Chesapeake Bay Monitoring and Modeling

Presentation to the
Rio de Janeiro
Delegation

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July 30, 2013

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NATURAL RESOURCES

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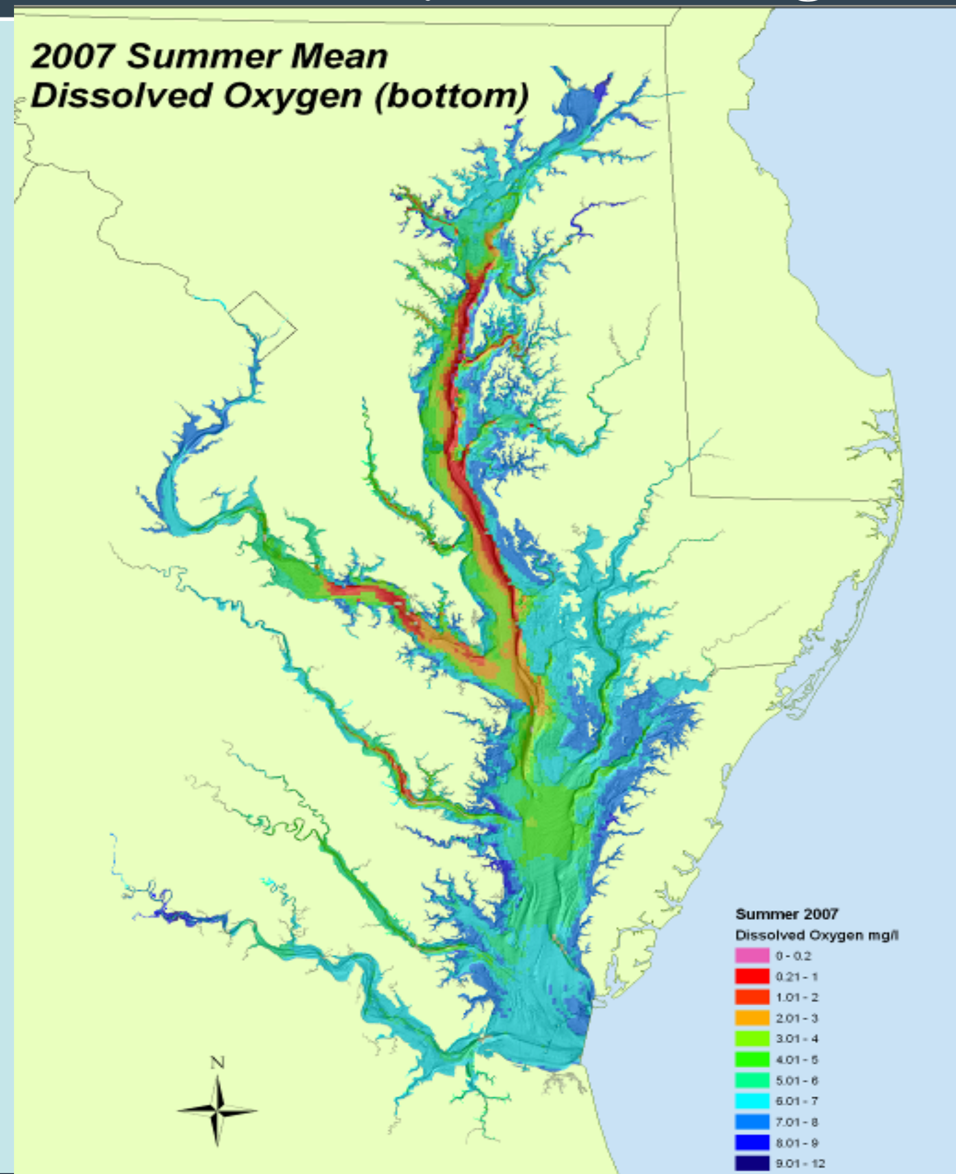
www.eyesonthebay.net

Maryland Water Quality Monitoring



Chesapeake Bay Challenges:

The Bay is Impaired for Water Quality

Extensive low to no summer dissolved oxygen conditions persist throughout the Chesapeake Bay and its Tidal Tributaries

Source: www.chesapeakebay.net/data

Chesapeake Bay Challenges

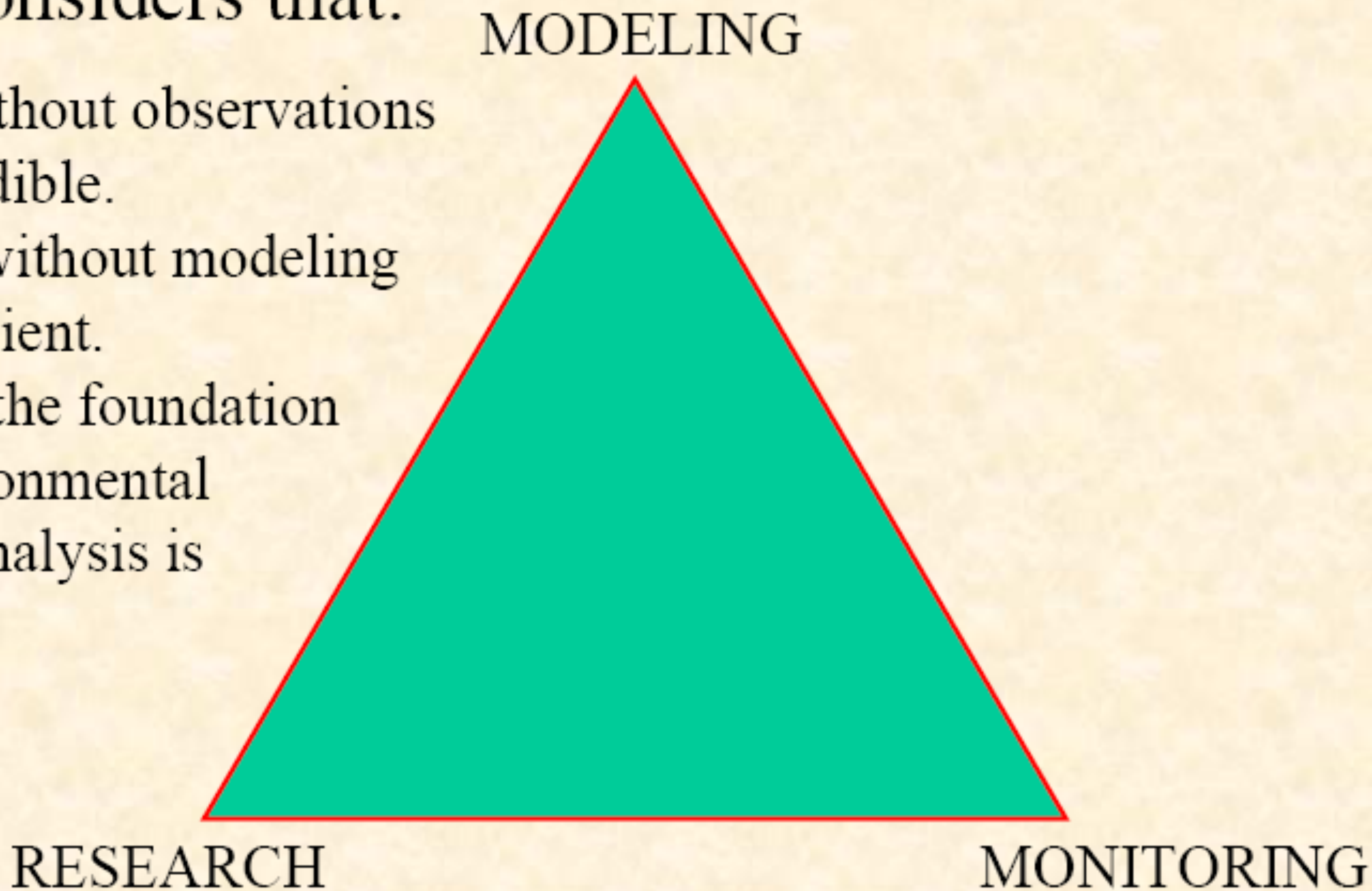
Nutrient and sediment pollution from:

- Wastewater (sewage treatment),
- Septic Systems,
- Urban/suburban runoff – storm water, sediment erosion),
- Industrial pollution (power plants, manufacturing)
- Dredging,
- Agriculture

Triad of Modeling, Monitoring, and Research

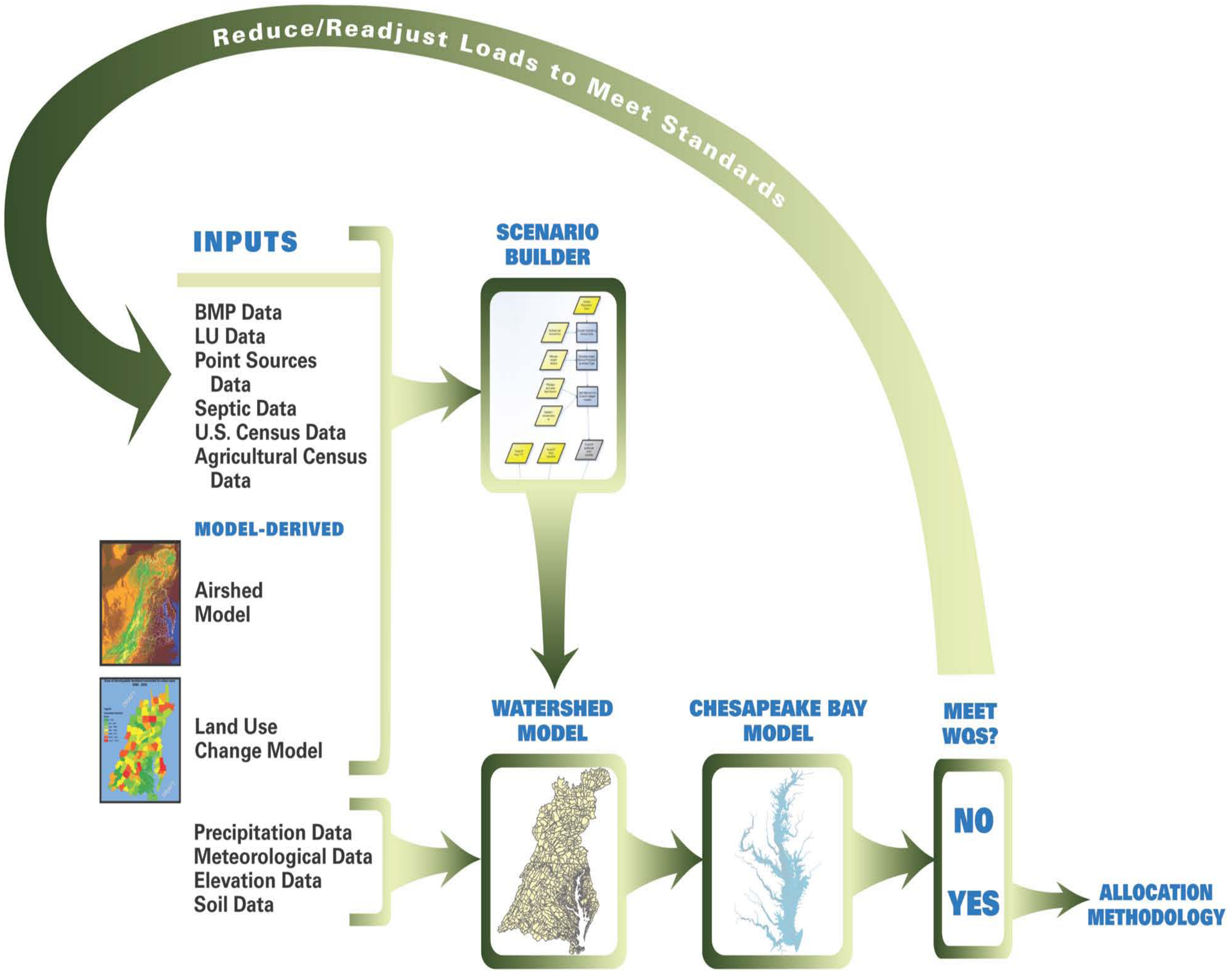
The current state of the science considers that:

- Modeling without observations to be not credible.
- Monitoring without modeling to be insufficient.
- Research is the foundation that all environmental restoration analysis is built on.



- The Chesapeake Bay Program models are used by government partners and private stakeholders to:
  - project the flow and loads of pollution
  - and simulate how changes to pollution controls, land use, atmospheric deposition and precipitation could impact the ecosystem, particularly water quality and living resources like fish and wildlife.

Chesapeake Bay Partnership Models



Monitoring Program Objectives

- Long-term Fixed
  - Status - Characterize existing conditions; water quality criteria
  - Trends - Evaluate changes in response to nutrient reductions
  - Understand ecosystem processes as they relate to management actions
  - Model support
  - Research and education
- Continuous Monitoring
  - Represents upstream and downstream conditions
  - Provides temporal resolution for evaluating water quality criteria
  - Calibration for water quality mapping
  - Event based monitoring – fish kills, algal blooms, storm impacts
- Water Quality Mapping
  - Provides spatial resolution for evaluating new WQ criteria
  - Targeting submerged aquatic vegetation (SAV) restoration activities
  - Assessing habitat for fish and other living resources
  - Biweekly calibration, light attenuation, chlorophyll and total suspended solids

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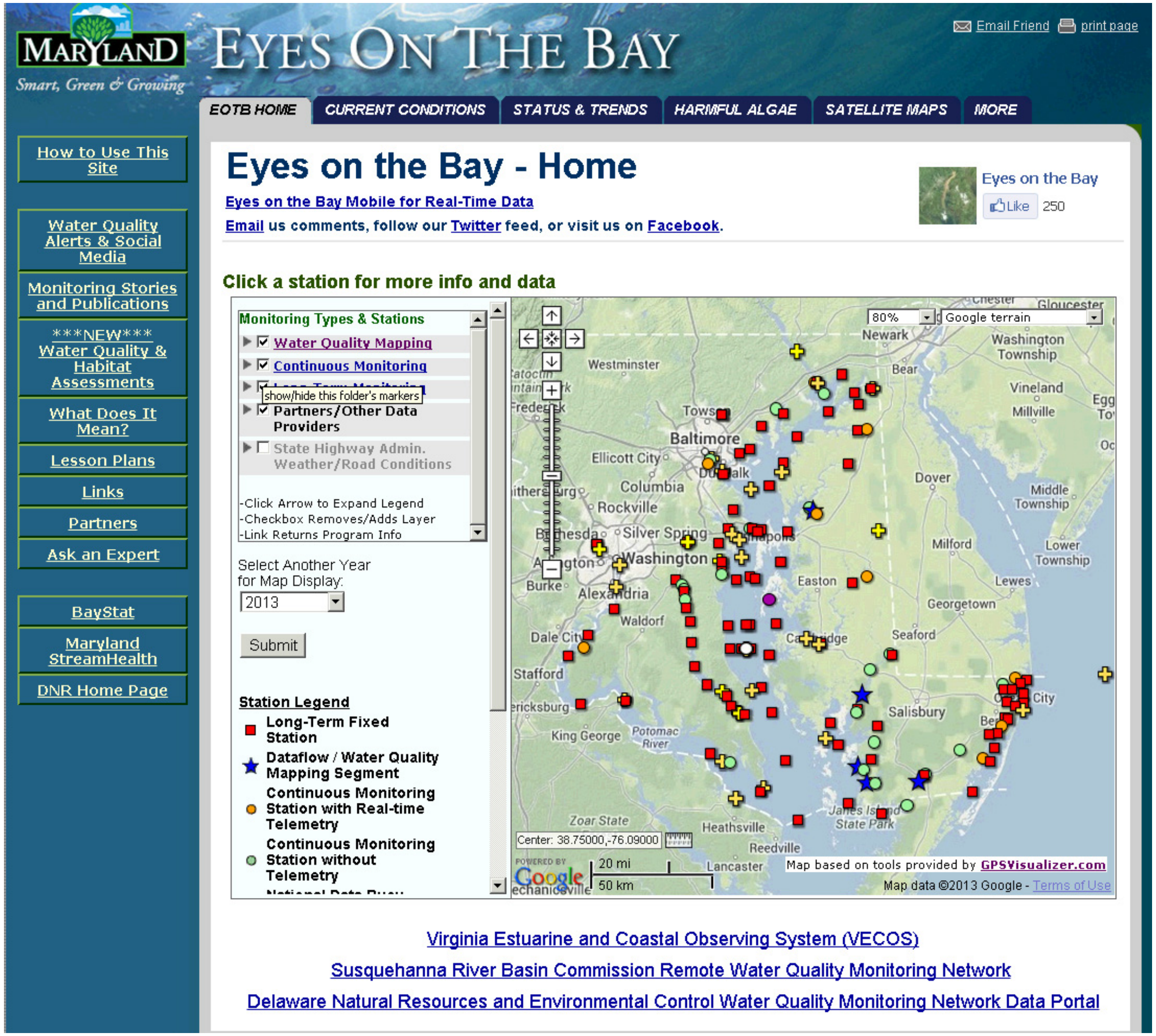
- Portal for Maryland DNR water quality data and analyses, harmful algal blooms maps, and satellite imagery/data



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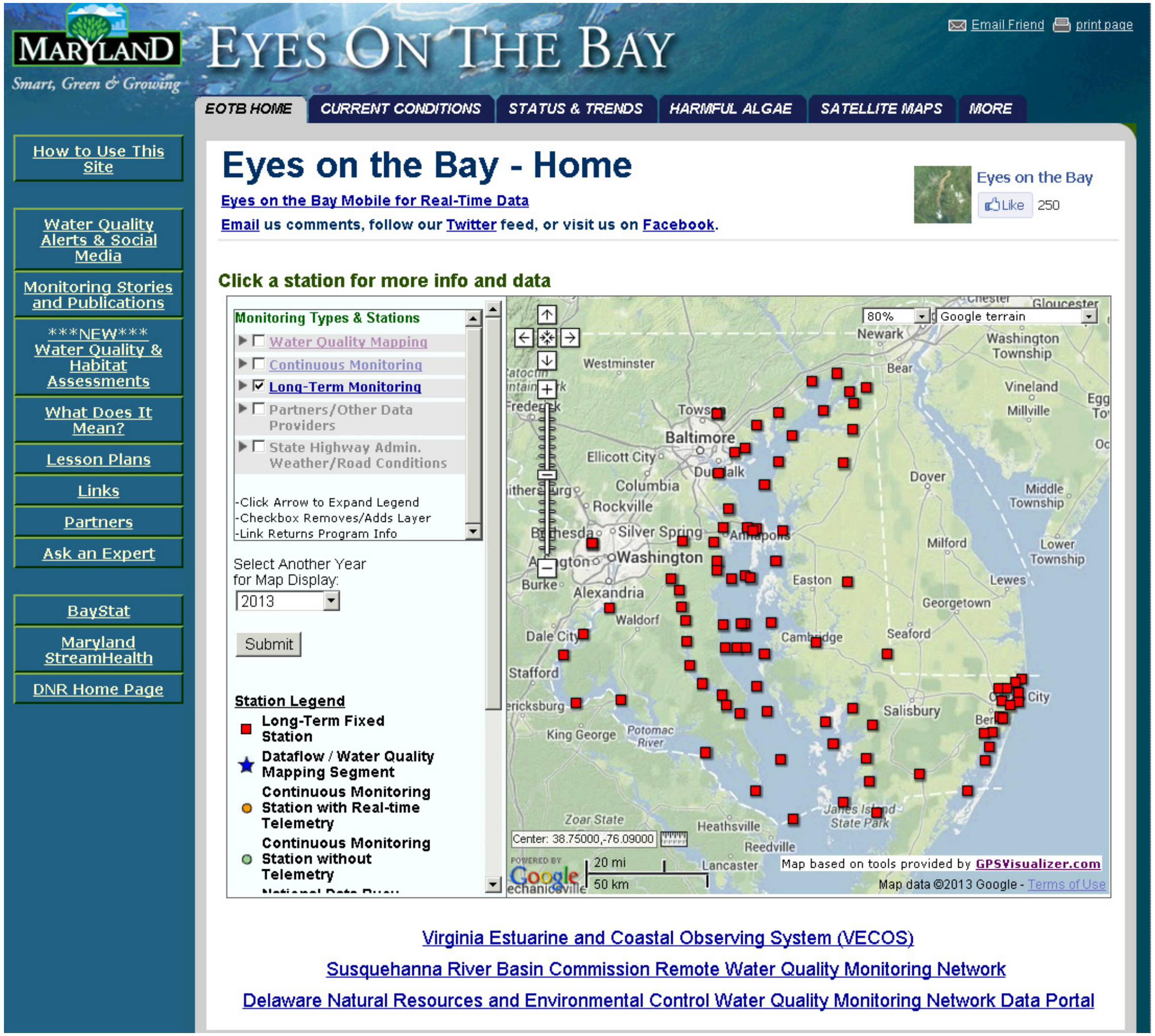
Long-term Monitoring Sites (1985-present)

- Monitored monthly or twice monthly
- Full suite of nutrients, sediment and chlorophyll
- Water quality profiles



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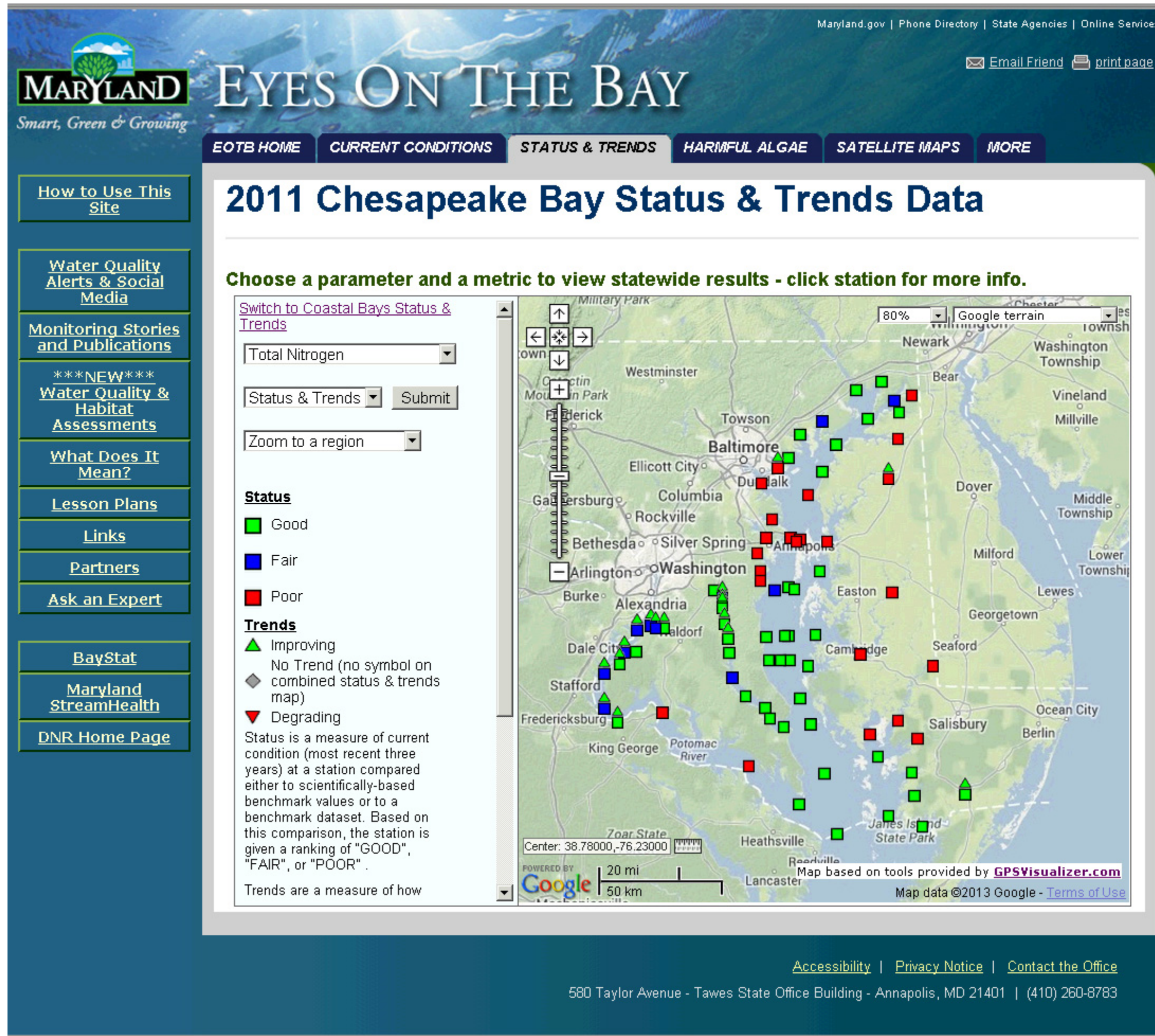
Status & Trends

- Parameters: TN, TP, TSS, DO, chl, secchi
- Status – Measure of latest 3 years (good, fair or poor)
- Trends – Measure of improving, degrading or no trend since 1985 or 1999. Can be linear or non-linear



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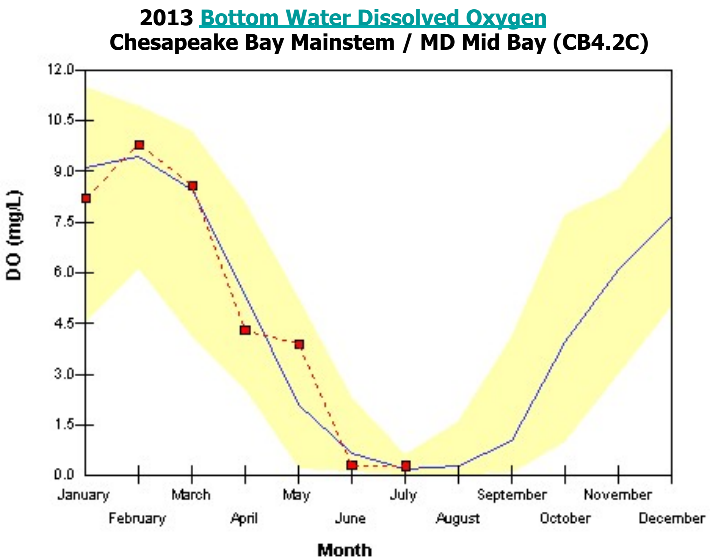
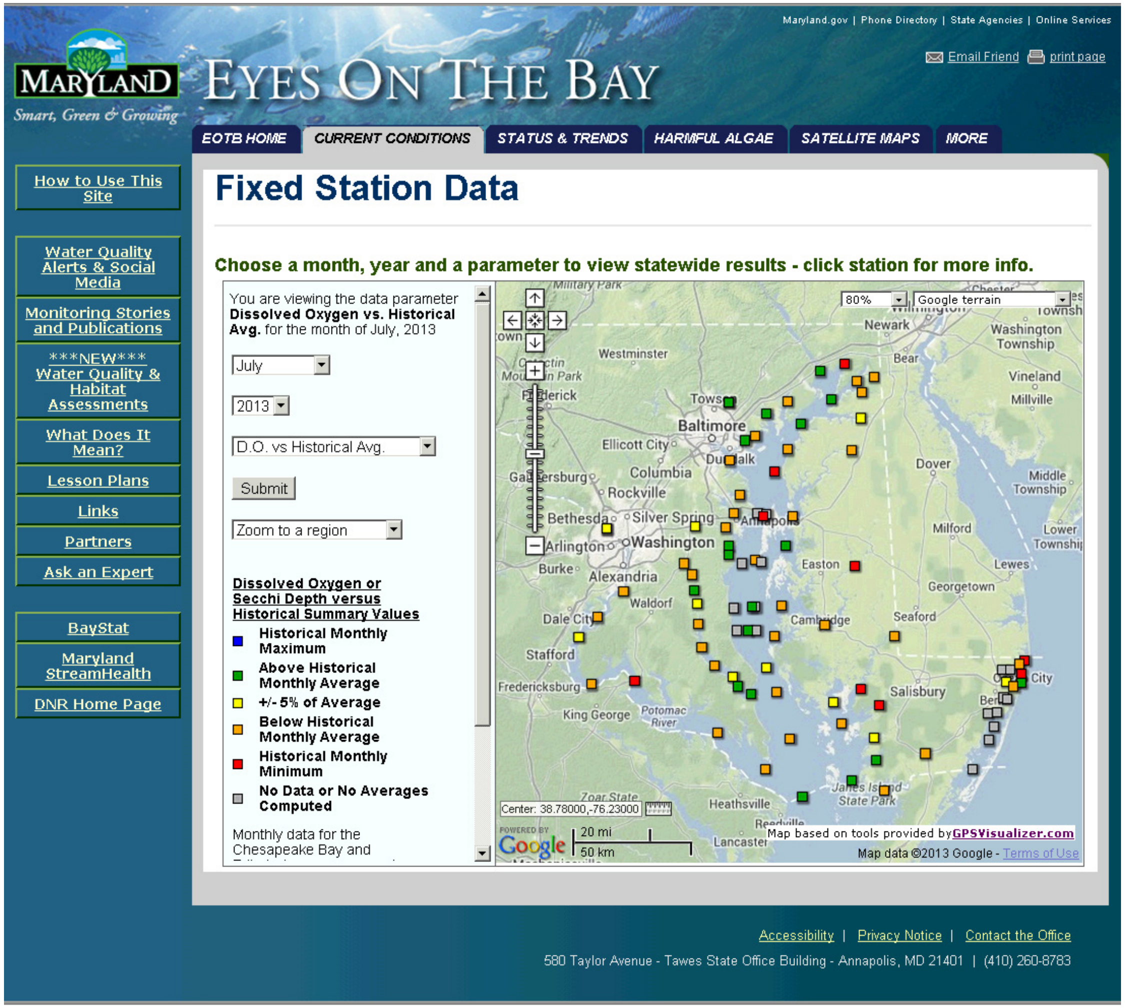
Current Conditions

- Compare current data to long-term averages and ranges.





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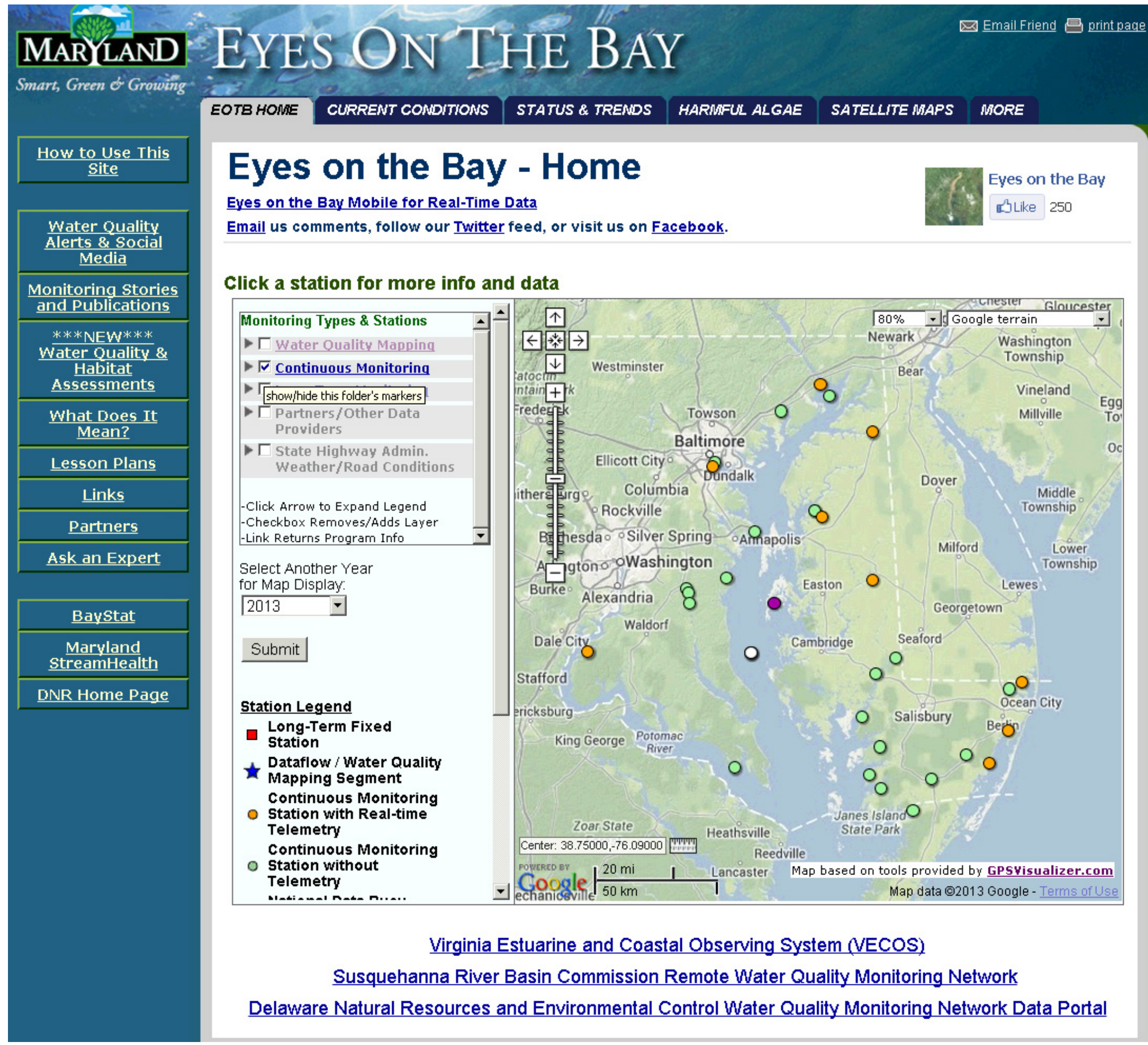

<u>Continuous monitoring</u>

- Up to 50 sites / year
- Measurements every 15 minutes
- Dissolved oxygen, pH, chl, turbidity, salinity, water temperature
- Serviced every 2 weeks with calibration samples and profiles taken

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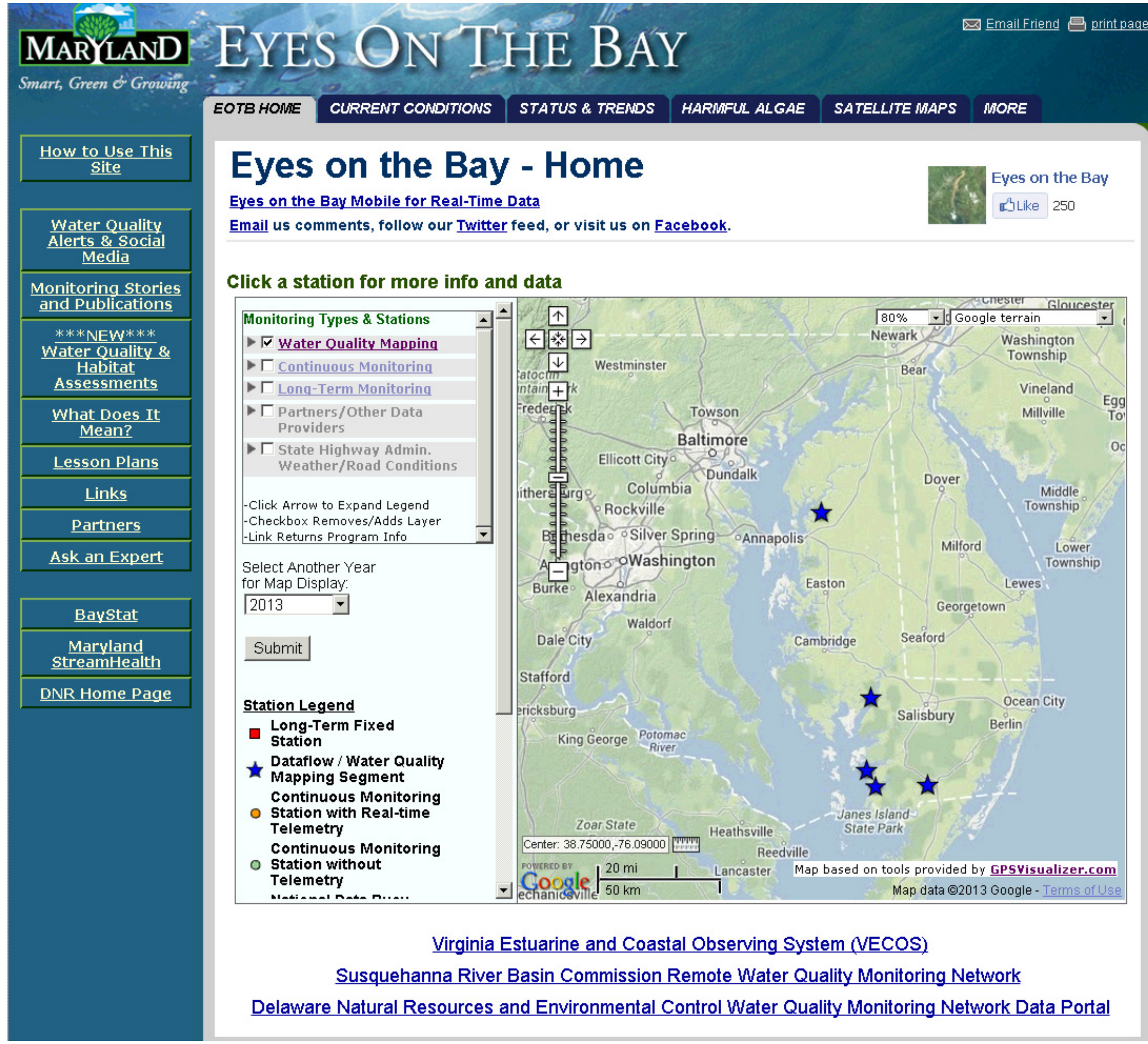
Water Quality Mapping

- Readings every 4 seconds at speeds of up to 25kts.



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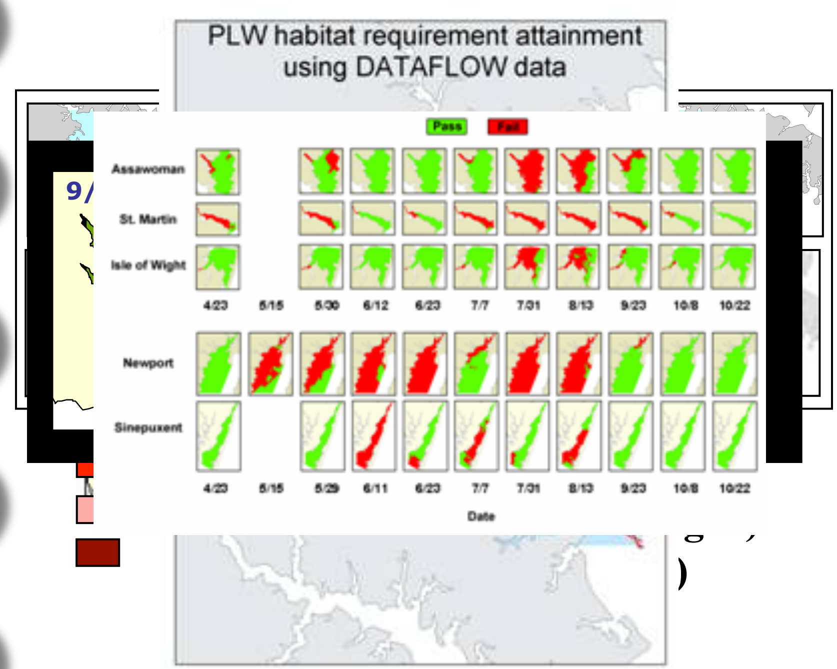
1. Water Quality Criteria Assessment
2. Input Data for SAV Restoration Models
3. Monitor Episodic Events
4. Monitor Habitat for Living Resources
5. Detect Harmful Algal Blooms / Hypoxia



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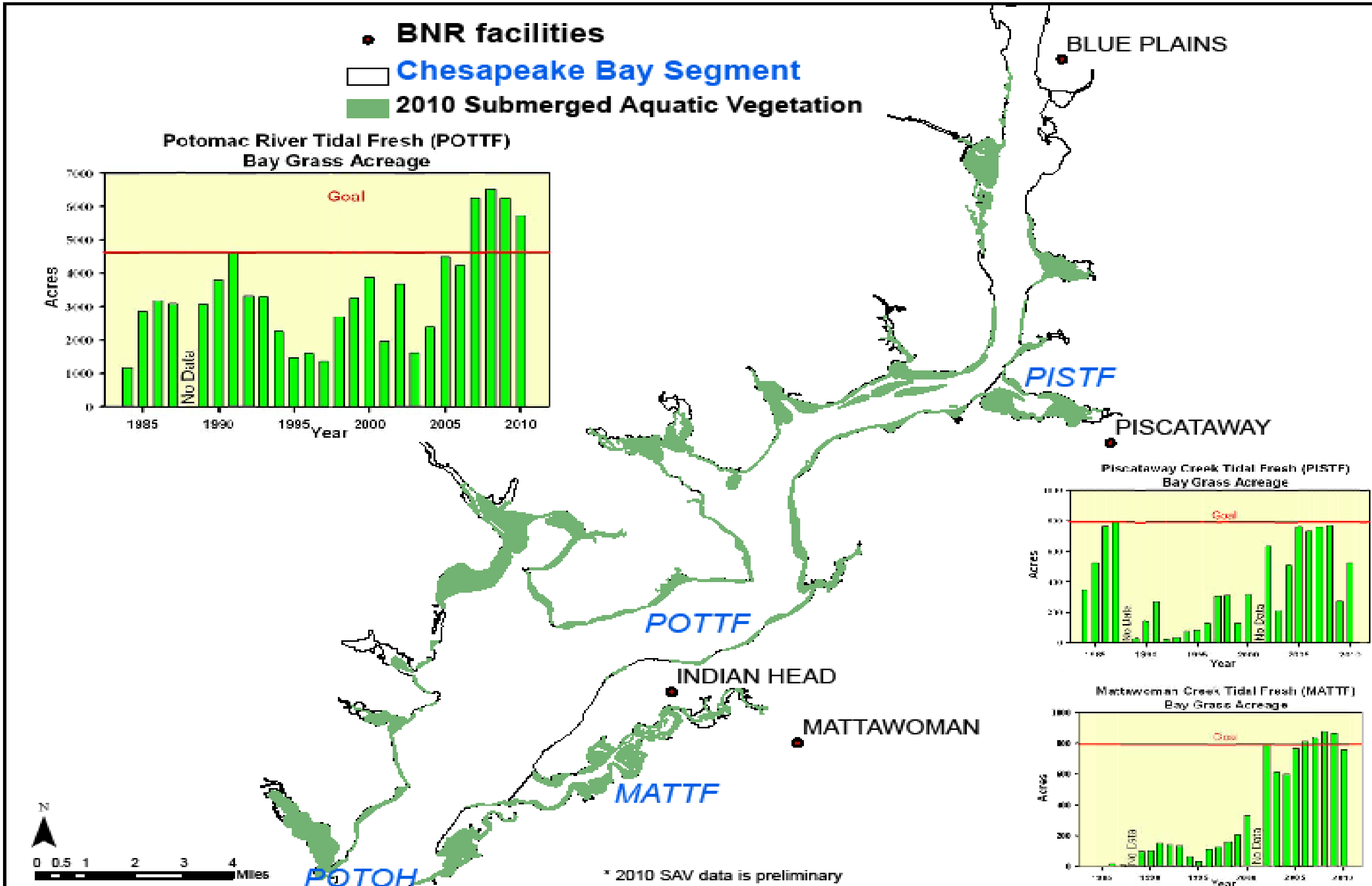

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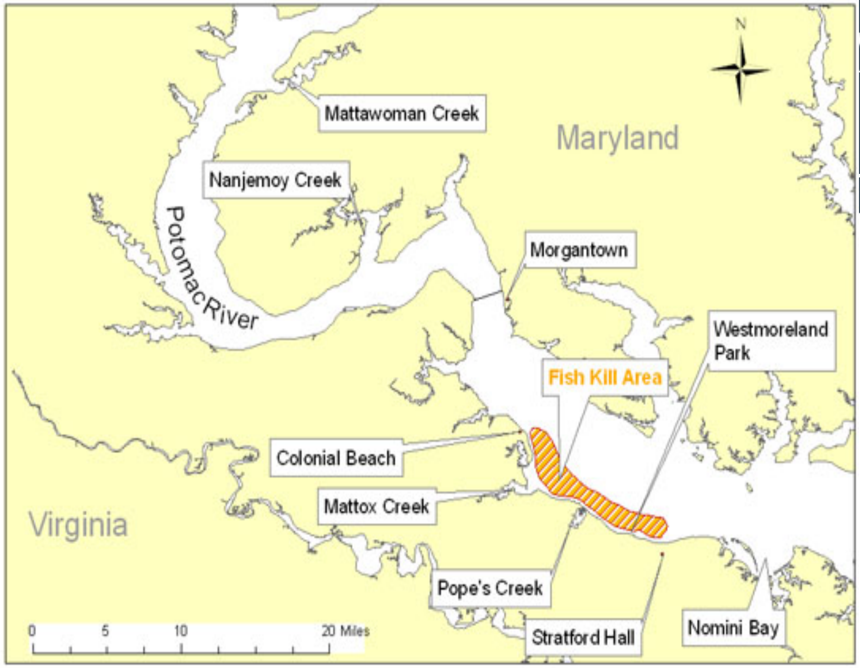
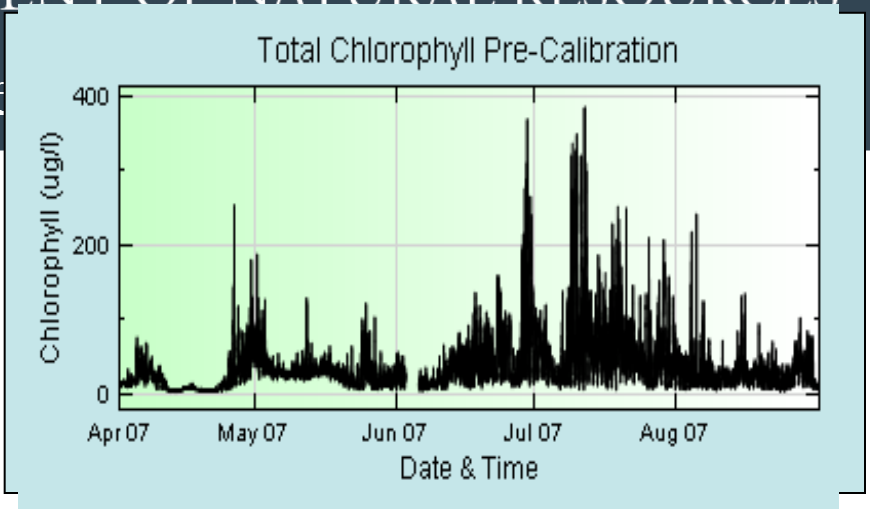
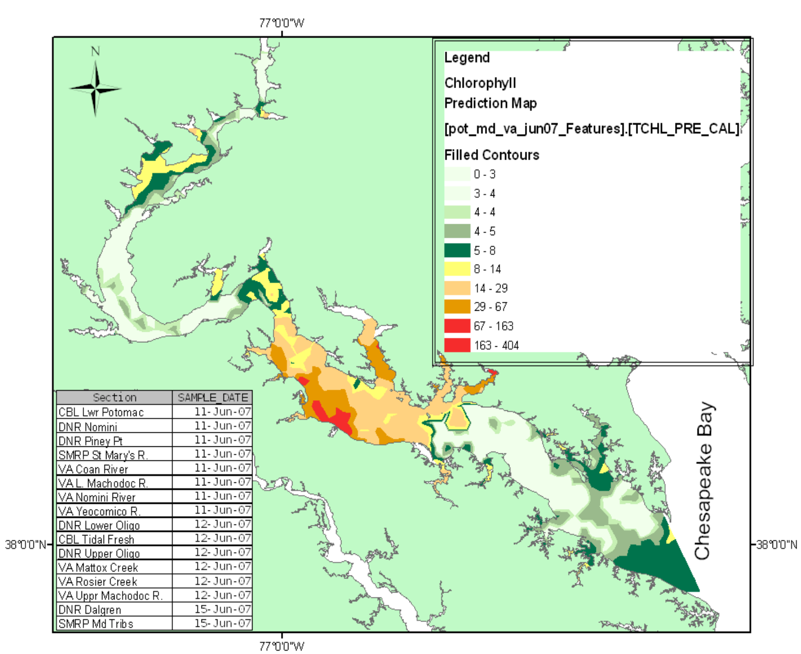
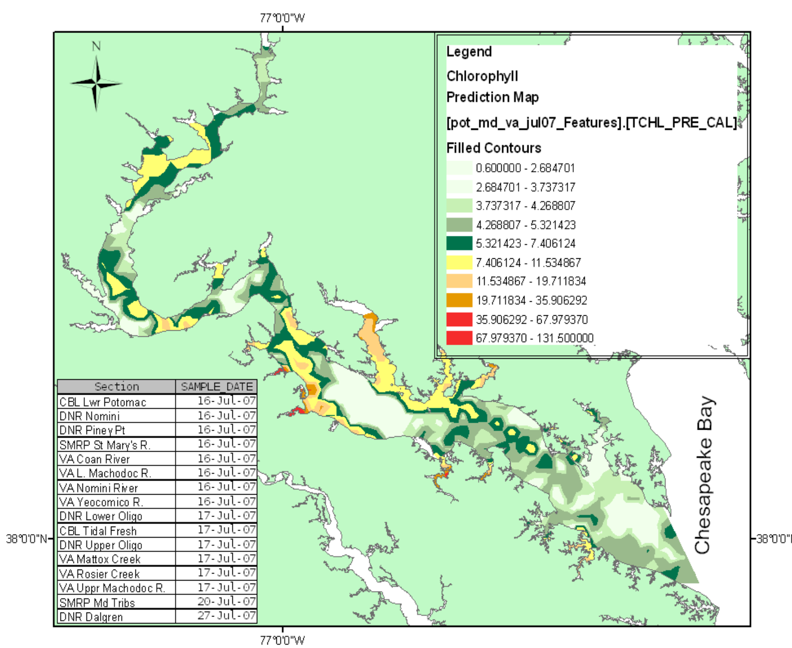


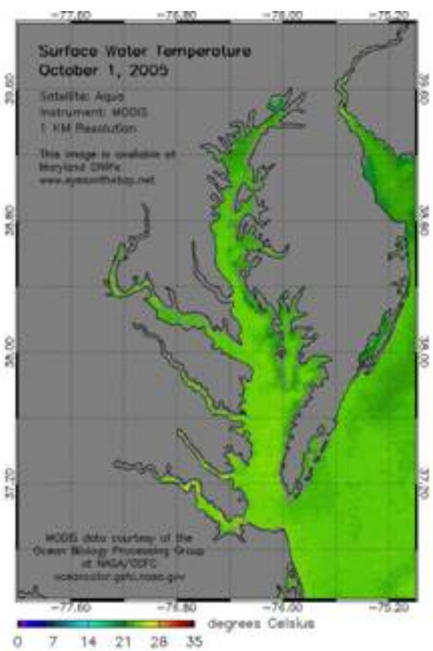


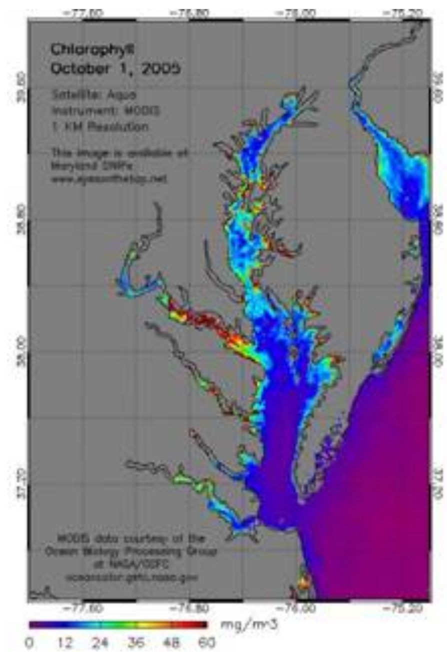




Incorporating New Technologies - Remote Sensing

mddnr.chesapeakebay.net/NASAimagery/EyesInTheSky.cfm





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Major N reductions have occurred near large and small urban centers in the Chesapeake Bay Watershed.

Upgrades in WWTPs represent many of the success stories within The Watershed, but point sources continue to contribute approximately 20% of the nutrient loads (UMCES 2010). Figure [X] illustrates progress from the late 1980s to 2012. TN at some WWTPs—particularly those in highly populated areas—decreased as upgrades were implemented. However, other areas are experiencing increases in TN, partly resulting from WWTPs that have yet to be upgraded due to long implementation times or lack of funding (UMCES 2010). The map reveals that much work is yet to be done while simultaneously demonstrating promising opportunities for significant and relatively rapid improvements. In particular, the James, Potomac and Back Rivers represent areas that would likely see continuing improvements as WWTPs undergo Enhanced Nutrient Removal (ENR) upgrades.

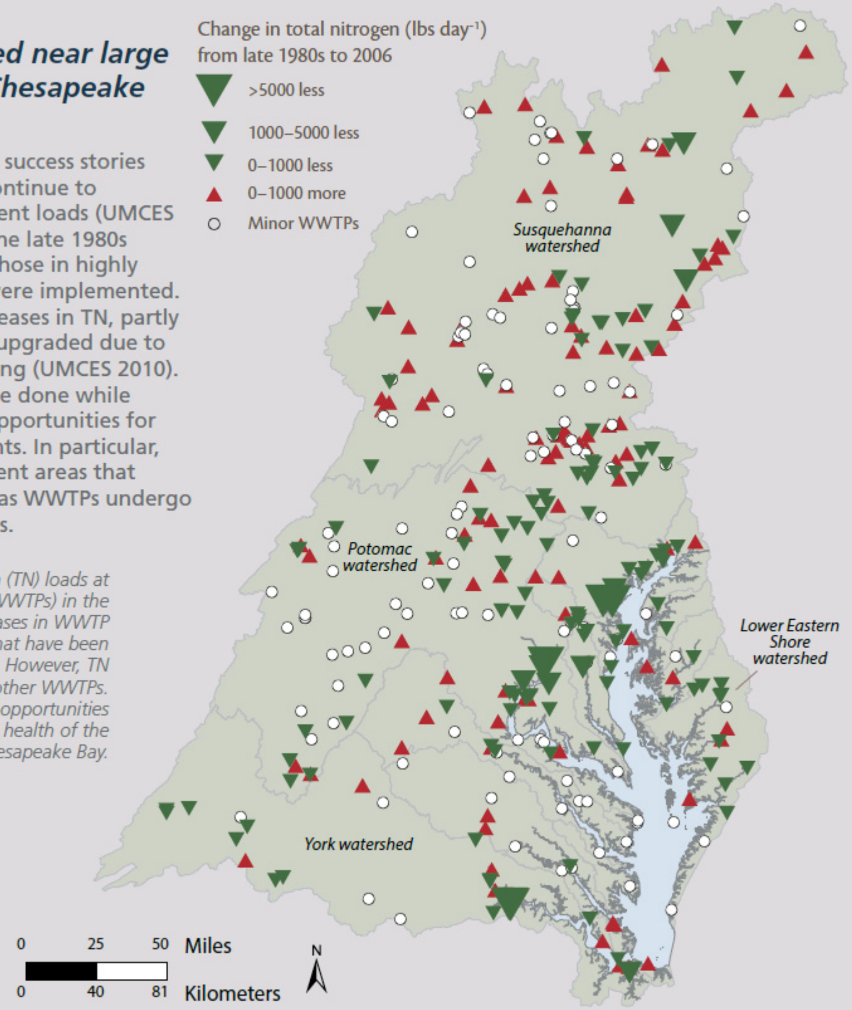

Figure X. Changes in total nitrogen (TN) loads at major wastewater treatment plants (WWTPs) in the Chesapeake Bay Watershed. The decreases in WWTP TN loads illustrate the advances that have been made as WWTPs have been upgraded. However, TN loads have increased at numerous other WWTPs. These WWTPs represent significant opportunities for even greater improvement in the health of the Chesapeake Bay.

Lyerly, C.M., A.L. Hernandez Cordero, K.L. Foreman, S.W Phillips, W.C. Dennison (eds.). 2013. Lessons from Chesapeake Bay Restoration Efforts: Understanding the role of nutrient reduction activities in improving water quality.

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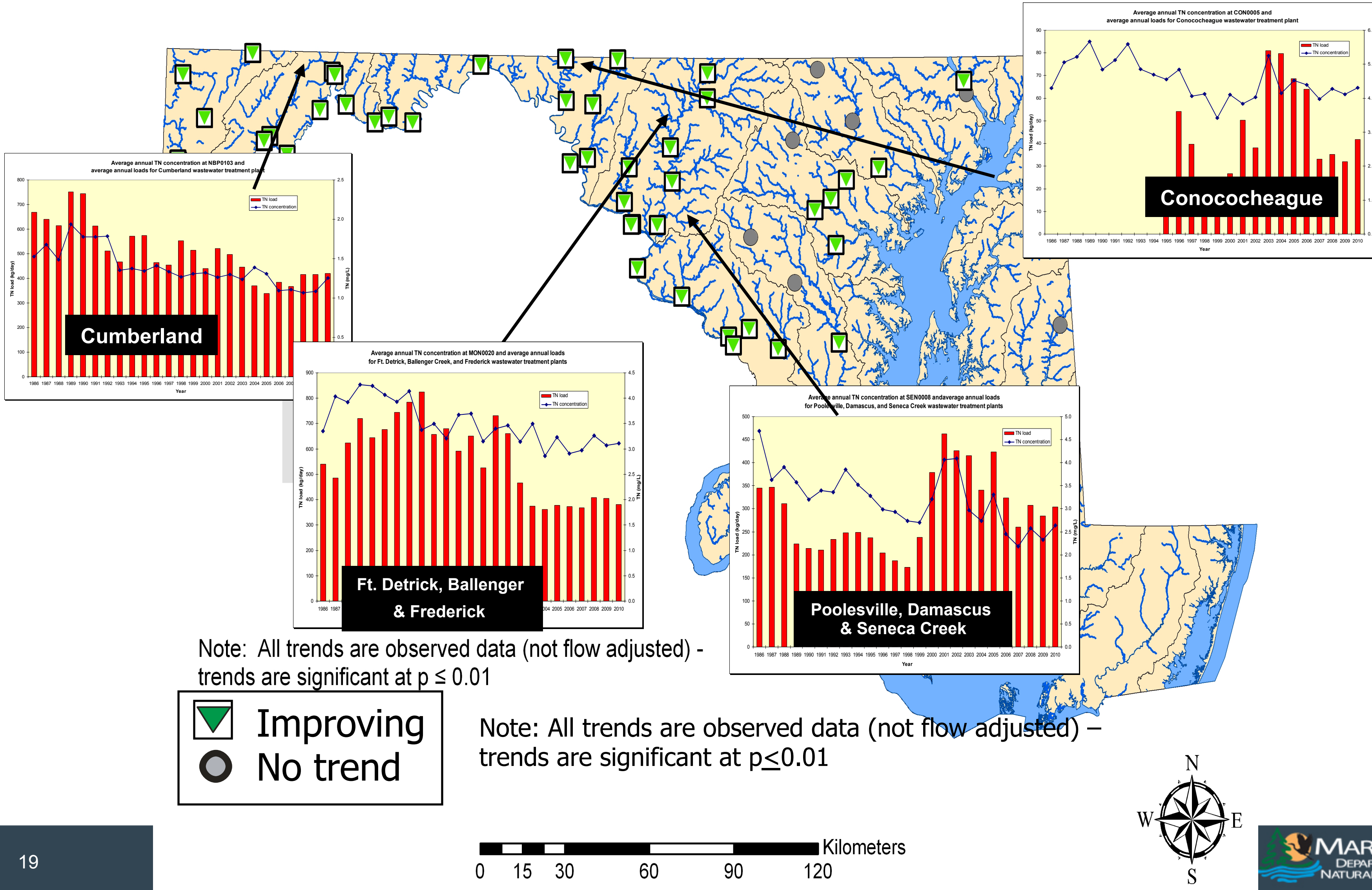
TN Trends (1986-2010) at Non Tidal Monitoring Stations – 46 of 54 Show Improvement



Note: All trends are observed data (not flow adjusted) – trends are significant at $p \leq 0.01$

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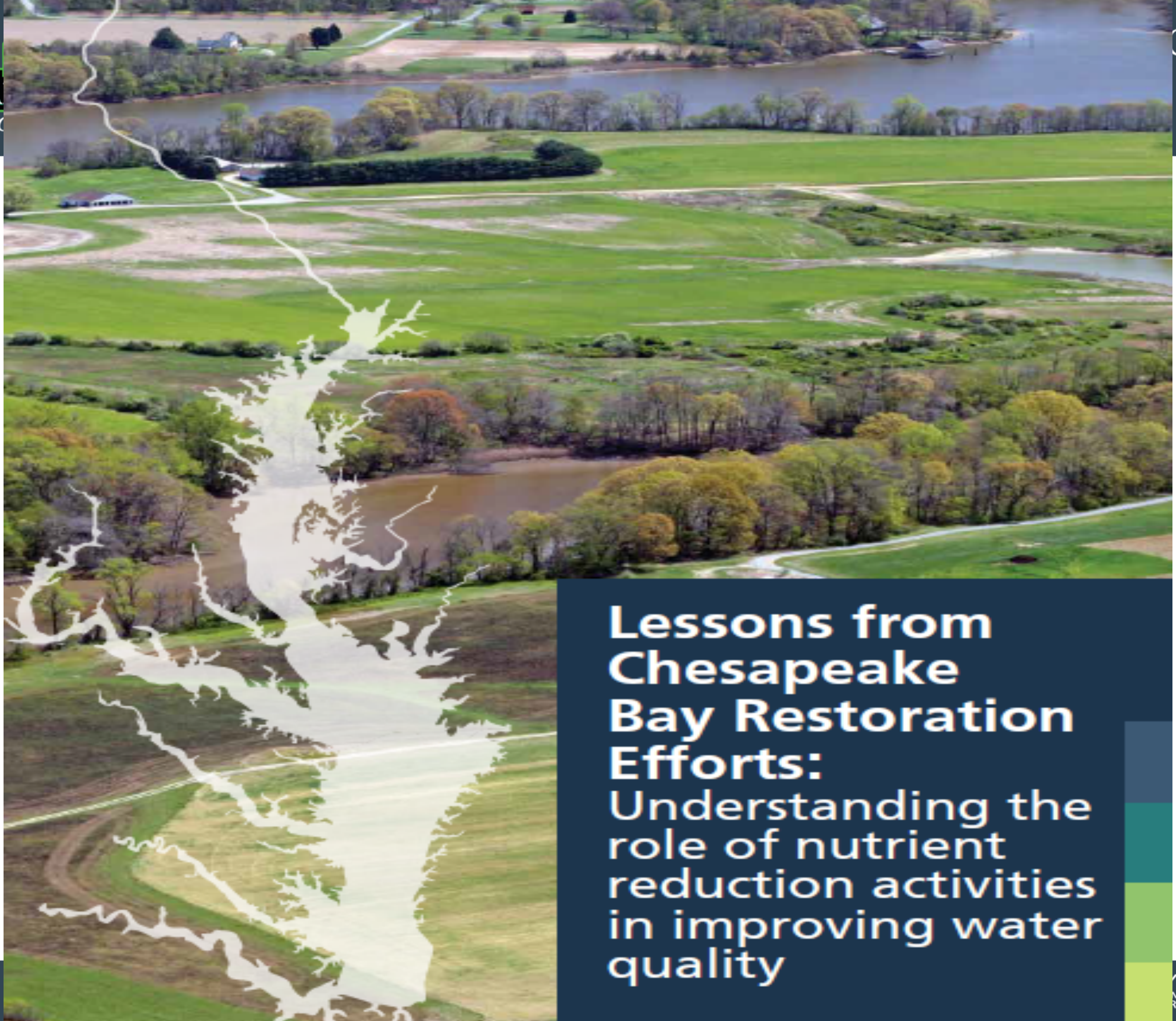
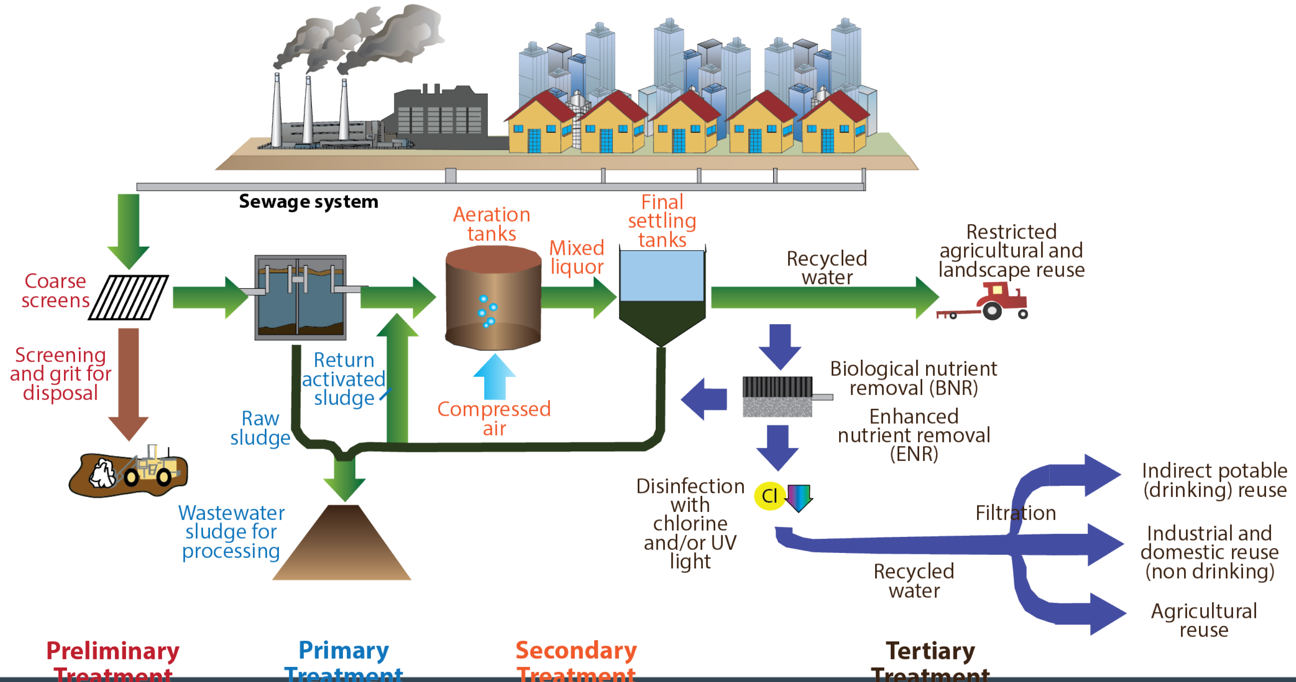
- EPA Chesapeake Bay Program
- NOAA Chesapeake Bay Program
- NOAA National Estuarine Research Reserve (NERR), Patuxent and Bush
- Chesapeake Biological Laboratory, Patuxent and Upper Potomac
- St. Mary's College, Lower Potomac
- Smithsonian Environmental Research Center, Rhode
- Harford County Government, Bush
- Anne Arundel Government, Severn
- National Aquarium in Baltimore, Patapsco


Lessons from Chesapeake Bay Restoration Efforts:
Understanding the role of nutrient reduction activities in improving water quality

Lesson 1

- Upgrades in both nitrogen and phosphorus wastewater treatment result in rapid local water quality improvements



Case Studies

- Back River Estuary
- Gunston Cove
- Potomac River
- Mattawoman Creek
- Patuxent River

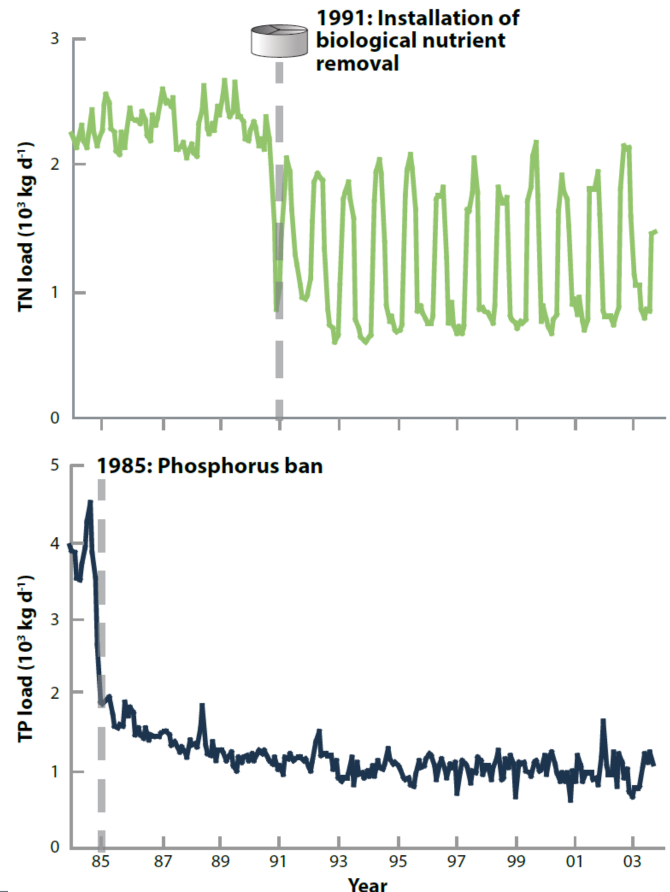
Photo credit: Alexandra Fries, IAN Image Library

Photo credit: Cassie Gurbisz, UMCES

Upper Patuxent River

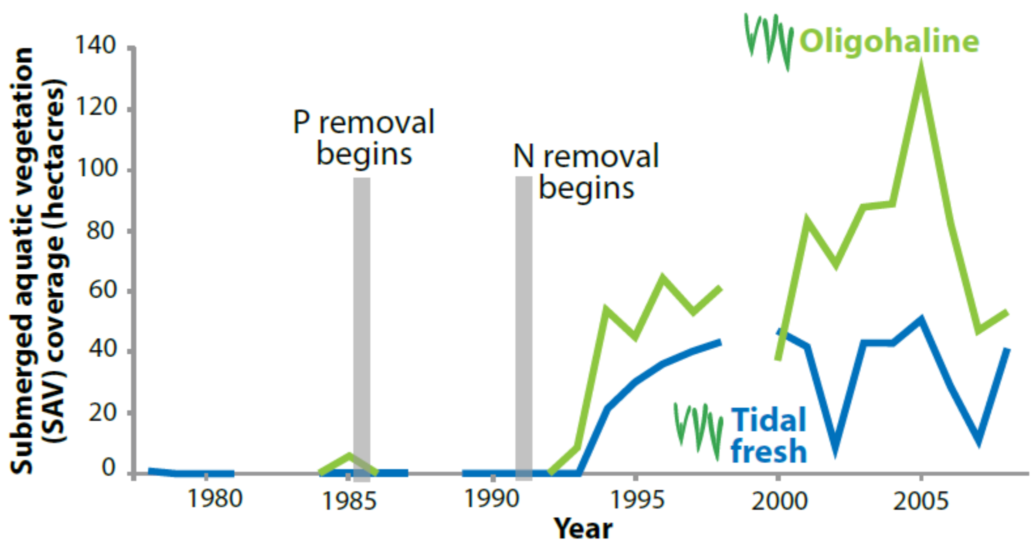
- Nutrient removal upgrades at WWTPs
- Decreases in phytoplankton, N and P
- Increases in SAV

Changes in TN and TP Concentrations (1984-2004)



Data from Testa et al., 2008

Changes in SAV (1978-2008)



Data from Boynton et al., 2008

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Key Messages

- Chesapeake Bay is responding to Baywide TMDL and nutrient reduction strategies in some locations
- Must link nutrient source load reductions to water quality and habitat improvements
- Most nutrient reduction responses are due to point source upgrades on Maryland's western shore
- Non point source water quality improvements will take longer to achieve
- Must manage expectations for immediate response
- Need commitment to long-term monitoring to document success

QUESTIONS?