Tidal Trends Maps

Presentation to the

Water Quality Goal Implementation Team

March 9, 2015

Rebecca Murphy (UMCES at CBP)

With input from:

Mike Lane (VA trends), Renee Karrh (MD trends), Howard Weinberg (maps), Jeni Keisman, and team

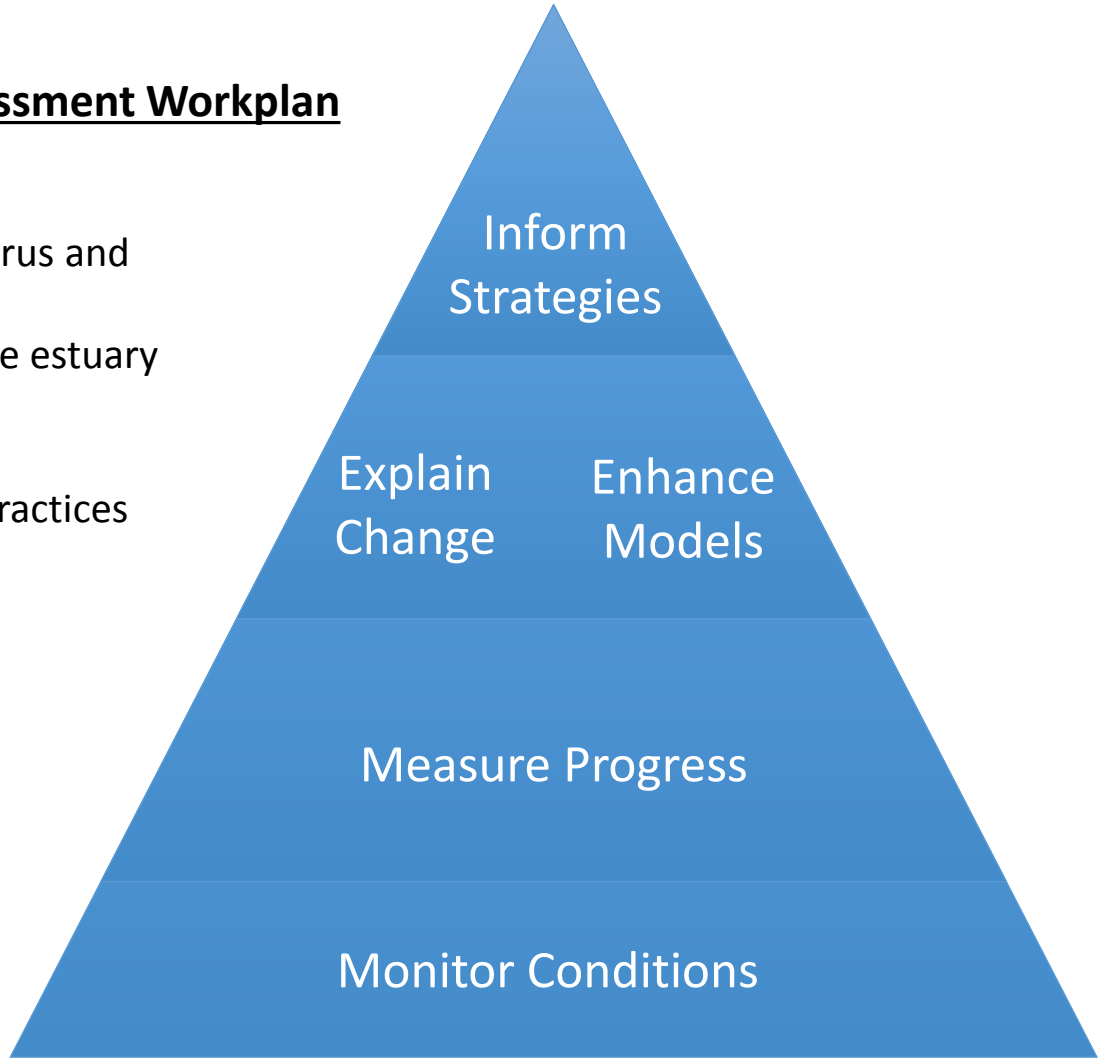
Chesapeake Bay Program

Science. Restoration. Partnership.

Using Monitoring Data To Measure Progress and Explain Change

Elements of STAR Mid-Point Assessment Workplan

1. Measure progress
   - Trends of nitrogen, phosphorus and sediment in the watershed.
   - Trends of water quality in the estuary
2. Explain water-quality changes
   - Response to management practices
3. Enhance CBP models
4. Inform management strategies
   - WIPs
   - Water-quality benefits



Using Monitoring Data To Measure Progress and Explain Change

Elements of STAR Mid-Point Assessment Workplan

1. Measure progress
   - Trends of nitrogen, phosphorus and sediment in the watershed.
   - Trends of water quality in the estuary
2. Explain water-quality changes
   - Response to management practices
3. Enhance CBP models
4. Inform management strategies
   - WIPs
   - Water-quality benefits

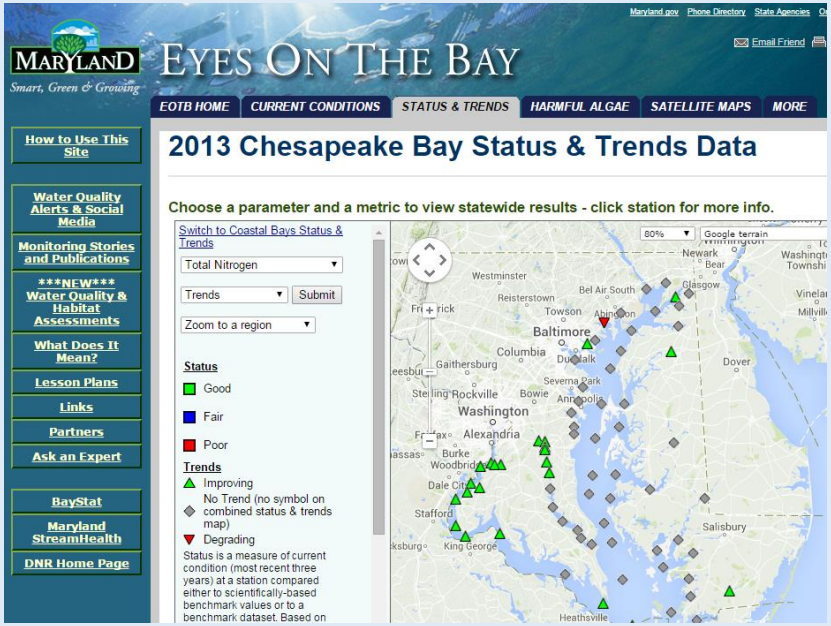
- First step: Understand and explore existing trend results generated by MDDNR and VADEQ
- This presentation: Show these existing trends to start the conversation about tidal monitoring data trends
- Next: More details about new methods and explanations

Seasonal-Kendall-Based Trends

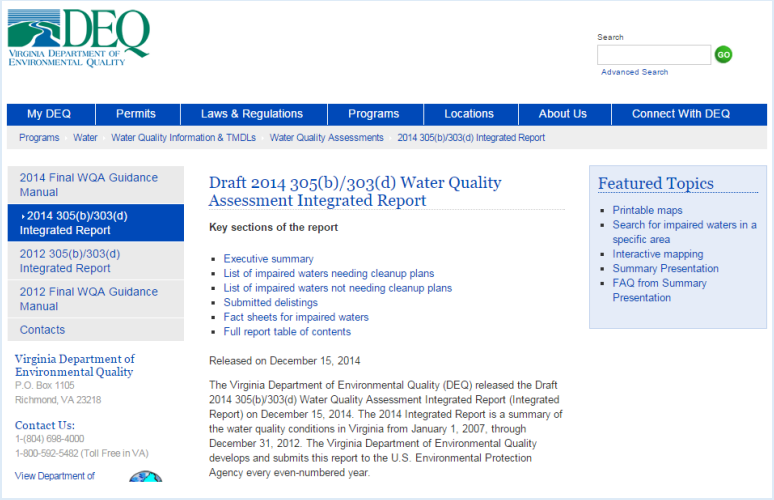
Computed by the states since the '90s:

- Maryland DNR
  - EOTB website and Tributary Water Quality and Habitat Assessments
  - Presentations to managers, politicians; press releases; assess habitat conditions for fisheries decisions and habitat characterizations; track progress in nutrient reduction strategies
- Virginia DEQ
  - Reports: Statewide 2014 Water Quality Assessment Report, Tributaries and Mainstem Trends report
  - Used in scientific studies

Teams involved in analyses/methods at the states: MDDNR and consultant: Renee Karrh, Mark Trice, Elgin Perry; VADEQ and Old Dominion: Mike Lane, Raghavendra Kurada, Arjun Poddar, and Monika Arora; PIs: Drs. Daniel Dauer, John Donat, Harold Marshall, Todd Egerton; Reviewers: Suzanne Doughten and Anthony Rodi



http://mddnr.chesapeakebay.net/eyesonthebay/statustrends.cfm



http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments/2014305(b)303(d)IntegratedReport.aspx

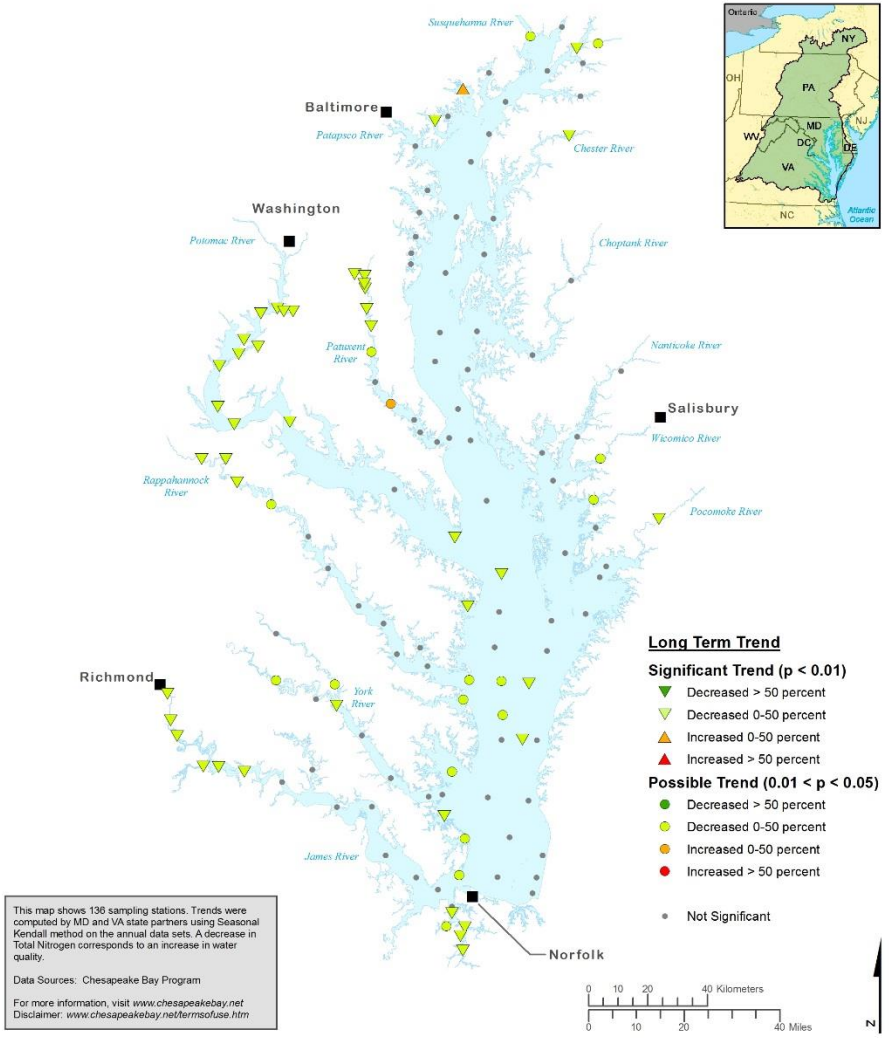
Combined VA and MD Seasonal Kendall Maps

- Analyses not new, but combining the state trends together has not been done recently
- Useful for seeing the big-picture and identifying local differences
- Currently using them to identify areas to target for detailed explaining trends analyses
- Learned about the Seasonal Kendall approach and improvements that could be made → *inform new technique (Generalized Additive Models, GAMs)*

- Map details:
  - Time-period: 1999-2013
  - Annual data
  - Parameters: TN, TP, Chlorophyll-*a*, Secchi Disk Depth

Long-Term Trends for Surface Total Nitrogen in the Chesapeake Bay: 1999-2013

Chesapeake Bay Program
A Watershed Partnership



This map shows 136 sampling stations. Trends were computed by MD and VA state partners using Seasonal Kendall method on the annual data sets. A decrease in Total Nitrogen corresponds to an increase in water quality.

Data Sources: Chesapeake Bay Program

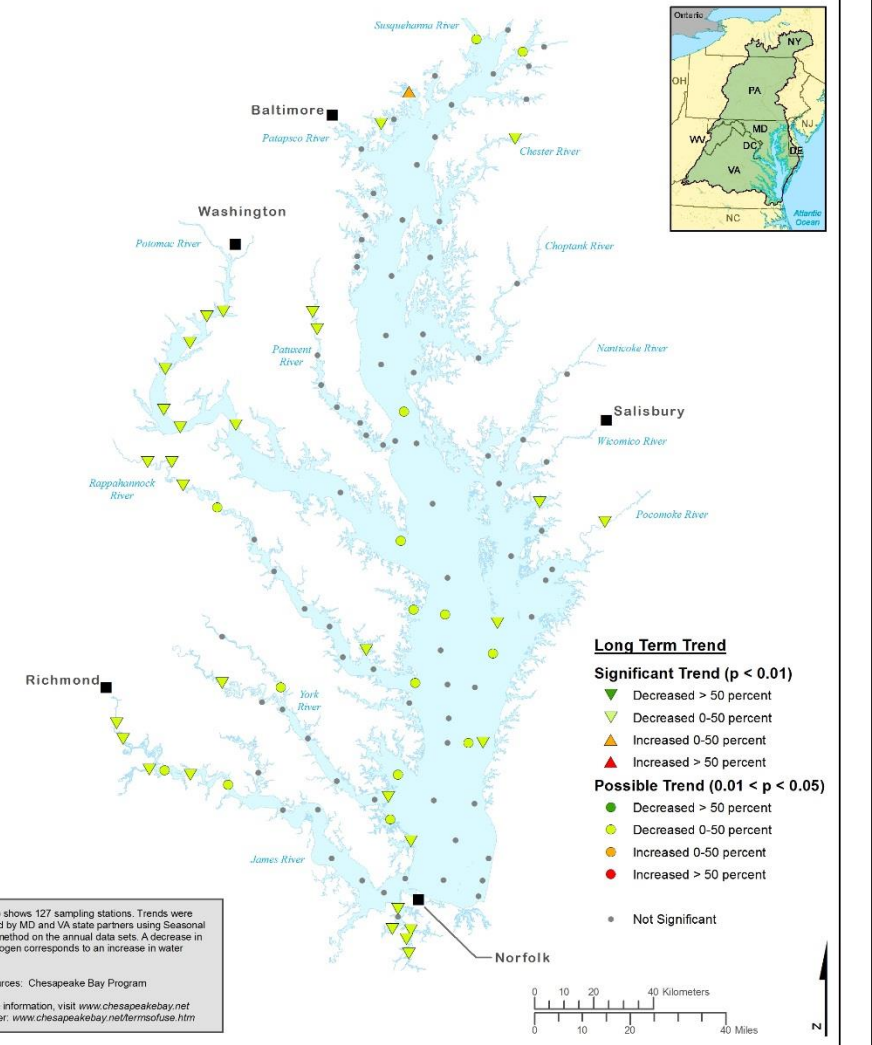
For more information, visit *www.chesapeakebay.net*
Disclaimer: *www.chesapeakebay.net/termsofuse.htm*

Created by HW, 02/23/15

UTM Zone 18N, NAD 83

Long-Term Trends for Bottom Total Nitrogen in the Chesapeake Bay: 1999-2013

Chesapeake Bay Program
A Watershed Partnership



This map shows 127 sampling stations. Trends were computed by MD and VA state partners using Seasonal Kendall method on the annual data sets. A decrease in Total Nitrogen corresponds to an increase in water quality.

Data Sources: Chesapeake Bay Program

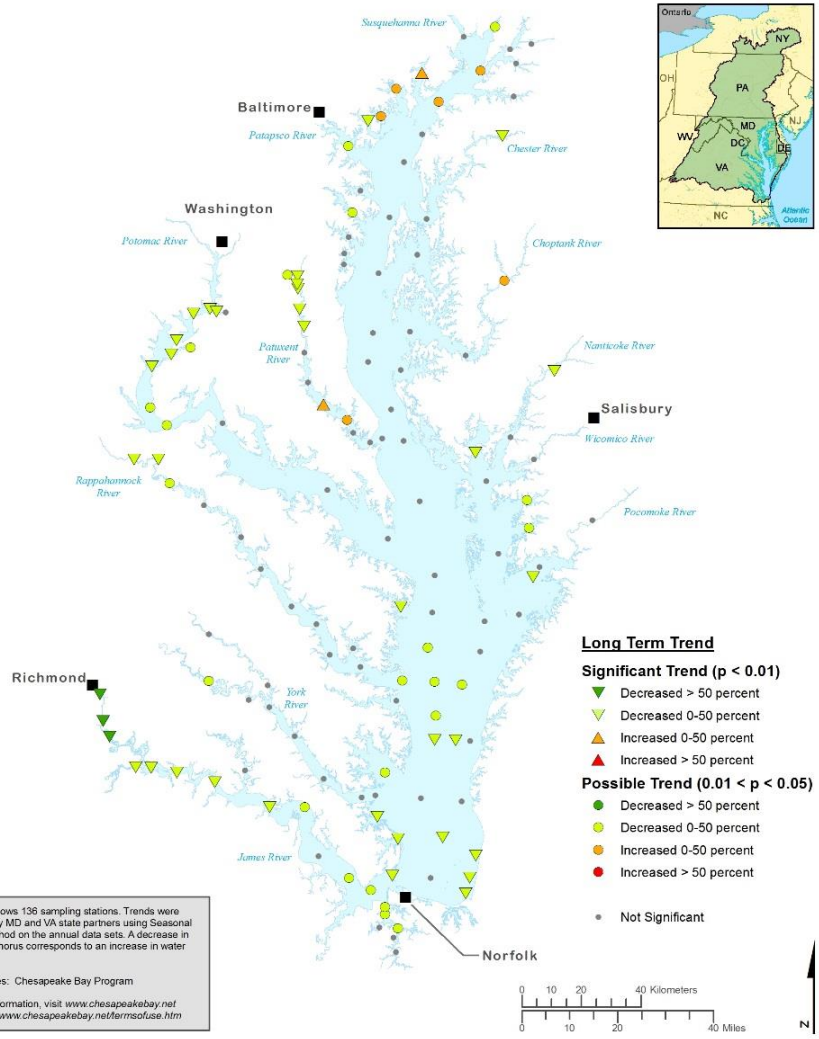
For more information, visit *www.chesapeakebay.net*
Disclaimer: *www.chesapeakebay.net/termsofuse.htm*

Created by HW, 02/23/15

UTM Zone 18N, NAD 83

Long-Term Trends for Surface Total Phosphorus in the Chesapeake Bay: 1999-2013

Chesapeake Bay Program
A Watershed Partnership



Long Term Trend

Significant Trend (p < 0.01)
- Decreased > 50 percent
- Decreased 0-50 percent
- Increased 0-50 percent
- Increased > 50 percent

Possible Trend (0.01 < p < 0.05)
- Decreased > 50 percent
- Decreased 0-50 percent
- Increased 0-50 percent
- Increased > 50 percent

- Not Significant

This map shows 136 sampling stations. Trends were computed by MD and VA state partners using Seasonal Kendall method on the annual data sets. A decrease in Total Phosphorus corresponds to an increase in water quality.

Data Sources: Chesapeake Bay Program

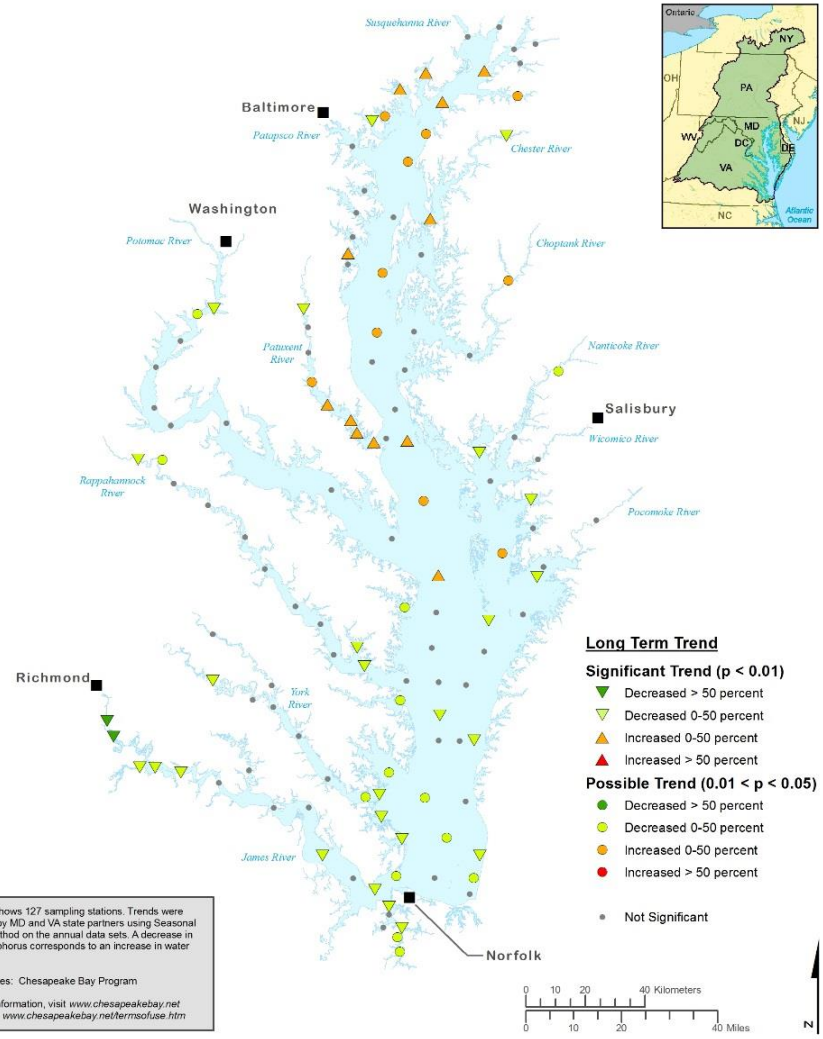
For more information, visit *www.chesapeakebay.net*
Disclaimer: *www.chesapeakebay.net/termsofuse.htm*

Created by HW, 02/23/15

UTM Zone 18N, NAD 83

Long-Term Trends for Bottom Total Phosphorus in the Chesapeake Bay: 1999-2013

Chesapeake Bay Program
A Watershed Partnership



Long Term Trend

Significant Trend (p < 0.01)
- Decreased > 50 percent
- Decreased 0-50 percent
- Increased 0-50 percent
- Increased > 50 percent

Possible Trend (0.01 < p < 0.05)
- Decreased > 50 percent
- Decreased 0-50 percent
- Increased 0-50 percent
- Increased > 50 percent

- Not Significant

This map shows 127 sampling stations. Trends were computed by MD and VA state partners using Seasonal Kendall method on the annual data sets. A decrease in Total Phosphorus corresponds to an increase in water quality.

Data Sources: Chesapeake Bay Program

For more information, visit *www.chesapeakebay.net*
Disclaimer: *www.chesapeakebay.net/termsofuse.htm*

Created by HW, 02/23/15

UTM Zone 18N, NAD 83

Long-Term Trends for Surface Chlorophyll-a in the Chesapeake Bay: 1999-2013

Chesapeake Bay Program
A Watershed Partnership

Susquehanna River
Baltimore
Patapsco River
Chester River
Washington
Potomac River
Choptank River
Patuxent River
Nanticoke River
Salisbury
Wicomico River
Rappahannock River
Pocomoke River
Richmond
York River
James River
Norfolk

Long Term Trend

Significant Trend ($p < 0.01$)
- Decreased > 50 percent
- Decreased 0-50 percent
- Increased 0-50 percent
- Increased > 50 percent

Possible Trend ($0.01 < p < 0.05$)
- Decreased > 50 percent
- Decreased 0-50 percent
- Increased 0-50 percent
- Increased > 50 percent

- Not Significant

0 10 20 40 Kilometers
0 10 20 40 Miles
N

This map shows 136 sampling stations. Trends were computed by MD and VA state partners using Seasonal Kendall method on the annual data sets. A decrease in Chlorophyll-a (Chla) corresponds to an increase in water quality.

Data Sources: Chesapeake Bay Program

For more information, visit *www.chesapeakebay.net*
Disclaimer: *www.chesapeakebay.net/termsofuse.htm*

Created by HW, 02/23/15

UTM Zone 18N, NAD 83

Long-Term Trends for Secchi Disk Depth in the Chesapeake Bay: 1999-2013

Chesapeake Bay Program
A Watershed Partnership

Susquehanna River
Baltimore
Patapsco River
Chester River
Washington
Potomac River
Choptank River
Patuxent River
Nanticoke River
Salisbury
Wicomico River
Rappahannock River
Pocomoke River
Richmond
York River
James River
Norfolk

Long Term Trend

Significant Trend (p < 0.01)

- Secchi depth increased > 50 percent
- Secchi depth increased 0-50 Percent
- Secchi depth decreased 0-50 Percent
- Secchi depth decreased > 50 percent

Possible Trend (0.01 < p < 0.05)

- Secchi depth increased > 50 percent
- Secchi depth increased 0-50 Percent
- Secchi depth decreased 0-50 Percent
- Secchi depth decreased > 50 percent

- Not Significant

This map shows 132 sampling stations. Trends were computed by MD and VA state partners using Seasonal Kendall method on the annual data sets. A decrease in Secchi Depth corresponds to a decrease in water quality.

Data Sources: Chesapeake Bay Program

For more information, visit *www.chesapeakebay.net*
Disclaimer: *www.chesapeakebay.net/termsofuse.htm*

0 10 20 40 Kilometers
0 10 20 40 Miles

N

Created by HW, 02/24/15

UTM Zone 18N, NAD 83

Tidal Trends: Next/on-going efforts

1. Measure Progress

   Actively developing a new trend approach (GAMs)

   - Captures nonlinear patterns and relationships
   - Can be used to test hypotheses of factors affecting trends

2. Explain water-quality changes

   Actively performing and identifying analyses to evaluate trends

   - Examine patterns observed in maps with links to watershed loads, estuarine processes, and climatic forces
   - Link observed trends to patterns in water quality criteria attainment
   - Engaging research community and partners in explanations