

# Updating the Tributary Summaries

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# Tributary Summaries Content

## Potomac Tributary Report:

A summary of trends in tidal water quality and associated factors, 1985-2018.

December 18, 2020

Prepared for the Chesapeake Bay Program (CBP) Partnership by the CBP Integrated Trends Analysis Team (ITAT)



Recommended Citation: Keisman, J., Murphy, R. R., Devereux, O.H., Harcum, J., Karrh, R., Lane, M., Perry, E., Webber, J., Wei, Z., Zhang, Q., Petenbrink, M. 2020. Potomac Tributary Report: A summary of trends in tidal water quality and associated factors. Chesapeake Bay Program, Annapolis MD.

- **Purpose and Scope**
- **Location**
  - *Watershed Physiography*
  - *Land Use*
  - *Tidal Waters and Stations*
- **Tidal Water Quality Status**
- **Tidal Water Quality Trends**
  - *Surface Total Nitrogen*
  - *Surface Total Phosphorous*
  - *Surface Chlorophyll a: Spring*
  - *Surface Chlorophyll a: Summer*
  - *Secchi Disk Depth*
  - *Summer Bottom Dissolved Oxygen*
  - *Water Temperature*
- **Factors Affecting Trends**
  - Watershed Factors
    - *Effects of Physical Setting*
    - *Estimated Nutrient and Sediment Loads*
    - *Expected Effects of Changing Watershed Conditions*
    - *Best Management Practices (BMPs) Implementation.*
  - Tidal Factors
  - Insights on Changes in the Potomac
- **Summary**
- **References**
- **Appendices**



# Needs from this discussion

Are we missing  
any steps?

2) What the time  
frames are for  
each step?

3) What needs to  
be done to  
operationalize  
each step?

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# General Questions before we begin:

## 1. What is the timeline for updating CAST and Annual Progress? *(Every 2 years for CAST; 1 year for Annual Progress)*

- Should we wait to update the graphs until we get 2021 Progress data in CAST-21?

## 2. What are the long-term goals?

- Update the tributary summaries every time the tidal data is updated?
- OR: Having staff in each tributary to update the tributary summary reports?

## 1. Purpose and Scope

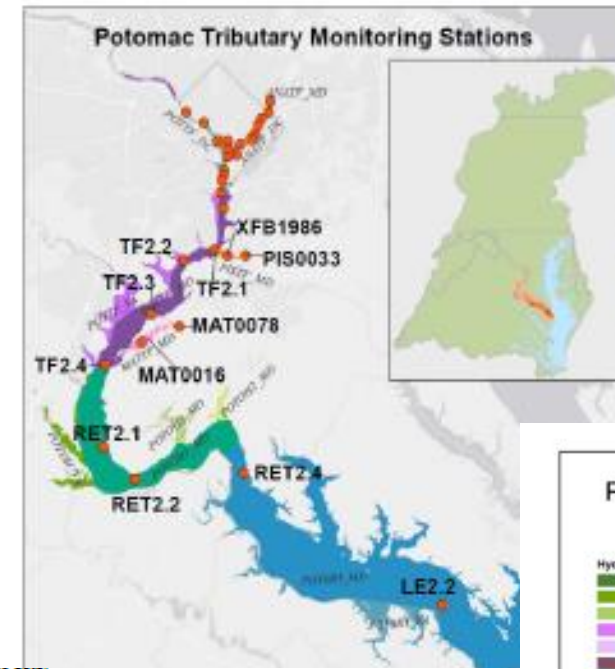
- Include Water Temperature text

## 2. Location

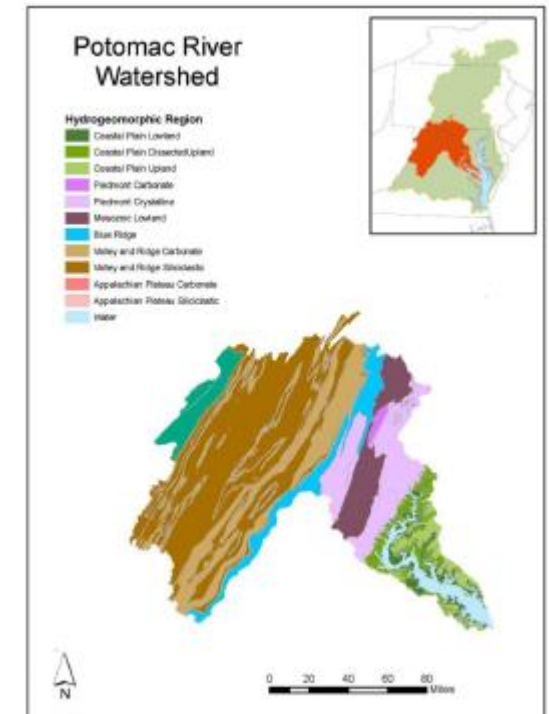
- *Watershed Physiography*
- *Land Use*
  - Olivia worked on this.
  - Update Land Use text and land use graph to include CAST 2019 data
- *Tidal Waters and Stations*

## 3. Tidal Water Quality Status

- Rebecca and Qian worked on this
- Update with 2017 - 2019 data text and tables on criteria, update text and graphs of comparing criteria with water quality trends

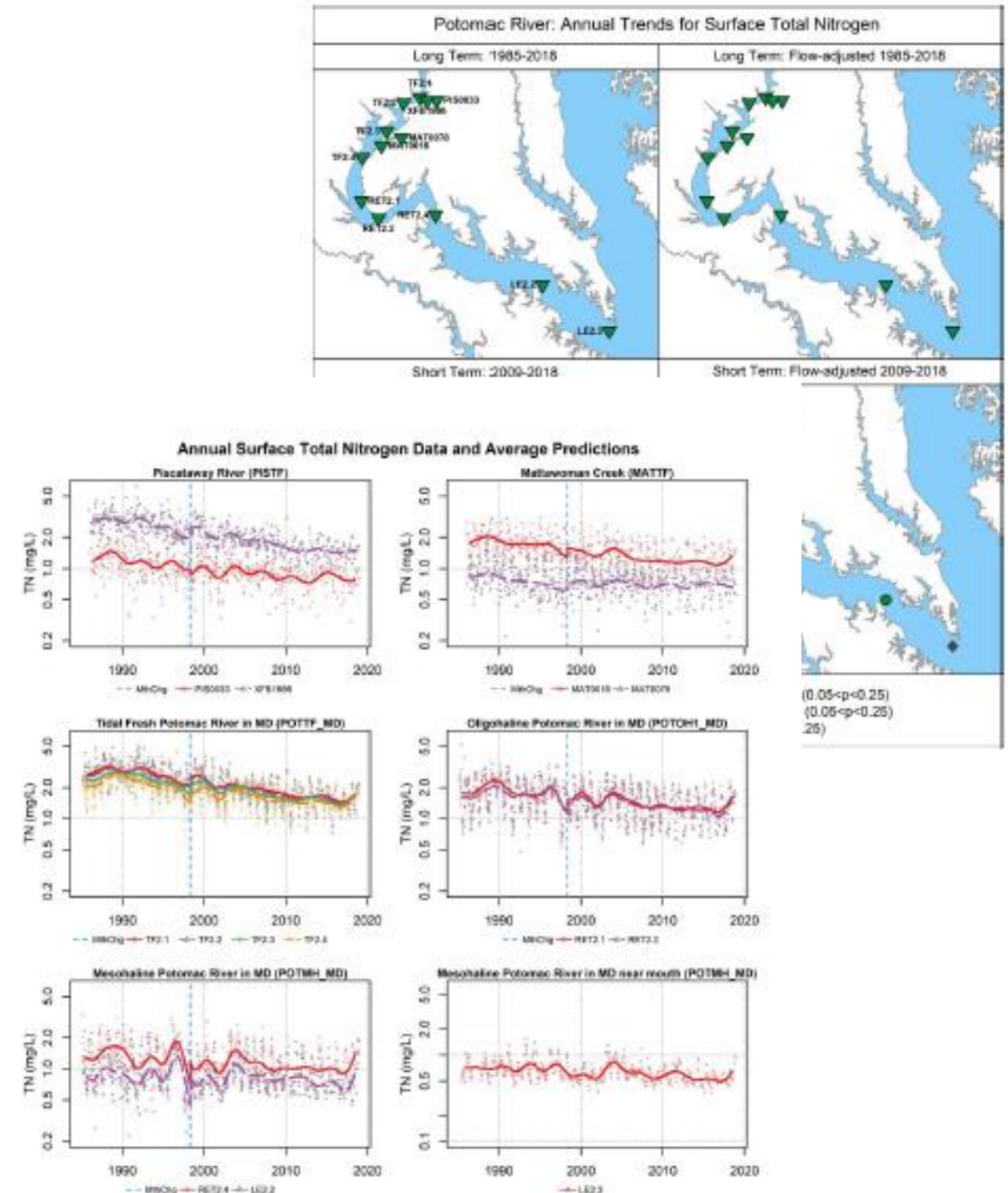


| Time period | ANAT_DC | ANAT_MD | PSIF | MATF | POTF_DC | POTF_MD | POTF_VA | POT1_MD | POT2_MD | POT3_MD | POT4_VA | POT5_MD | POT6_VA |
|-------------|---------|---------|------|------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1985-1987   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 1988-1989   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 1990-1991   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 1992-1993   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 1994-1995   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 1996-1997   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 1998-1999   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2000-2001   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2002-2003   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2004-2005   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2006-2007   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2008-2009   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2010-2011   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2012-2013   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2014-2015   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2016-2017   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |
| 2018-2019   |         |         |      |      |         |         |         | ND      | ND      | ND      |         |         | ND      |



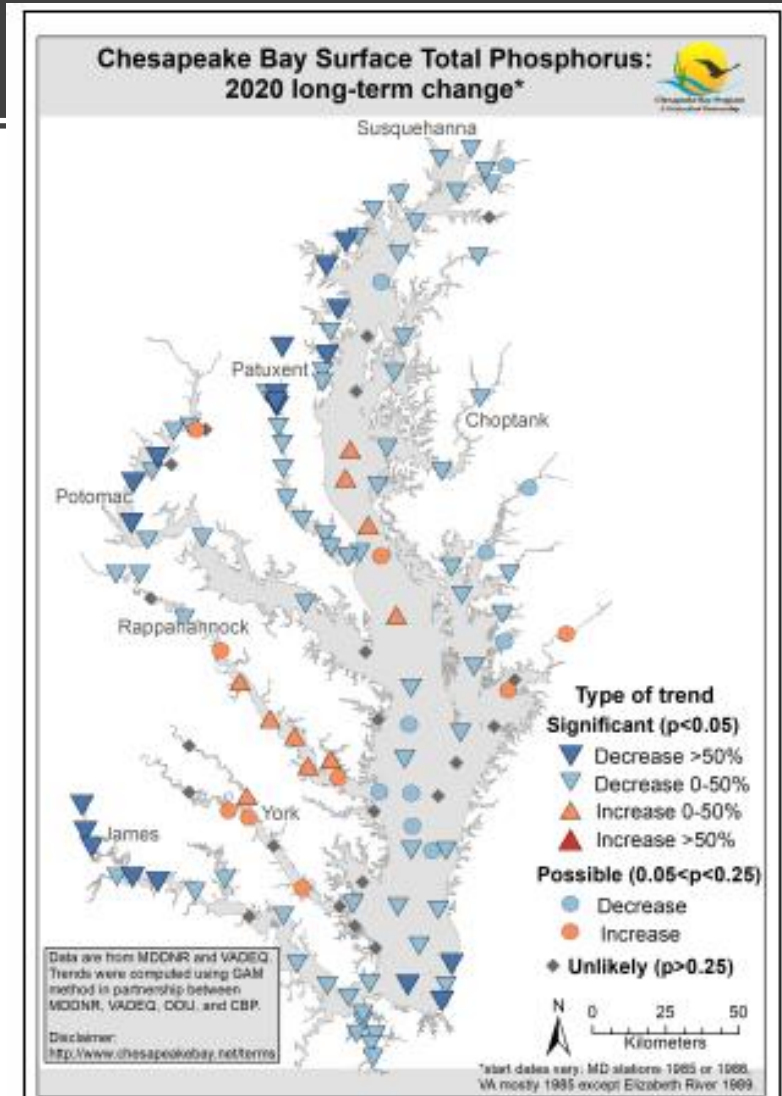
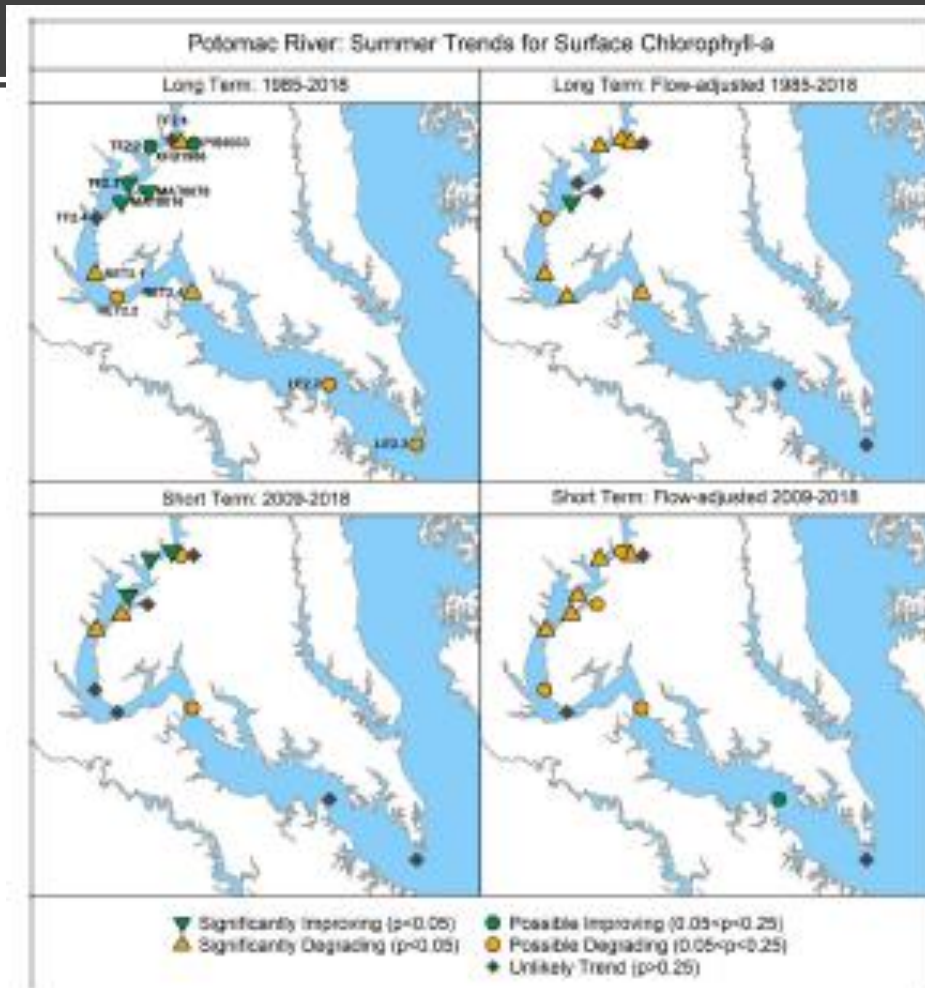
## 4. Tidal Water Quality Trends

- *Surface Total Nitrogen*
- *Surface Total Phosphorous*
- *Surface Chlorophyll a: Spring*
- *Surface Chlorophyll a: Summer*
- *Secchi Disk Depth*
- *Summer Bottom Dissolved Oxygen*
  - Update text, four planal plots, annual surface total nitrogen data and average predictions
  - Rebecca has created the 2020 line plots with instructions. She will be re-running the maps.
- ***Water Temperature***
  - Need to Add





# Should we change the colors on the trend graphics?



# 5. Factors Affecting Trends

## ○ Watershed Factors

### • *Effects of Physical Setting*

- Jimmy Webber worked on this. Note that the FN load table is provided as Section 5.1.5 (last part of Section 5)
- Update Table of flow normalized TN, TP, SS for nontidal network (more recent data available?; where/who does this data come from?)
- Are there updated studies we would like to reference in the text?

### • *Estimated Nutrient and Sediment Loads*

- Qian worked on this.
- Source data from Gopal (for below-RIM load) and USGS CBRIM website (for RIM load).
- Qian did subsequent analysis in Excel and R to get the time series shown in the Figure, Trends shown in the Table, and Numbers shown in the text.
- Steps to reproduce the analysis and tables/figures have been documented.
- Update Mann-Kendall trends and Sen slope estimates table
- Update Text
- Update Estimated loads from RIM and below-RIM graph

Table 3. Trends (2009 – 2018) in flow normalized total nitrogen (TN), total phosphorus (TP), and suspended sediment (SS) for nontidal network monitoring locations in the Potomac River watershed.

| Parameter | No. of stations | Value    | Trend direction |           |          |
|-----------|-----------------|----------|-----------------|-----------|----------|
|           |                 |          | degrading       | improving | no trend |
| TN        | 28              | n        | 7               | 14        | 7        |
|           |                 | median % | 15.4%           | -5.8%     | 1.1%     |
| TP        | 18              | n        | 0               | 12        | 6        |
|           |                 | median % | -               | -28.9%    | 8.5%     |
| SSC       | 18              | n        | 5               | 5         | 8        |
|           |                 |          |                 |           |          |

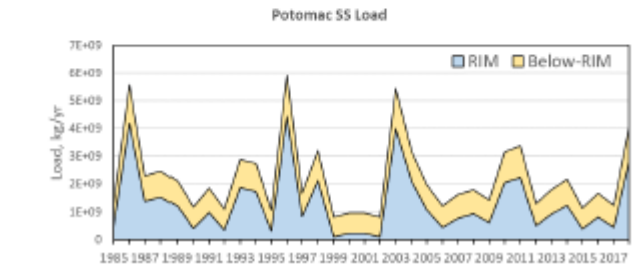
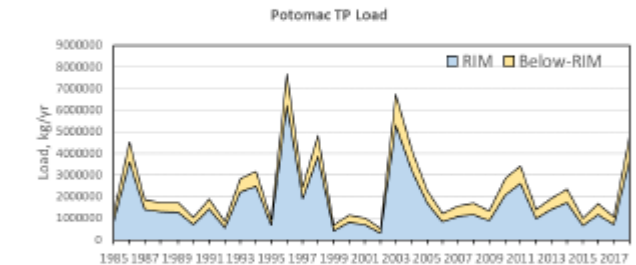
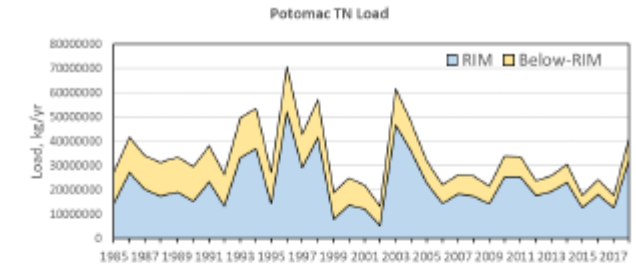


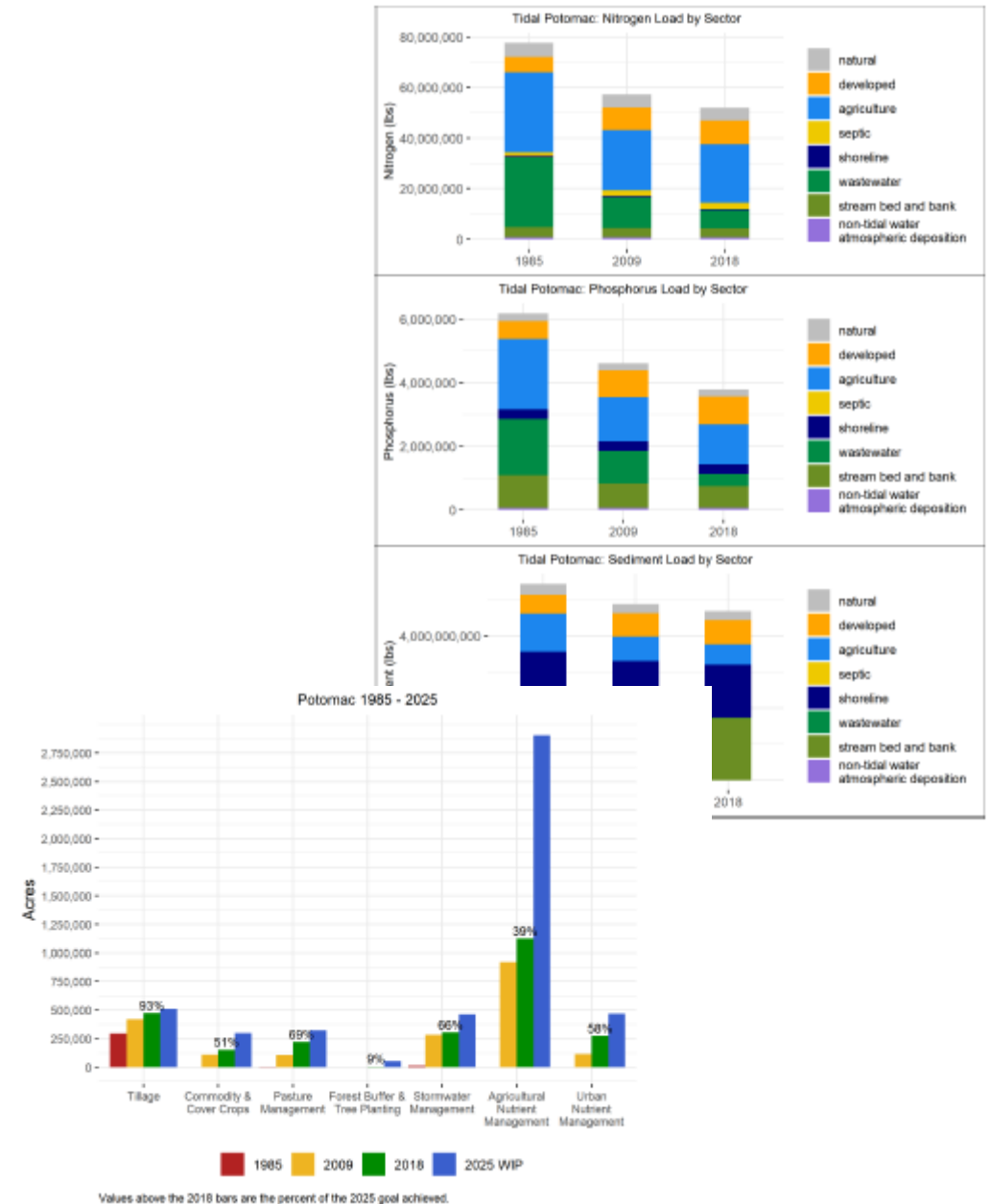
Table 4. Summary of Mann-Kendall trends for the phosphorus (TP), and suspended sediment (SS) load

| Variable                               | Trend  |
|--|--------|
| <b>TN</b>                              |        |
| Total watershed                        | -349   |
| RIM watershed <sup>1</sup>             | -47    |
| Below-RIM watershed <sup>2</sup>       | -306   |
| Below-RIM point source                 | -316   |
| Below-RIM nonpoint source <sup>3</sup> | 13     |
| Below-RIM tidal deposition             | -7.6   |
| <b>TP</b>                              |        |
| Total watershed                        | 1.6    |
| RIM watershed                          | 0.0    |
| Below-RIM watershed                    | 2.4    |
| Below-RIM point source                 | -1.8   |
| Below-RIM nonpoint source              | 4.7    |
| <b>SS</b>                              |        |
| Total watershed                        | -4,988 |
| RIM watershed                          | -6,426 |
| Below-RIM watershed                    | -280   |
| Below-RIM point source                 | -138   |
| Below-RIM nonpoint source              | -152   |



## 5. Factors Affecting Trends

- Watershed Factors
  - *Expected Effects of Changing Watershed Conditions*
    - Did Olivia work on this?
    - Update text
    - Update Expected Long-term average loads graph from CAST
  - *Best Management Practices (BMPs) Implementation*
    - Olivia can update this automatically.
    - Update text
    - Update BMP implementation graph



## 5. Factors Affecting Trends

- **Tidal Factors**
  - Rebecca worked on
- **Insights on Changes in the Potomac**
  - Update for Potomac and Rappahannock
  - Rebecca worked on
  - Tom left instructions for Figures 24 and 25.

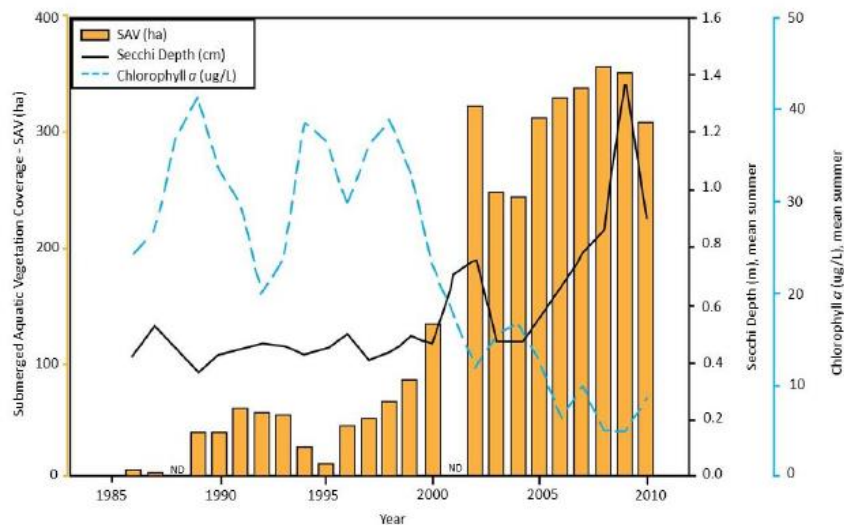


Figure 24. Annual summary of SAV coverage (ha), water clarity (Secchi disk depth), and algal biomass (chlorophyll *a* concentration) for the period 1986-2010 in Mattawoman Creek. Note the large change in SAV coverage and water clarity associated with the large decline in algal biomass. From Boynton *et al.* (2014).

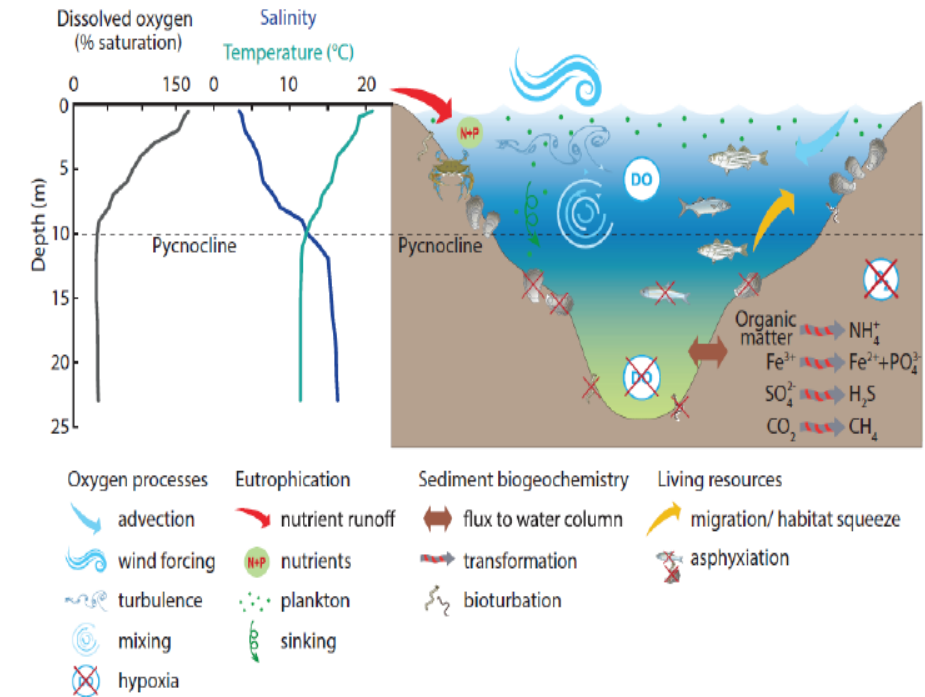


Figure 22. Conceptual diagram illustrating how hypoxia is driven by eutrophication and physical forcing, while affecting sediment biogeochemistry and living resources. From Testa *et al.* (2017).

## 6. Summary

- **References**
  - Qian worked on this
- **Appendices**
  - Rebecca worked on this
- ***Additional Need: Big Picture Review***
  - Checking figure numbers and their references, checking format, table of contents.
  - Meghan Petenbrink and Jeni originally did this for the reports.