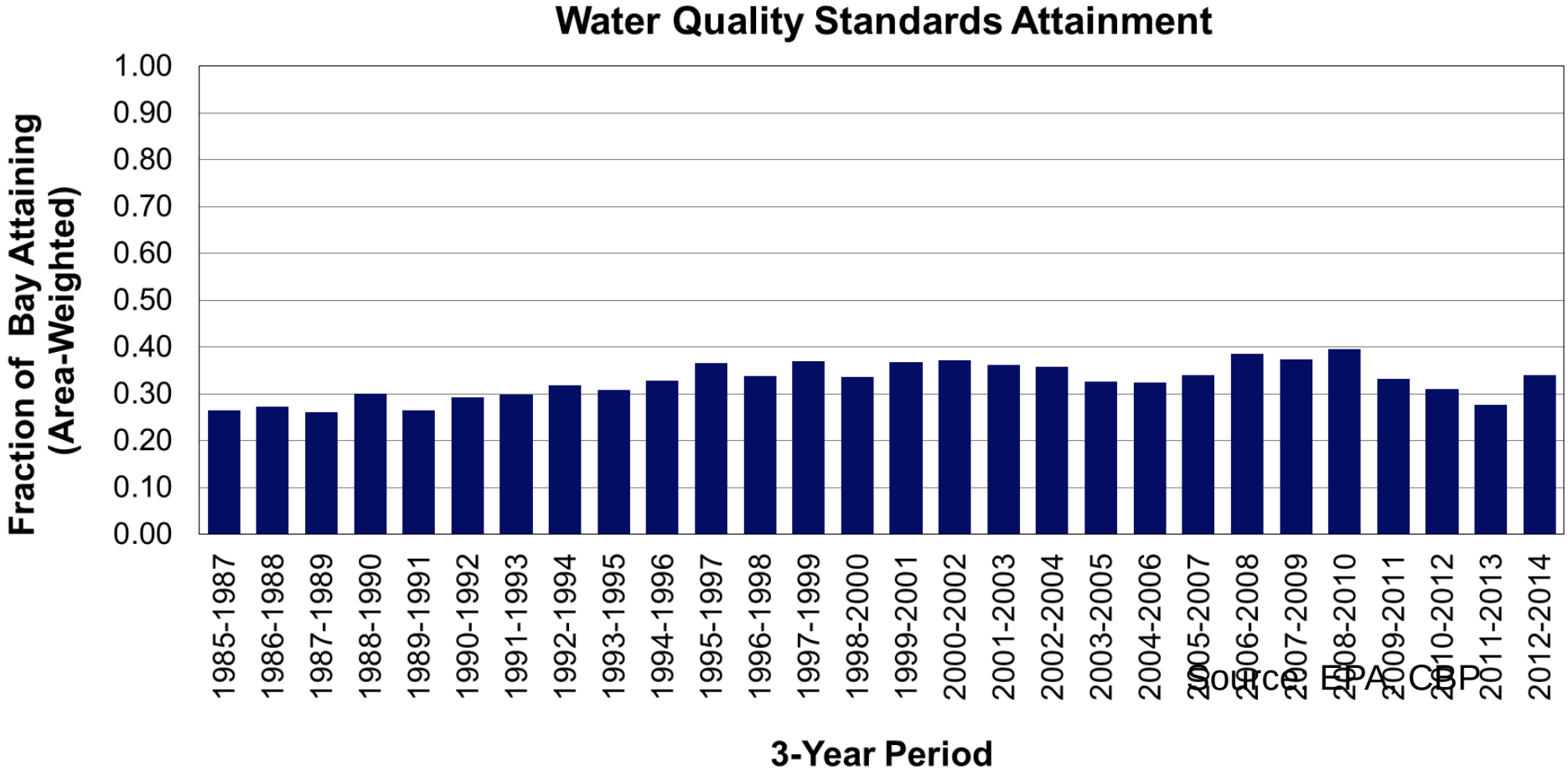
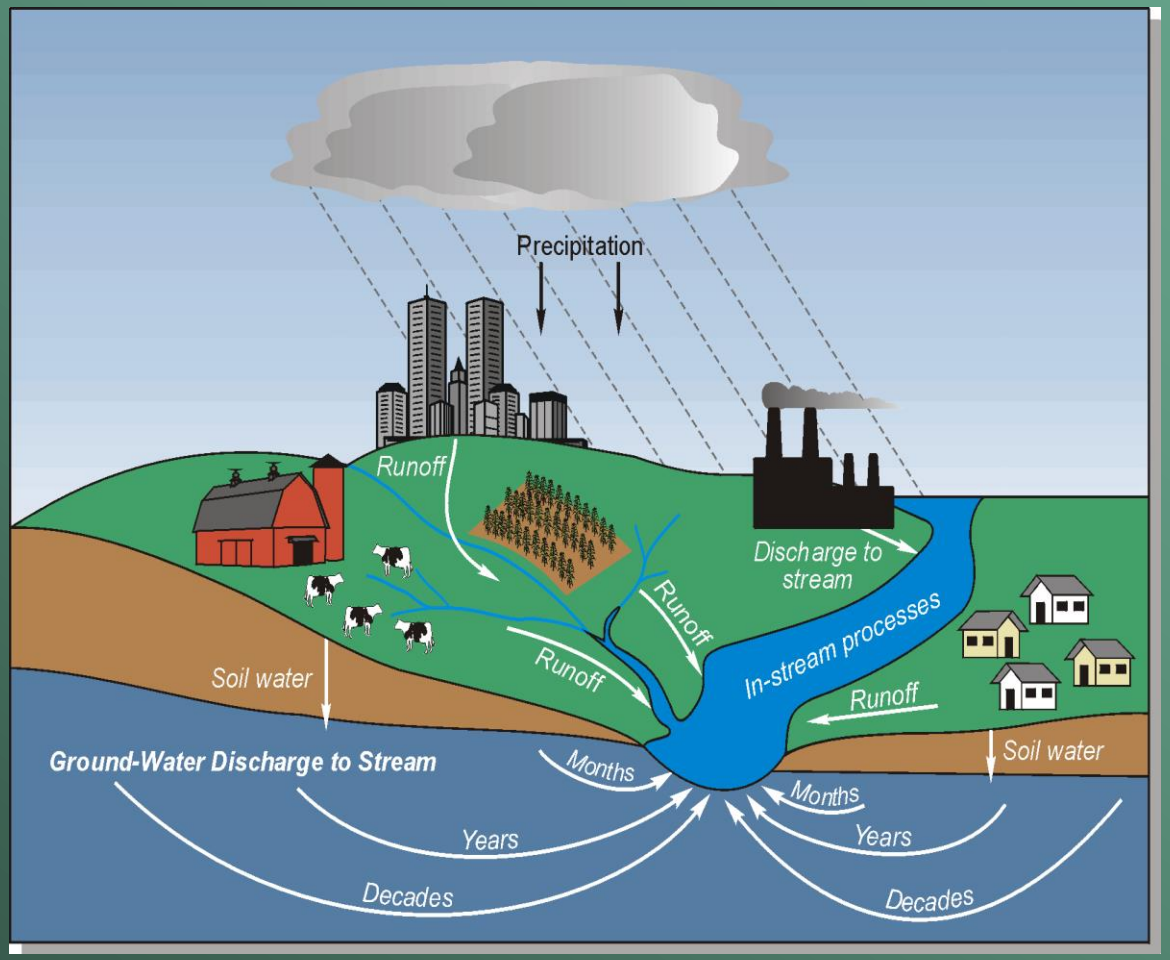
30-40% of tidal waters in attainment



Explain Water-Quality Changes

- Practices to water quality
- Sources and land use
- Management practices
- Water monitoring
- Smaller areas



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Monitoring and Restoration Efforts

- 40 case studies
- Lessons under three broad categories:

1. **What Works**
2. **Challenges**
3. **What We Need**

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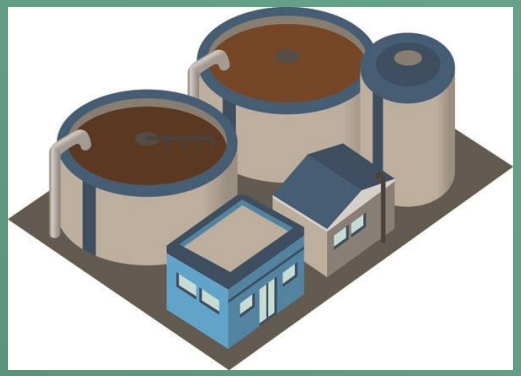
Explaining Trends

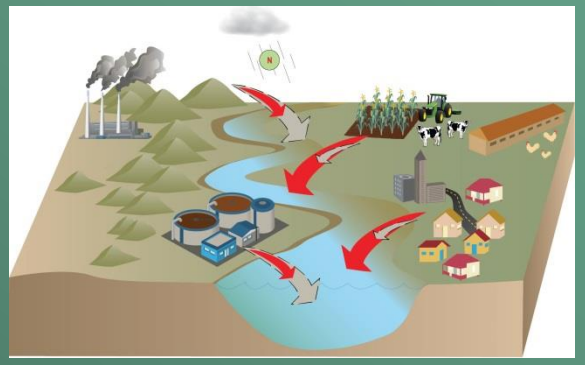
What Works

- Upgrades to WWTPs
- Reductions in air emissions
- Some agricultural practices



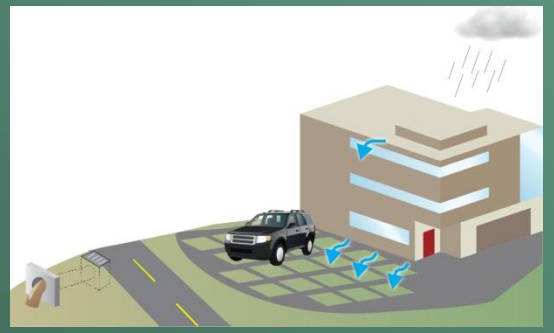
Challenges

- Response times
- Development and intensified agriculture



What We Need

- Location should guide efforts
- Stormwater management and monitoring



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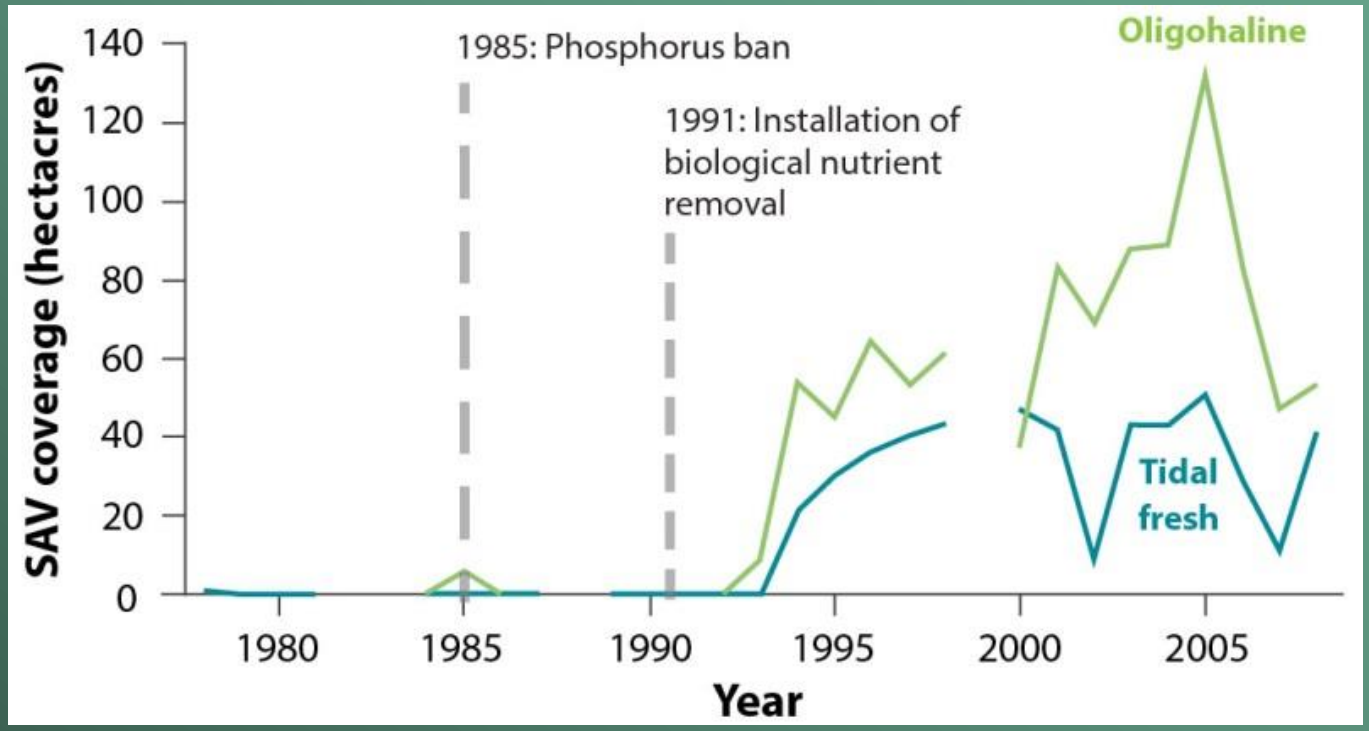
UMCES, USGS, EPA (2014)

Lesson 1: WWTP need to have both P and N upgrades

-Reduced loads to the Upper Patuxent River

-Resurgence of submerged aquatic vegetation



Changes in submerged aquatic vegetation (SAV) (1978–2008)

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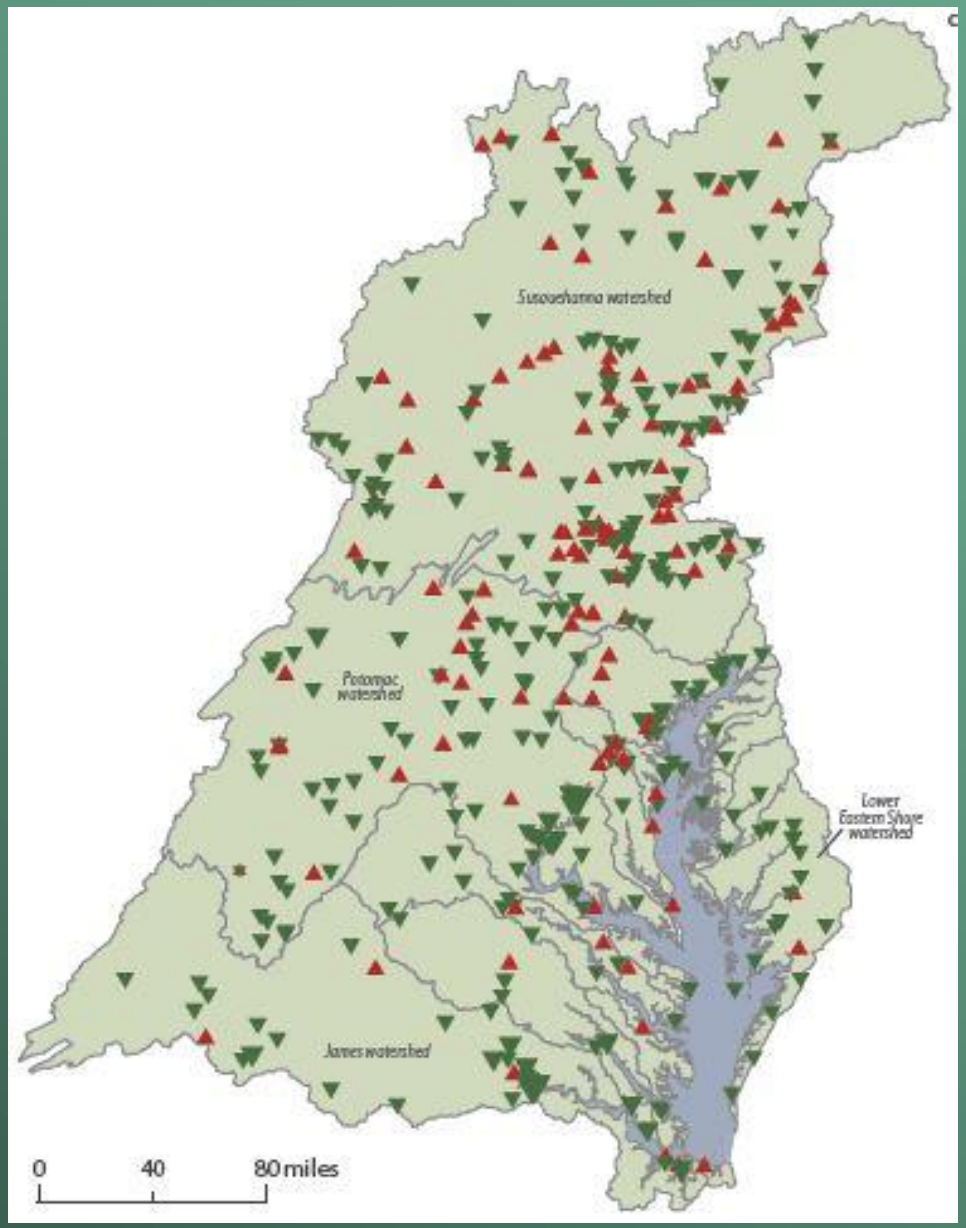
Data from Testa et al., 2008,
Data from Boynton et al., 2008

WWTP Upgrades: Improvements and challenges

- Potomac River
  - Blue Plains (DC)
  - Fairfax County
  - Mattawomen Creek
- Challenges:
  - Increasing population
  - Costs
  - Only 20% of load



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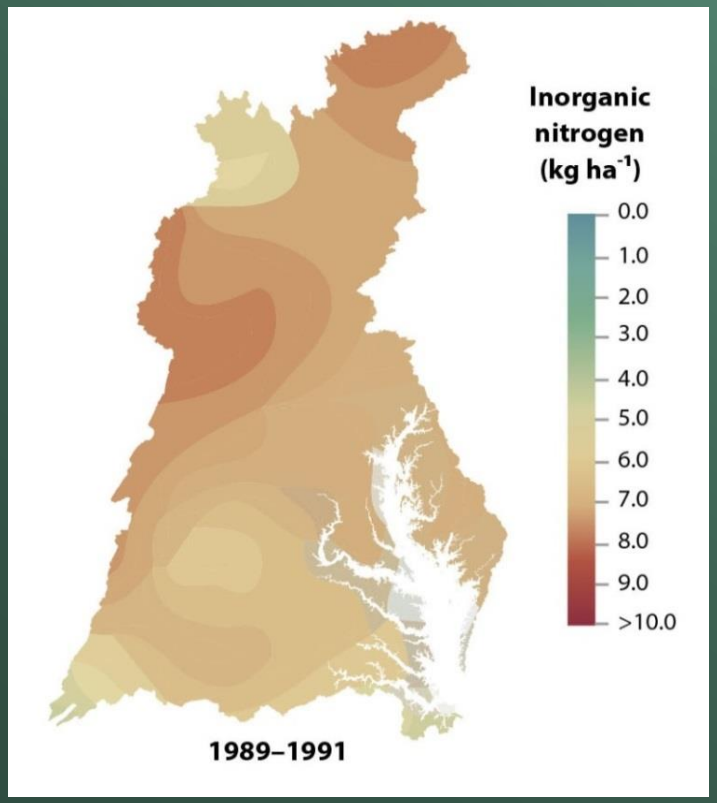
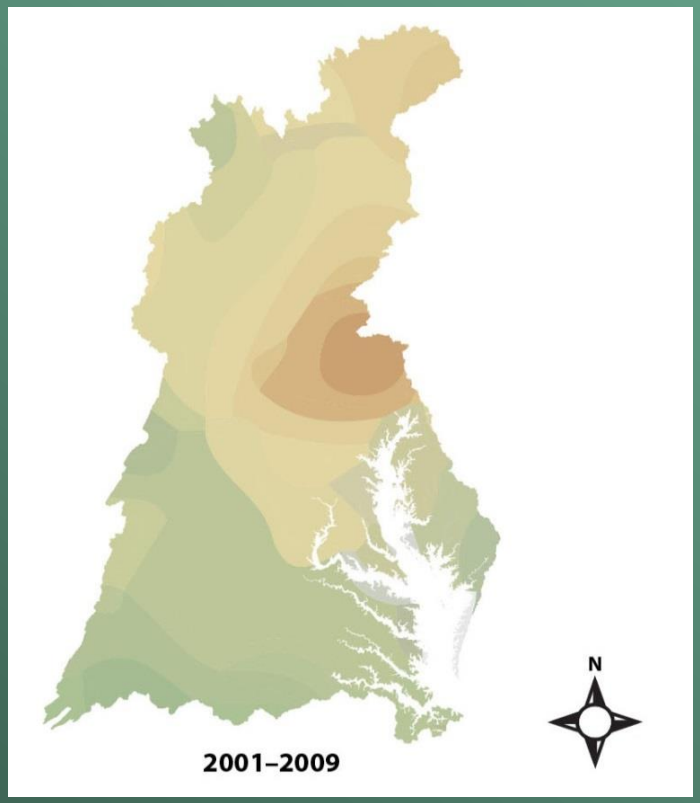
2: Nitrate reductions in air emissions

- Sources: power plants, vehicles, and manure
- Power plant controls lead to reductions in atmospheric nitrogen deposition

Annual mean wet inorganic nitrogen deposition





US EPA Clean Air Markets: 2009 Results

Lesson 3: Some agricultural practices

- Reductions of agricultural nutrient sources result in improved local stream quality

Cover crops

Livestock exclusion

Fertilizer management

Photo © top left: Nicholas Tonelli, Flickr; top right: Jeff Vanuga, USDA NRCS; bottom: USDA.

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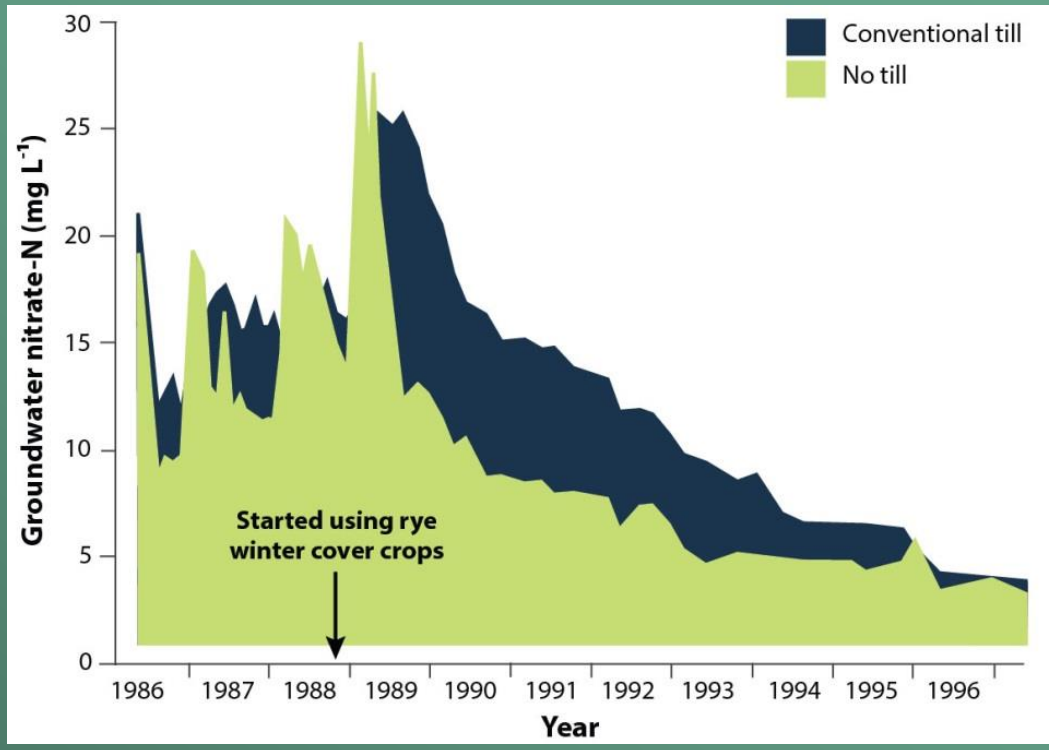
Agricultural practices

- Cover Crops
- Manure and fertilizer
- Stream bank fencing



Poultry litter is a source of nutrients that can negatively affect water quality by entering streams, rivers, and the Bay through runoff and groundwater. Photo © Chesapeake Bay Program.

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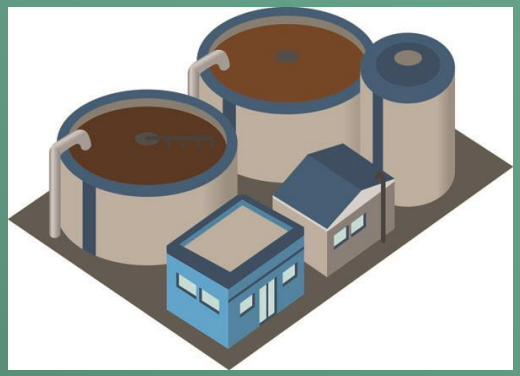
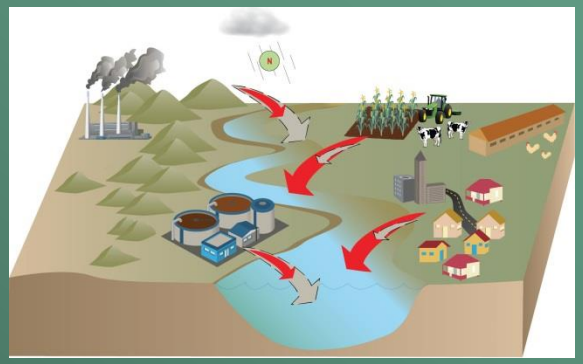
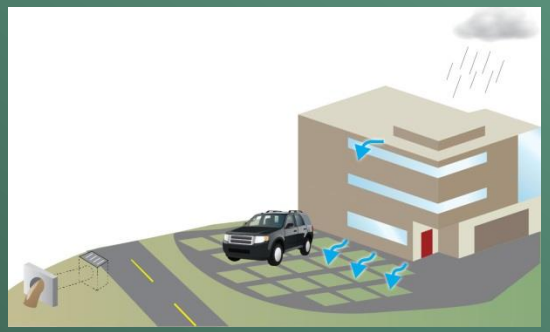
What Did We Learn?

1. What Works
   - Upgrades to WWTPs
   - Reductions in air emissions
   - Some agricultural practices
2. **Challenges**
   - Response times
   - Population growth
3. What We Need
   - Location should guide restoration efforts
   - Stormwater management and monitoring







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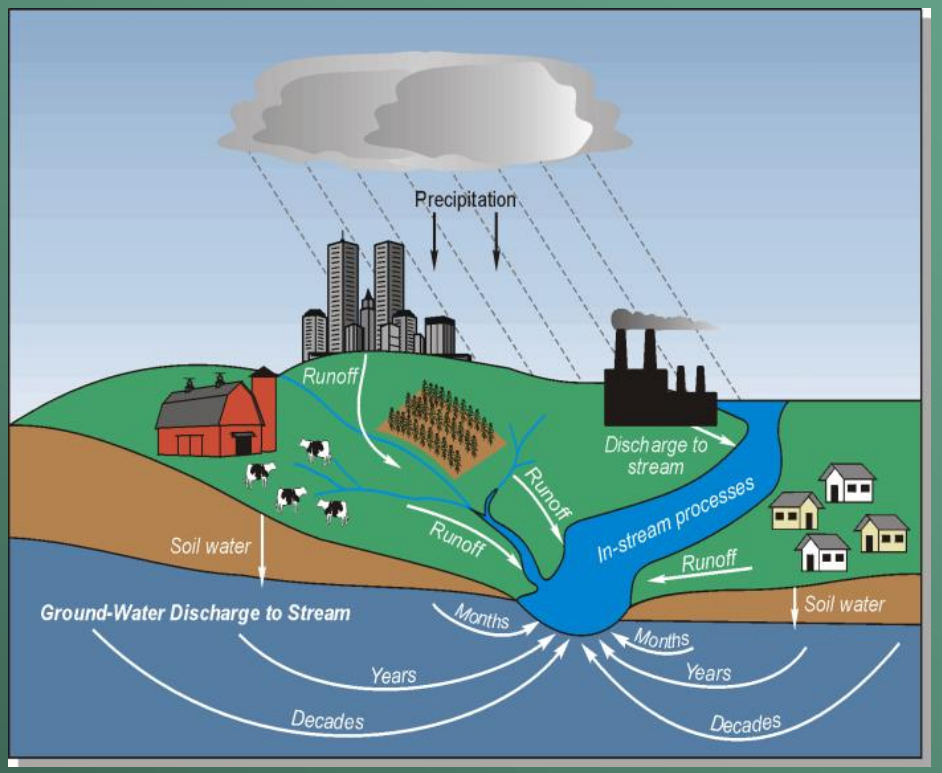
Challenges

Lesson 4: Response Times

- "Lag time"
- Many practices provide initial water-quality improvements
- Full benefits to stream conditions can be delayed
  - Groundwater
  - Phosphorus storage
  - Sediment movement
  - BMP effectiveness
- Response times vary



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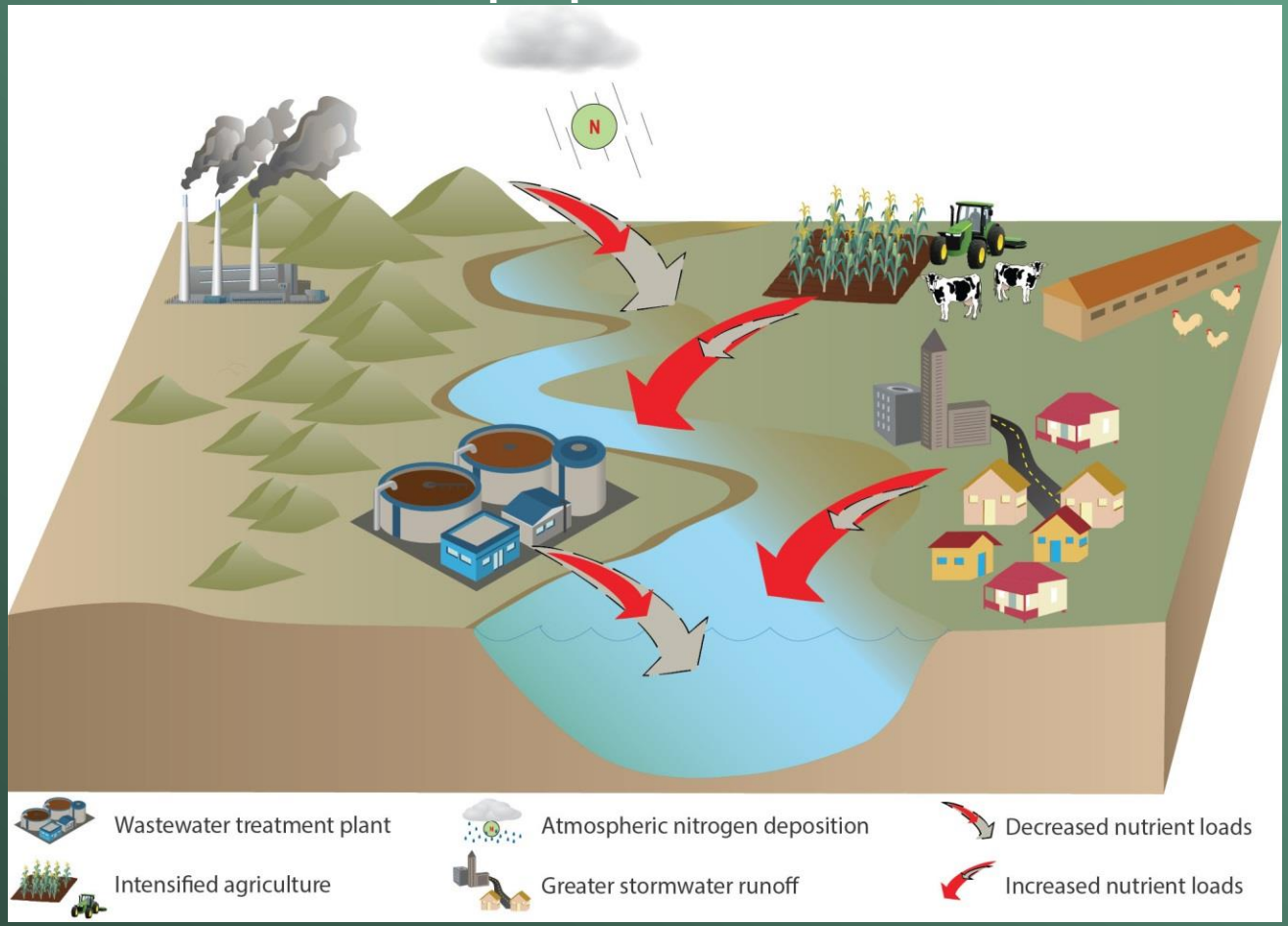
Phillips and Lindsey, 2003

Lesson 5: Population growth

- Improvements in water quality can be counteracted:
  - Human and animal populations



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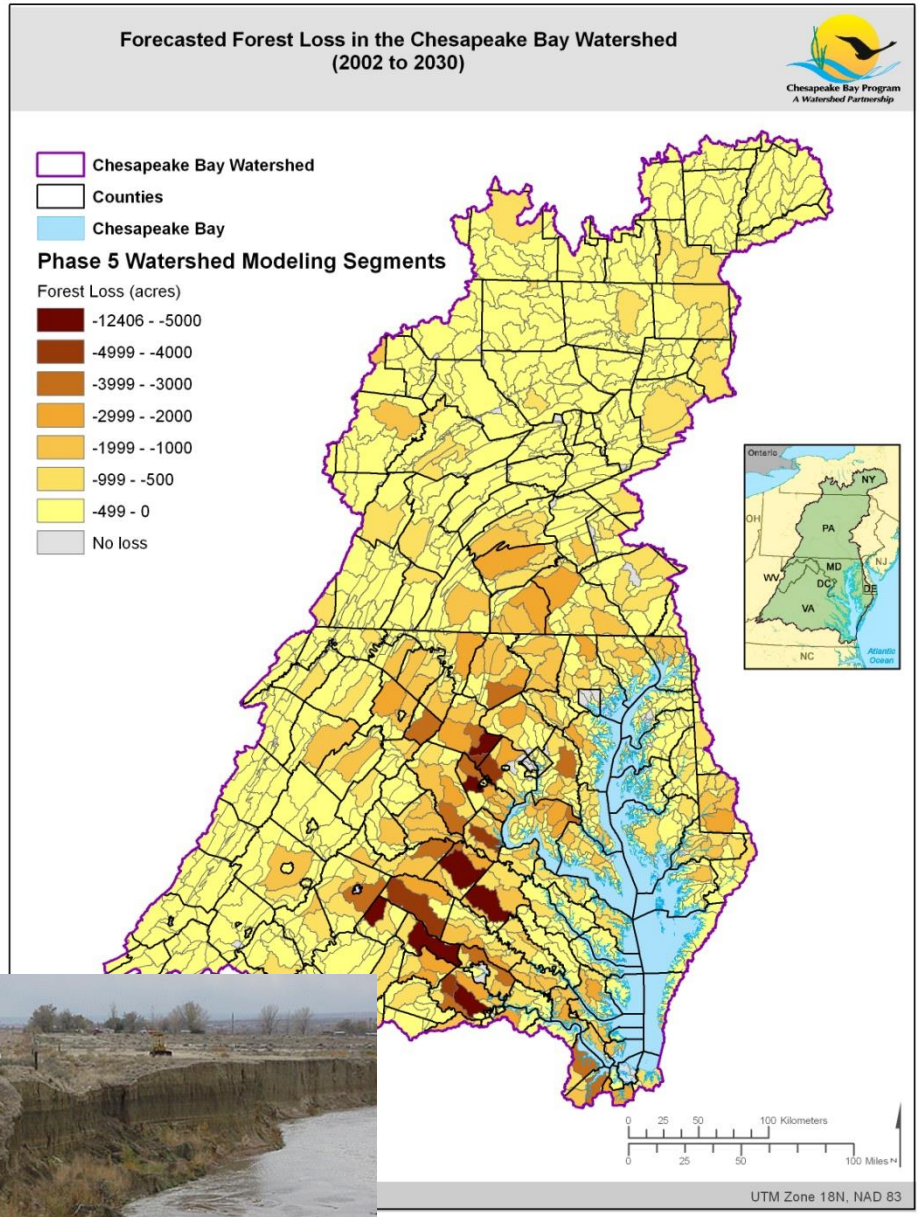
Human populations

- Increasing wastewater
- Vehicle emissions
- Development
  - Loss of forests
  - Impervious surface
  - Increased runoff
  - Erosion of “legacy” sediment



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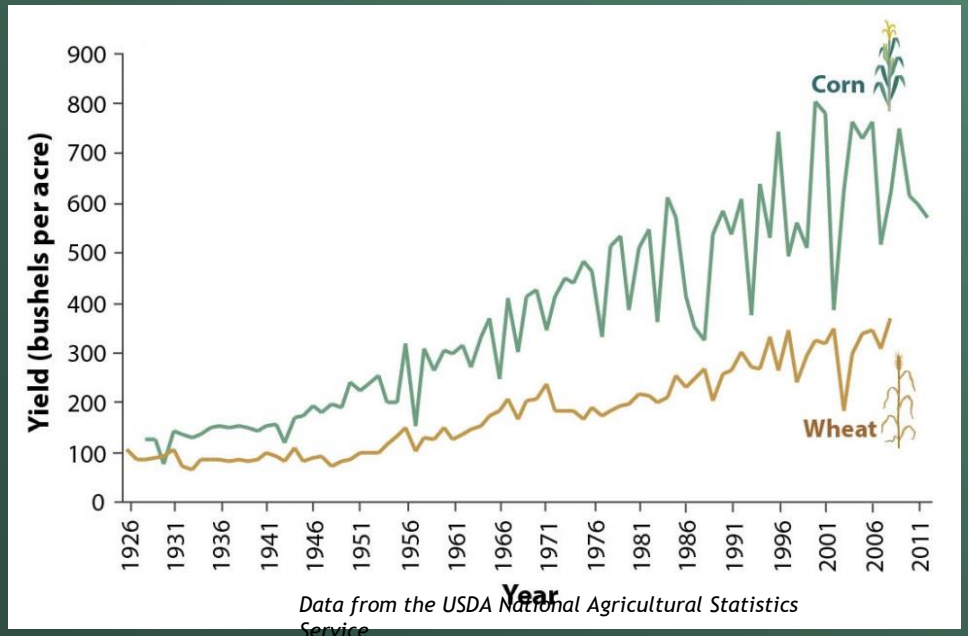
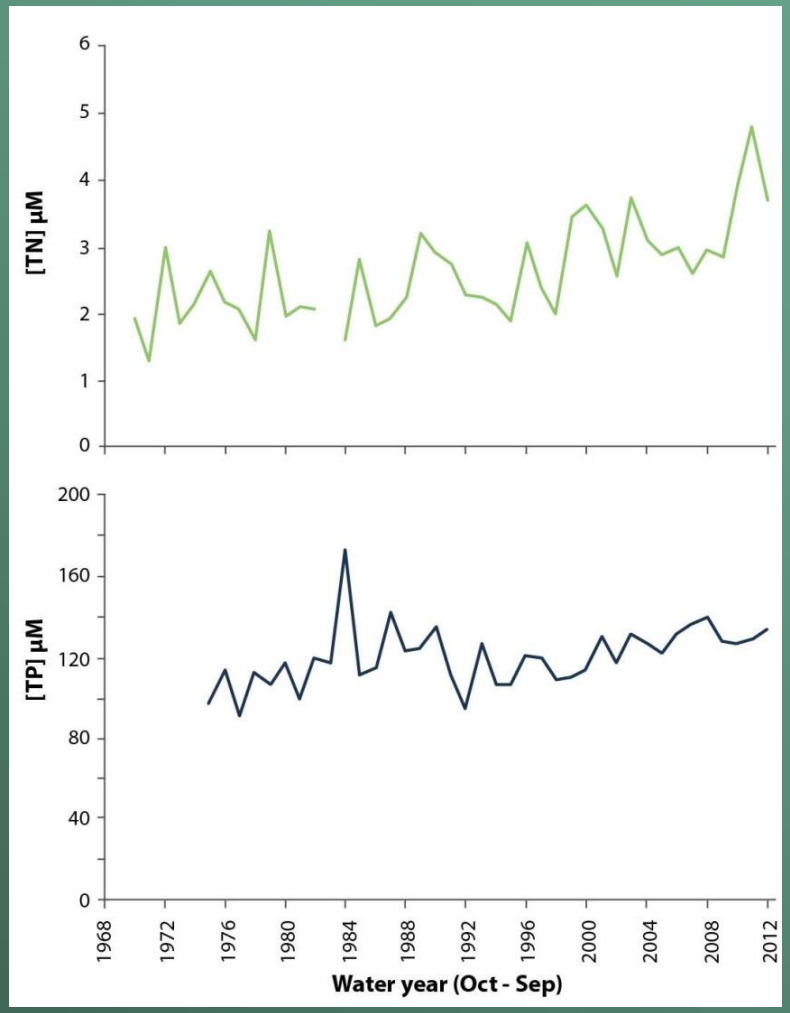
Animal populations: Intensified agriculture contributing to degrading water quality

Increases in wheat and corn yields (1926-2011)

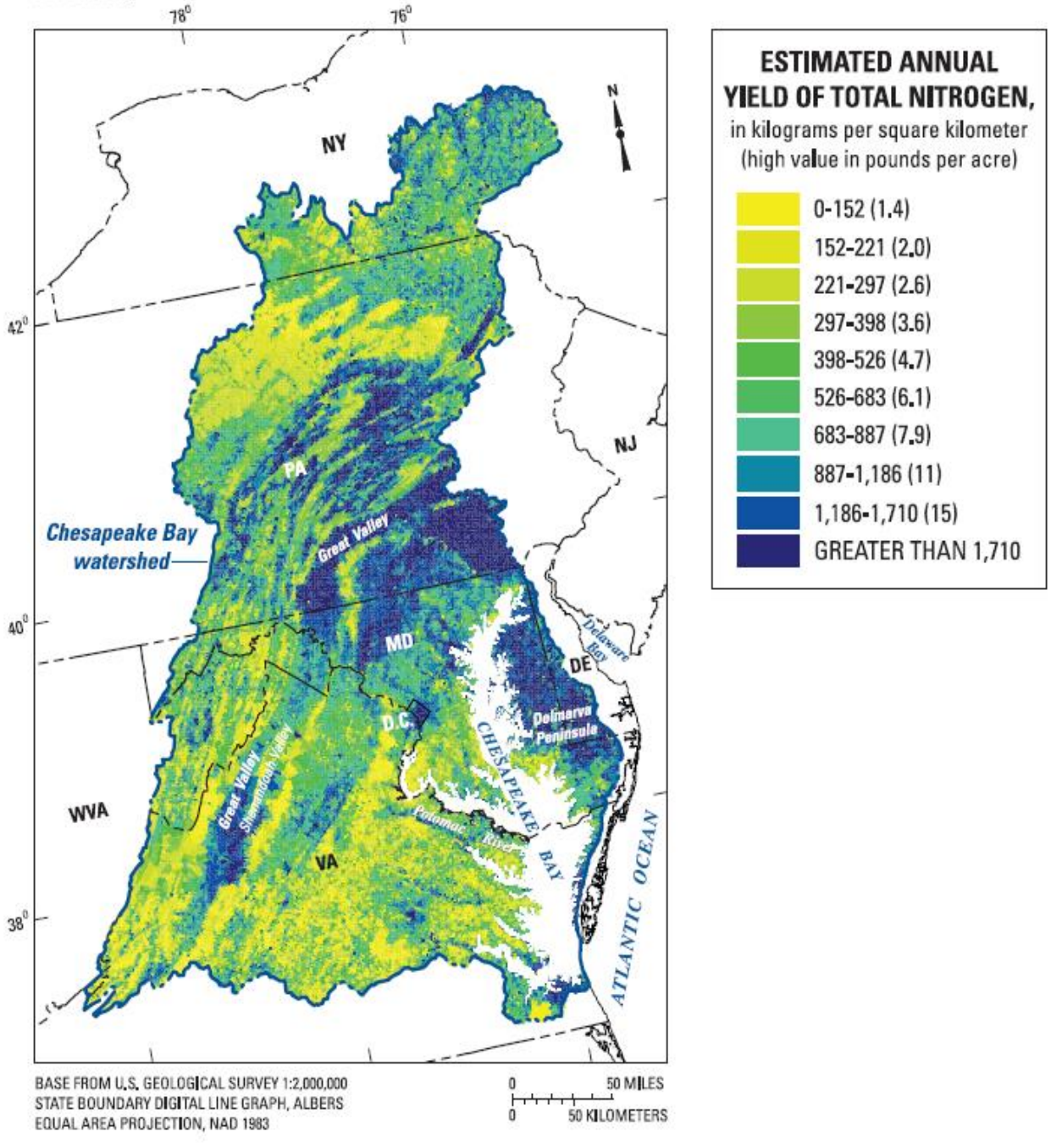


Data from the USDA National Agricultural Statistics Service

Increases in TN and TP (1968-2012)



Data from Fisher, 2006



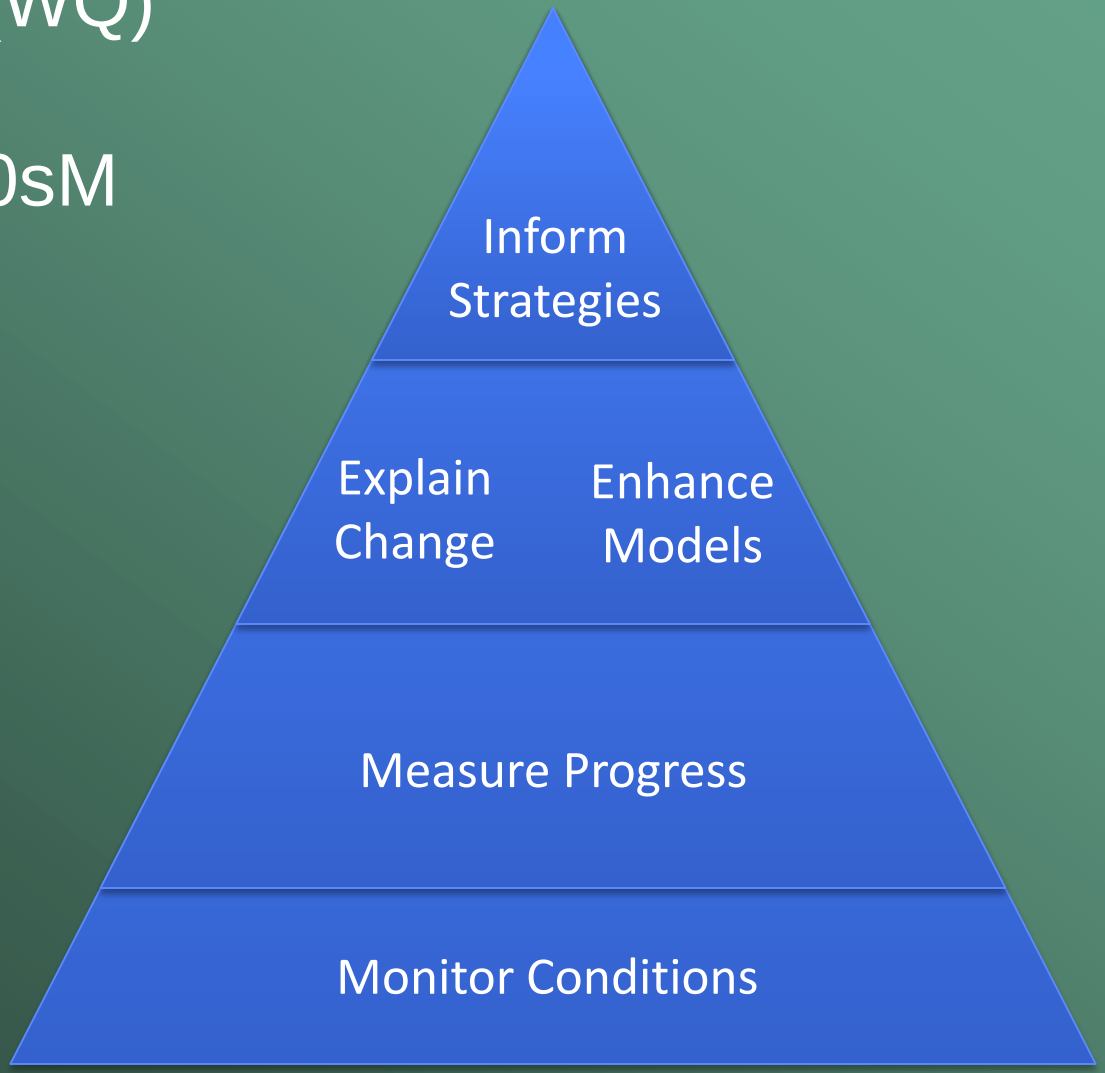
Lesson 6: Location matters

- Focus in areas of high loading
- N, P, S
- Source sectors

Lesson 7: Stormwater & monitoring

Monitoring is worth the cost!

- Costs: $12-15M (WQ)
- Restoration: $100sM
- Assess progress
- Calibrate models
- Explain change
- Inform decisions



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Management Implications for CBC

- Emphasize what is working…
  - WWTP, air emissions
  - Some Ag practices
- In the best places…
  - High loading areas
  - Benefits to other outcomes
- Address challenges…
  - Manure and livestock
  - Development and stormwater runoff
  - Susquehanna Reservoirs
  - Climate change

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