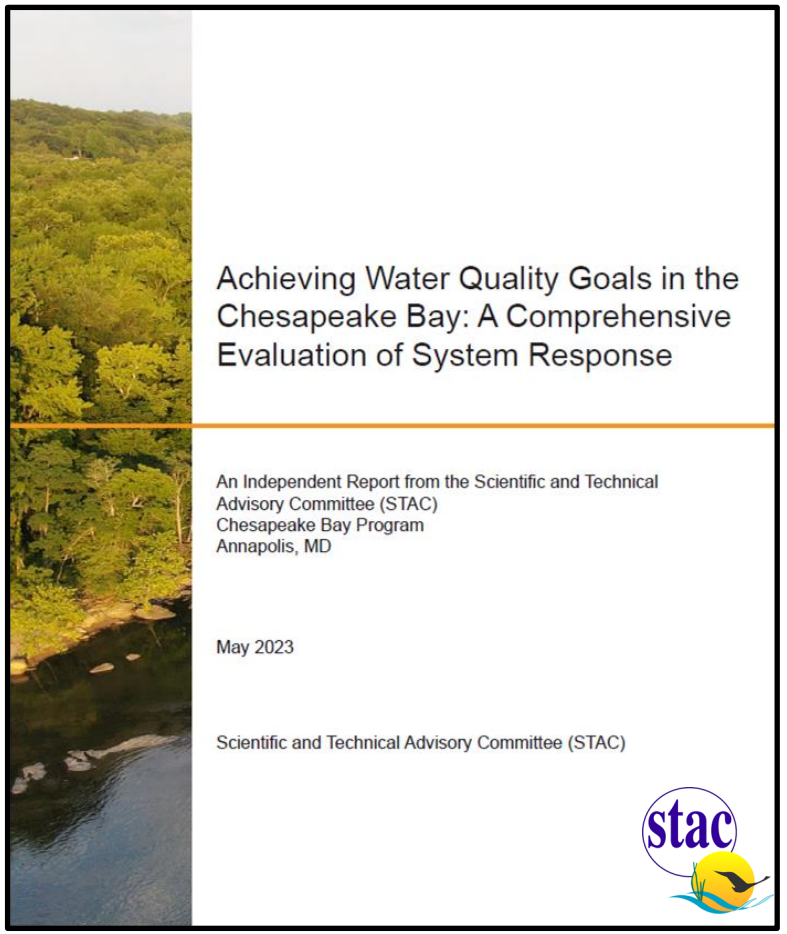
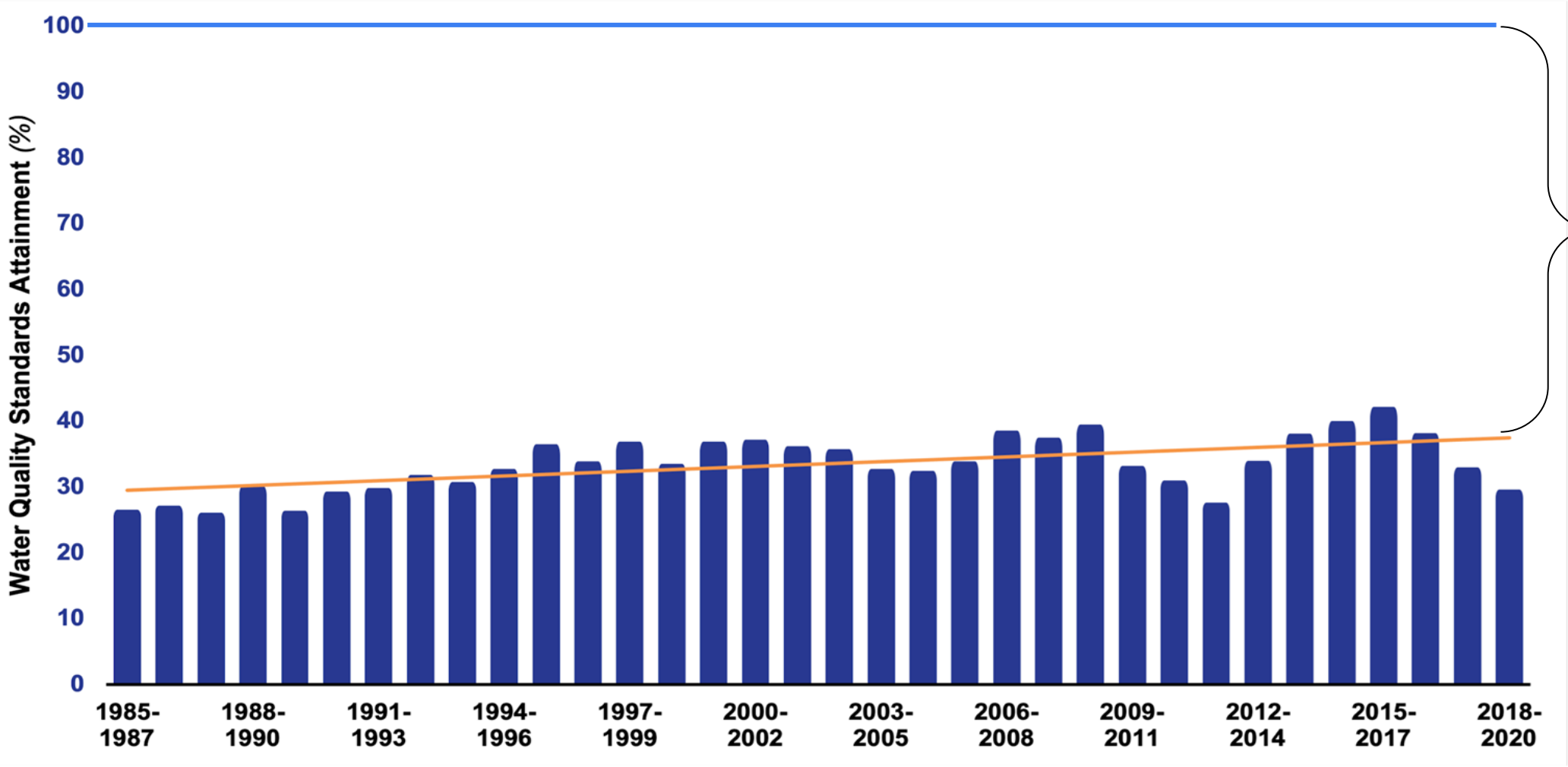
Unpacking CESR: Findings and implications for agricultural nonpoint sources

Kurt Stephenson
Virginia Tech

Ag Work Group
November 21, 2024



Motivation for the report



Why?

Chesapeake Bay Water Quality Goals

Chesapeake Bay Agreement → **Water Quality Goal** → **Measurement of the Goal** → **Achieving the Goal**

Restoration Goals
Sustainable Fisheries
Vital Habitat
Water Quality
Toxic Contaminants
Heathy Watershed
Climate Resiliency
Land Conservation
Stewardship
Public Access
Environmental Literacy

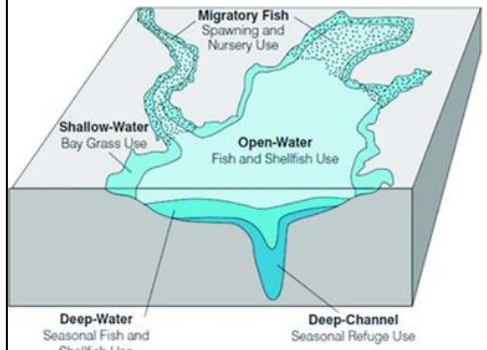
Protect aquatic living resources

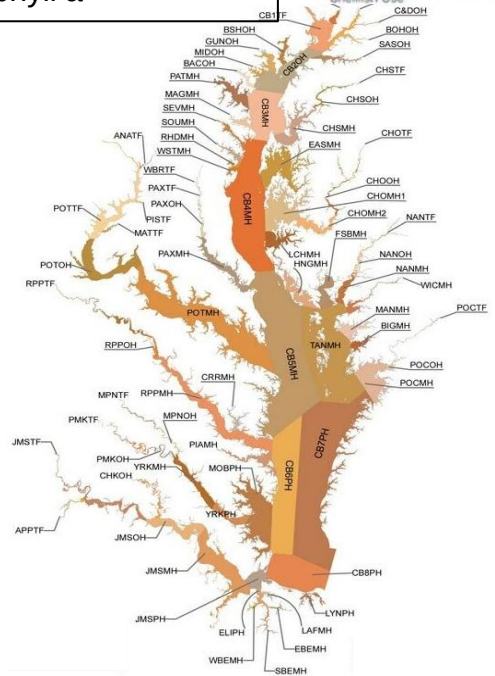
Numeric Criteria

Dissolved Oxygen (DO) (30 day avg, 7 day avg, instantaneous):

Water Clarity/Aquatic Vegetation

Chlorophyll a





TMDL
N, P, sediment targets to meet goal

Pollutant Control Programs

Accountability

CESR: “**C**omprehensive **E**valuation of **S**ystem **R**esponse”

CESR Themes

Many accomplishments and successes, but goals more difficult to achieve than expected

Opportunities to improve outcomes, but requires policy change

Acknowledge & address uncertainty

CESR highlights for this group

Findings

Meeting the TMDL depends on nonpoint sources, but current policies have not generated the scale of reductions needed

Actionable Ideas

1. Accounting for Outcomes
2. Mass Balance
3. Target Investments
4. Pay for Success/performance
5. Tiered Implementation of the TMDL

Findings

Meeting the TMDL depends on nonpoint sources, but current policies have not generated the scale of reductions needed

Findings

Meeting the TMDL depends on nonpoint sources, but current policies have not generated the scale of reductions needed

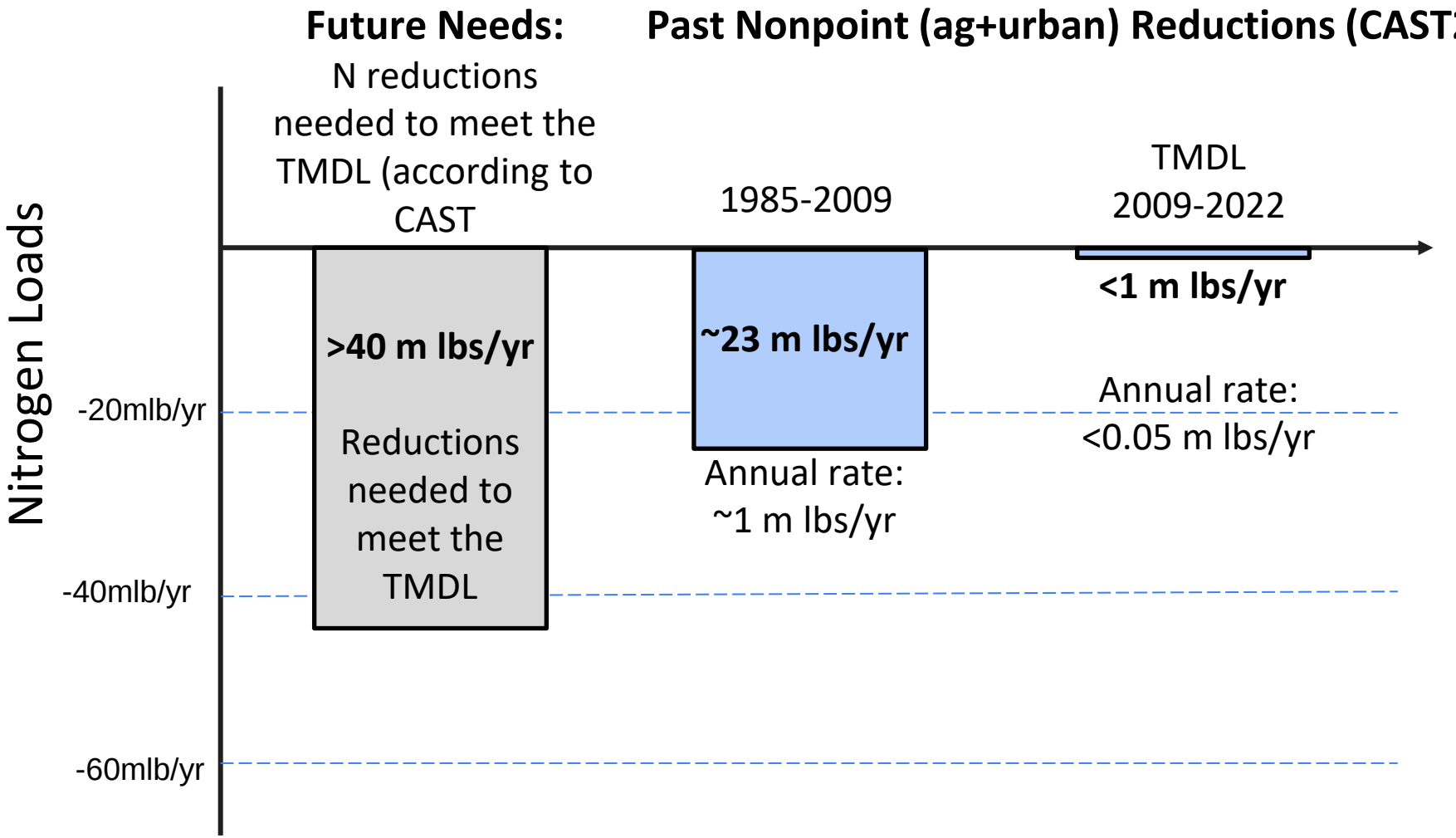
Implementation Gap

Response Gap

Uncertainty

Implementation Gap

Nitrogen



Response Gap

Nonpoint source load reductions may not be occurring at the levels predicted

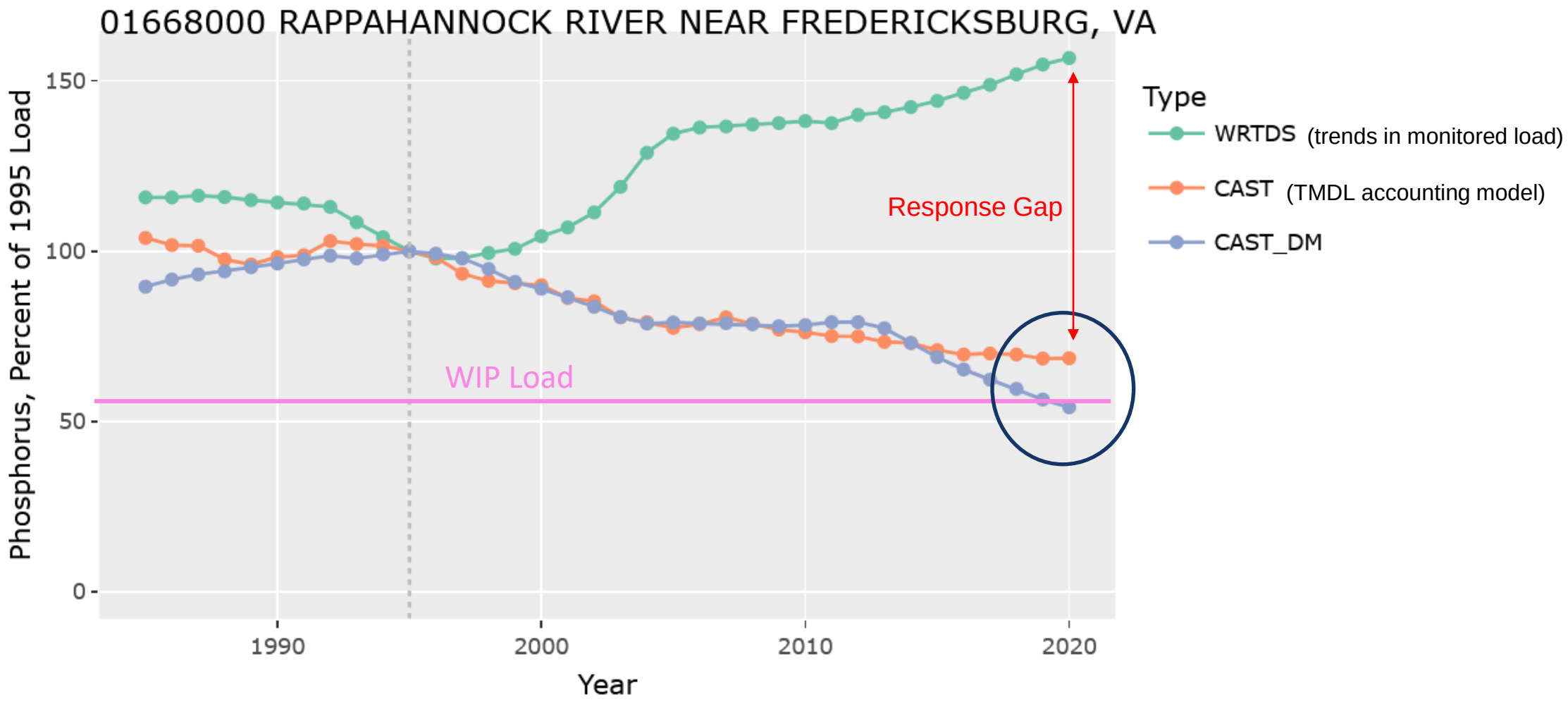
Response Gap:
Phosphorus

Long term Trends in Total Phosphorus Loads

River	Monitoring Observations	CAST Model
Susquehanna	—	↓
Potomac	↓	↓
Choptank	↑	↓
Patuxent	↓	↓
Rappahannock	↑	↓
Mattaponi	—	↑
Pamunkey	↑	↓
James	↓	↓
Appomattox	↑	↓

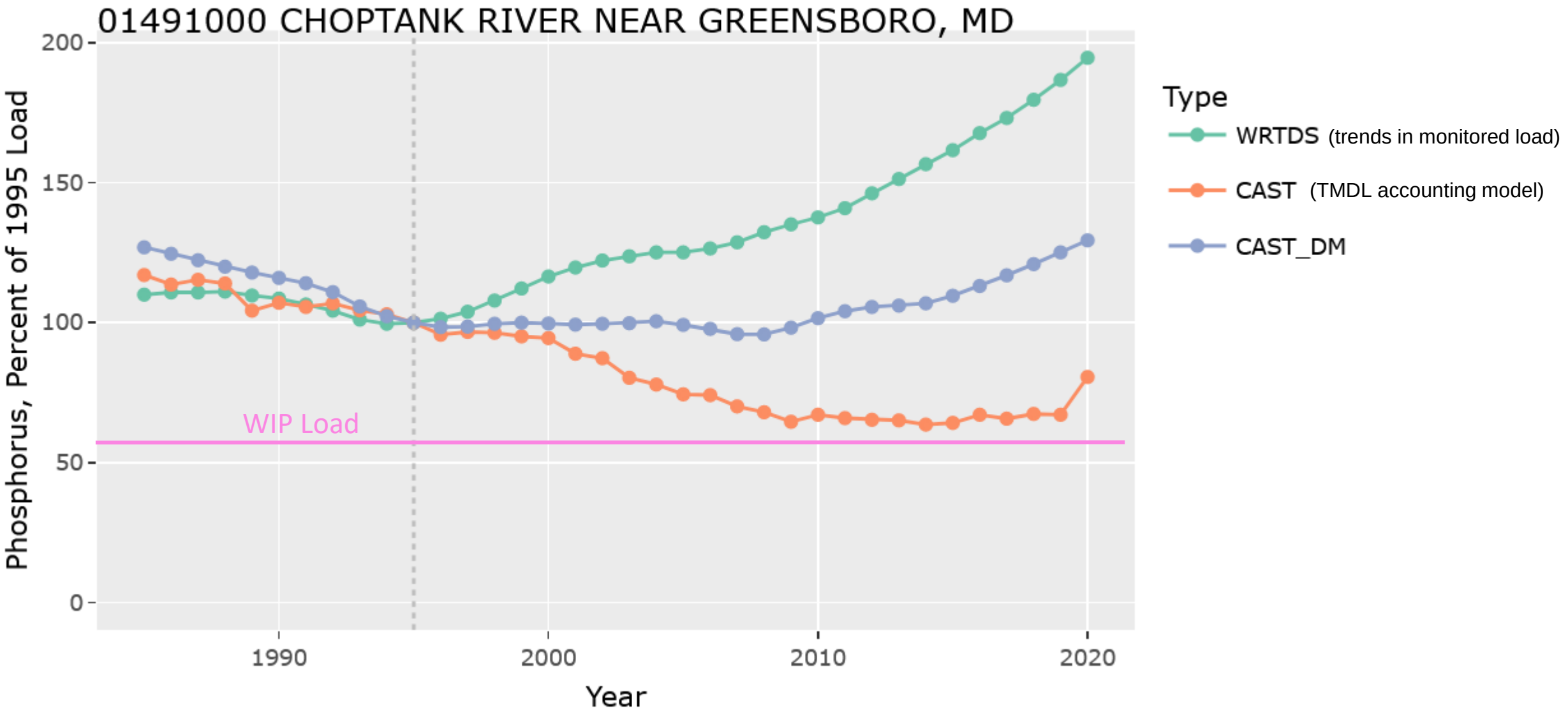
Increasing Loads	Decreasing Loads

Response gap
Ex P trends Rappahannock



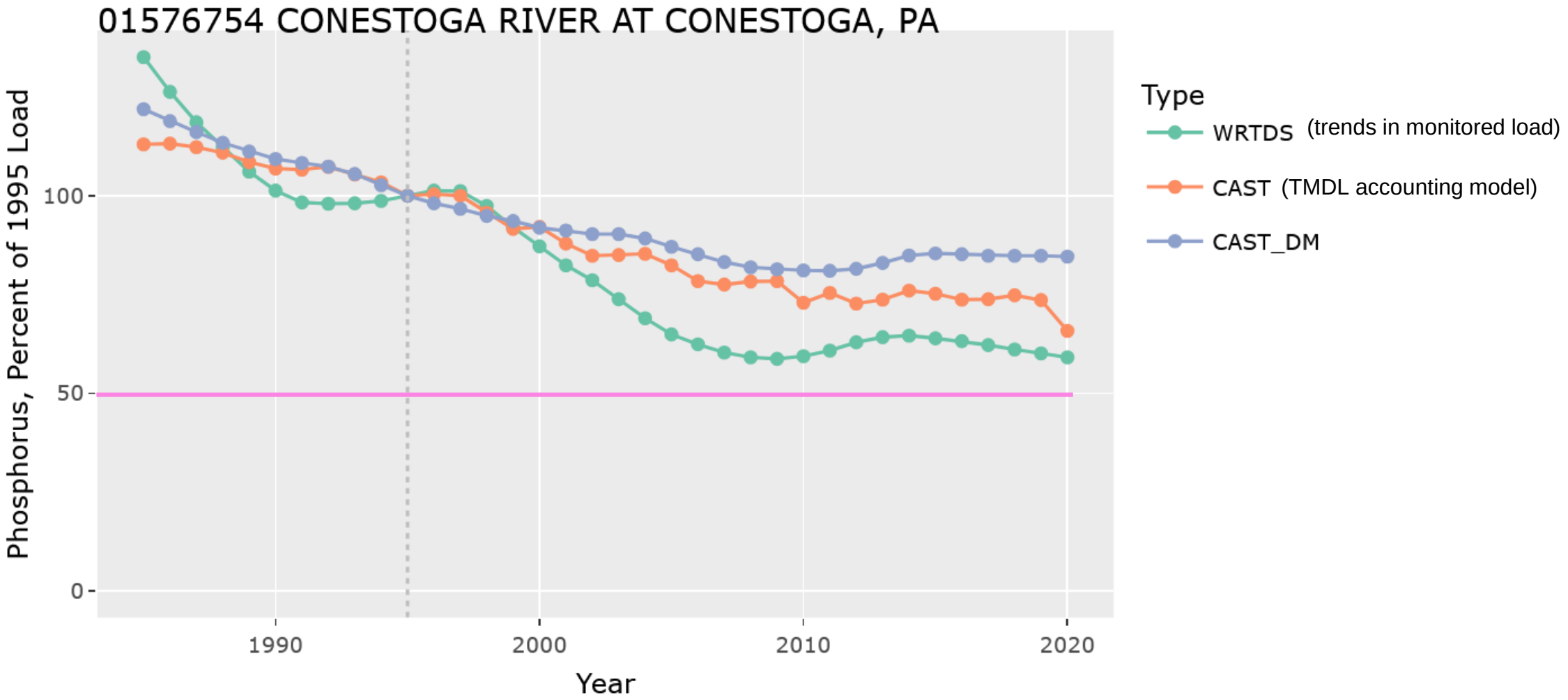
Source: https://zhangqian0324.shinyapps.io/CBNTN_TMDL_Indicator/

Response Gap
P Trends Choptank



Source: https://zhangqian0324.shinyapps.io/CBNTN_TMDL_Indicator/

Response gaps aren’t everywhere!
P Trends Conestoga, PA



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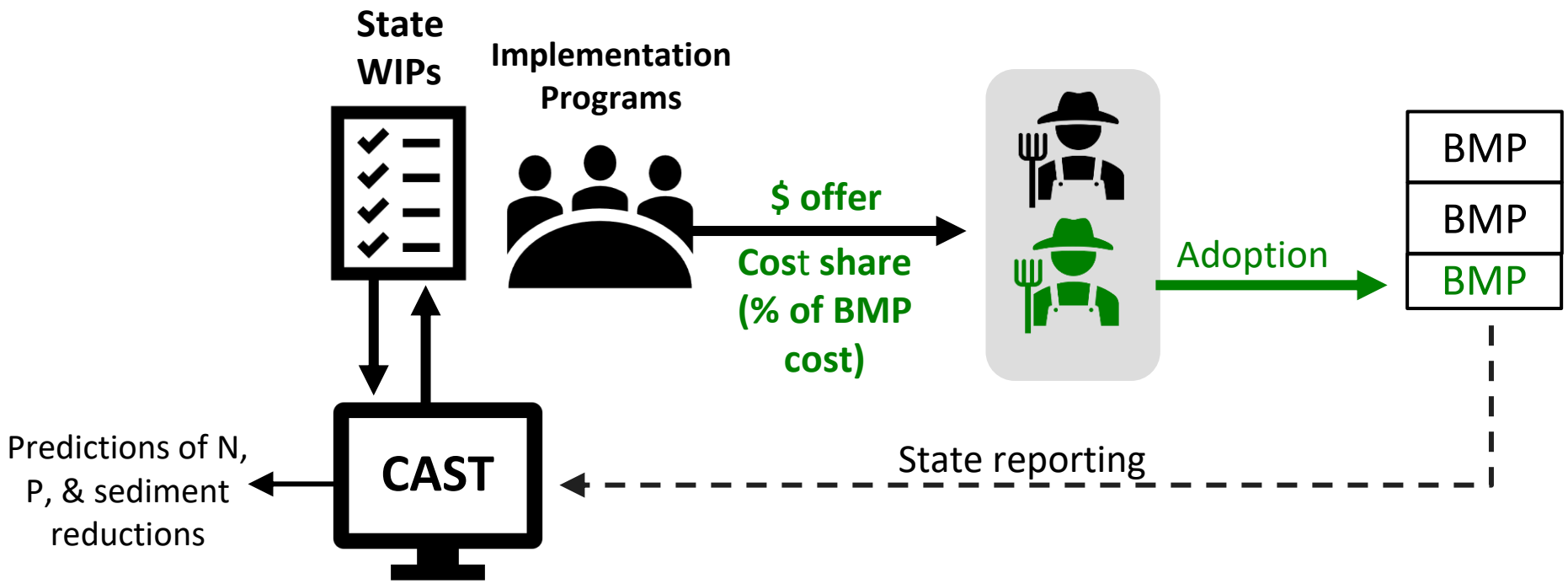
CESR actionable items with important implications for agriculture

1. Accounting for Outcomes
2. Mass Balance
3. Target Investments
4. Pay for Success/performance
5. Tiered Implementation of the TMDL

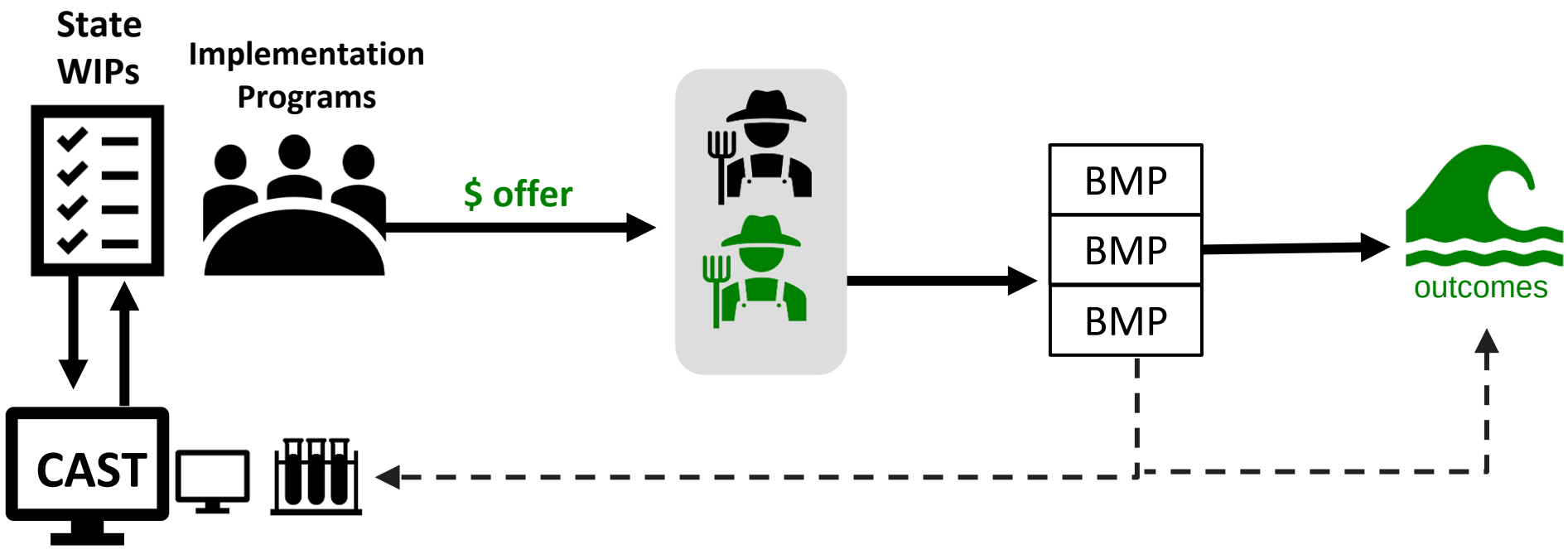
Nonpoint Source Policy



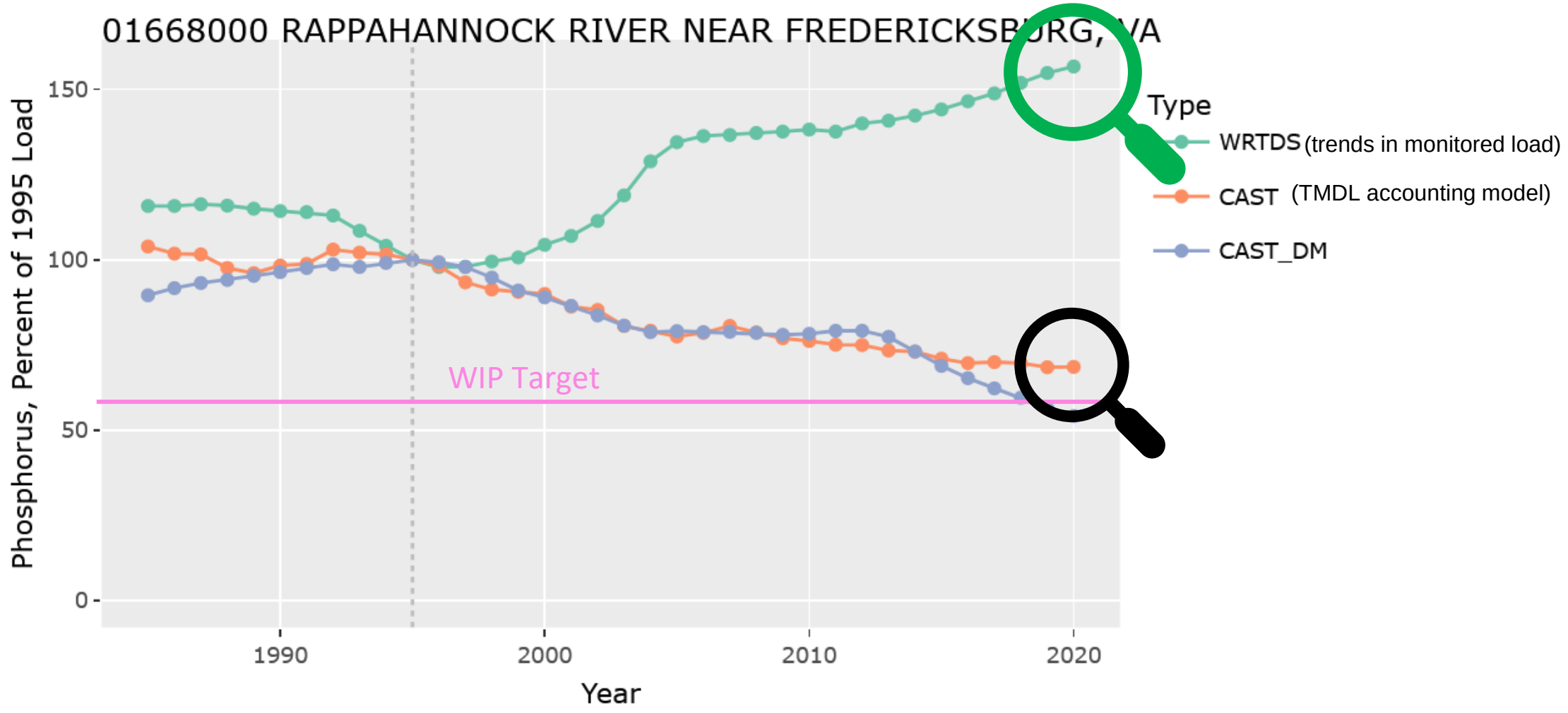
CESR Actionable Items

1. Accounting for Outcomes

Nonpoint Source Accounting and Accountability



Response gap
Ex P trends Rappahannock



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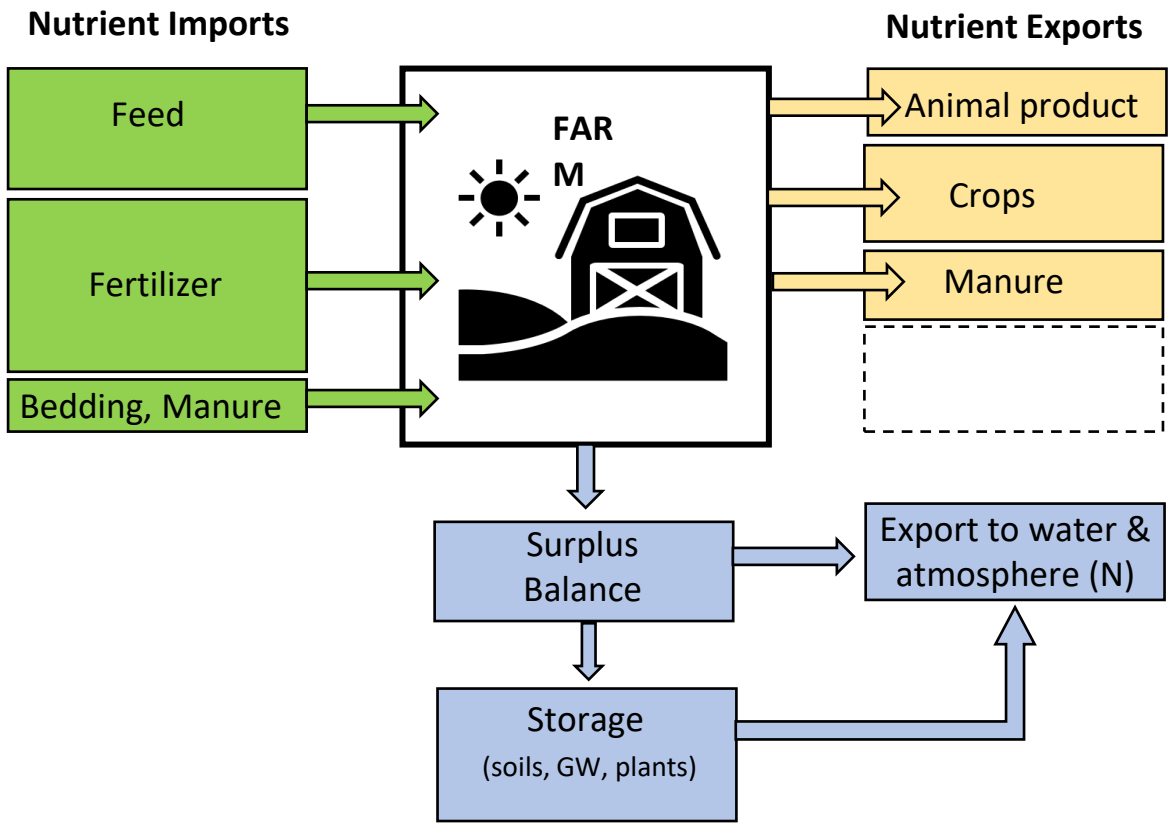
CESR Actionable Items

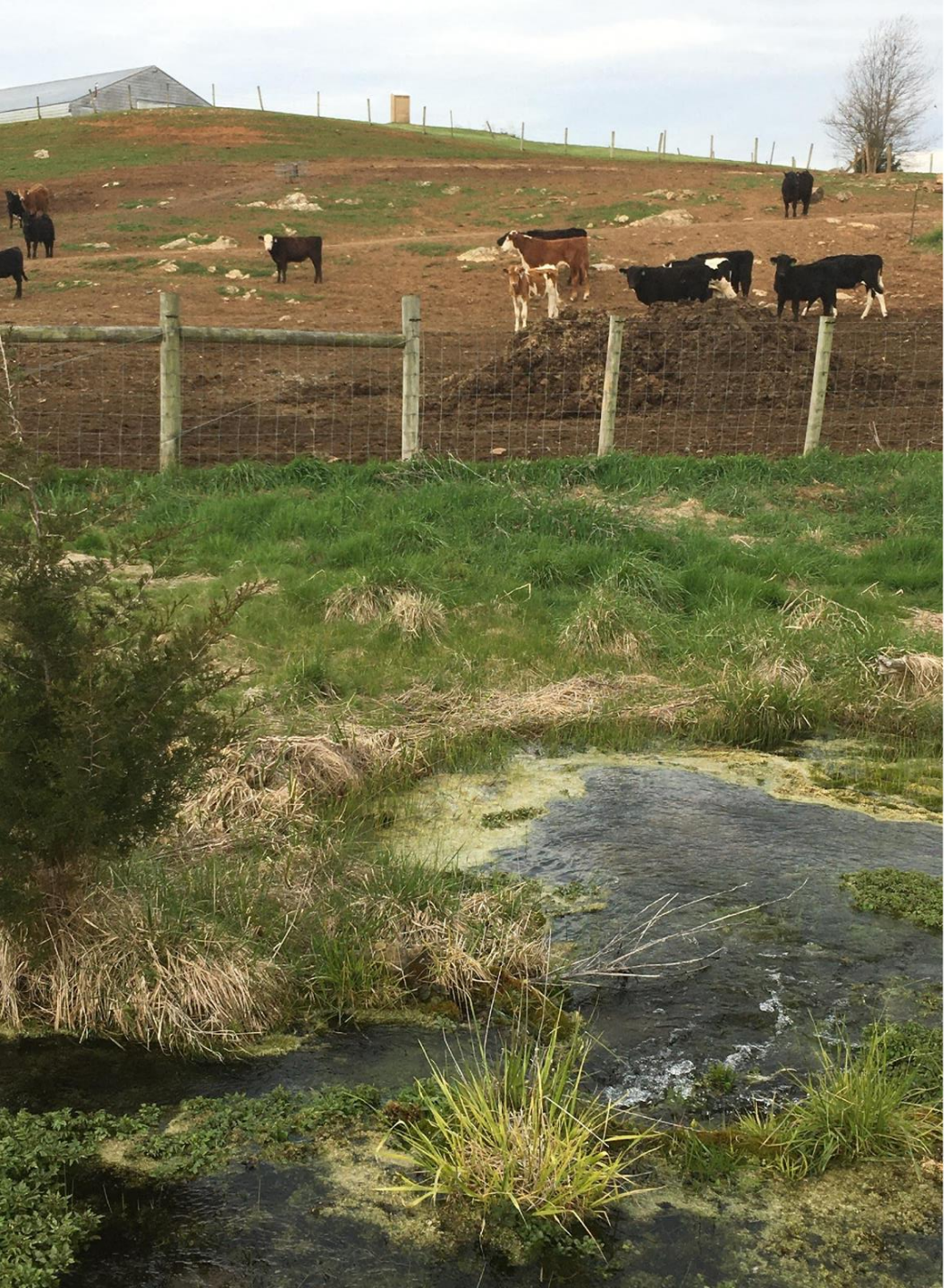
1. Accounting for Outcomes
2. Mass Balance

Nutrient Mass Balance



Inputs = Outputs ± Storage

Showcase Watershed: Smith Creek VA



Over past 3 decades, the number of animal units increasing

Over past 3 decades, 4x increase in # of BMPs installed in watershed

Pictured: riparian buffer at headwater spring

Result:

TN and TP loads increasing over time

Source: Webber et al, 2024, Evaluating Water-quality Trends in Agricultural Watersheds prioritized for best management practice implementation, *J of the Amer. Water Resources Association.*

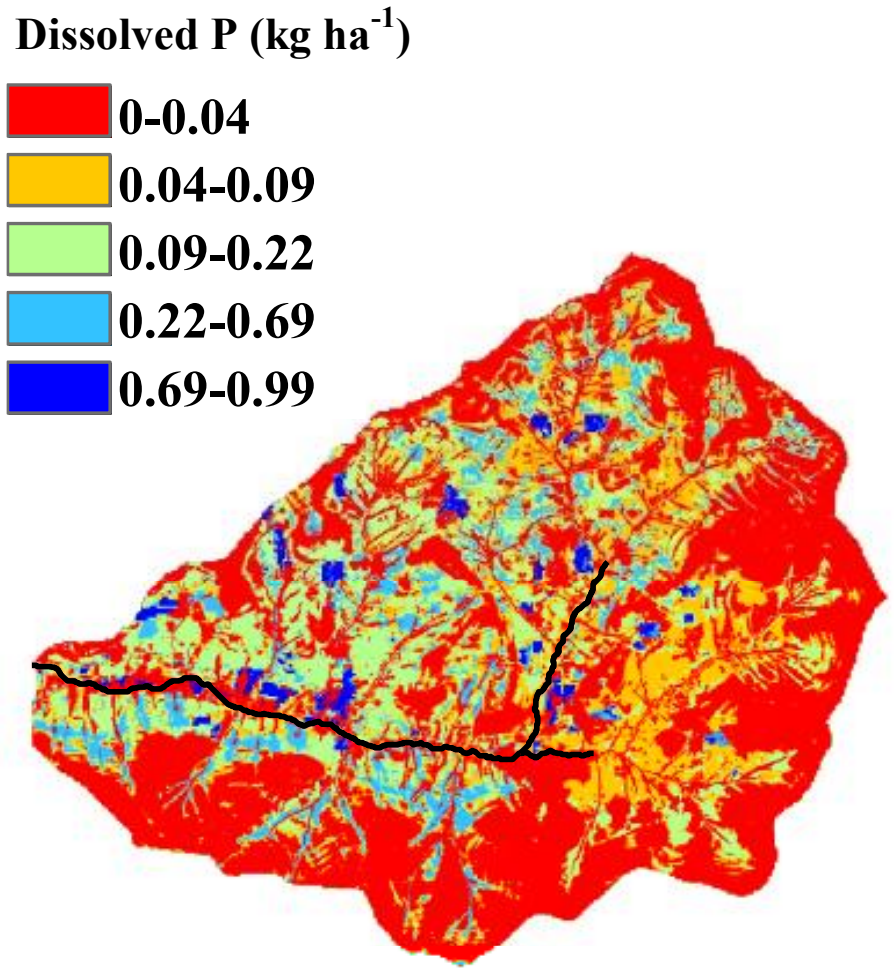
CESR Actionable Items

1. Accounting for Outcomes
2. Mass Balance
3. **Target Investments**

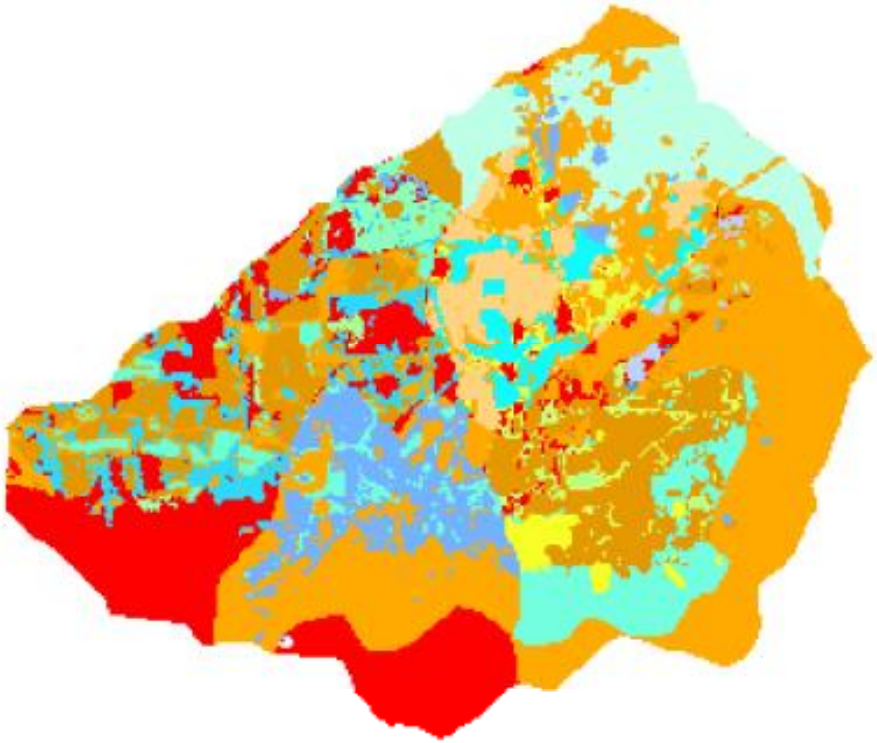
Phosphorus loads under different assumptions

Both have the same aggregate P load

Would you manage any differently if you assumed one or the other?



Loads under site specific conditions

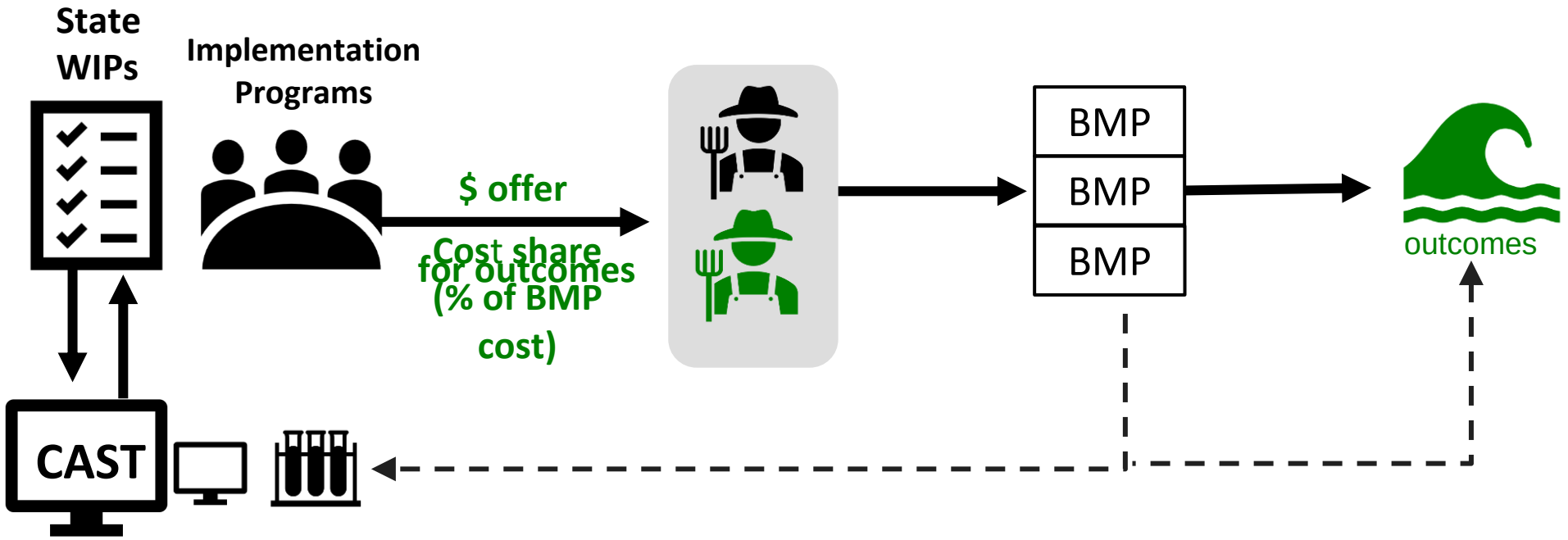


Loads under average conditions

CESR Actionable Items

1. Accounting for Outcomes
2. Mass Balance
3. Target Investments
4. **Pay for outcomes/performance**

Nonpoint source policy change & innovation



Incentivize Outcomes

Cover crops

Livestock Exclusion Fencing

Bioreactor

Low upfront installation costs
Some private benefits

High up front installation costs
No private benefits

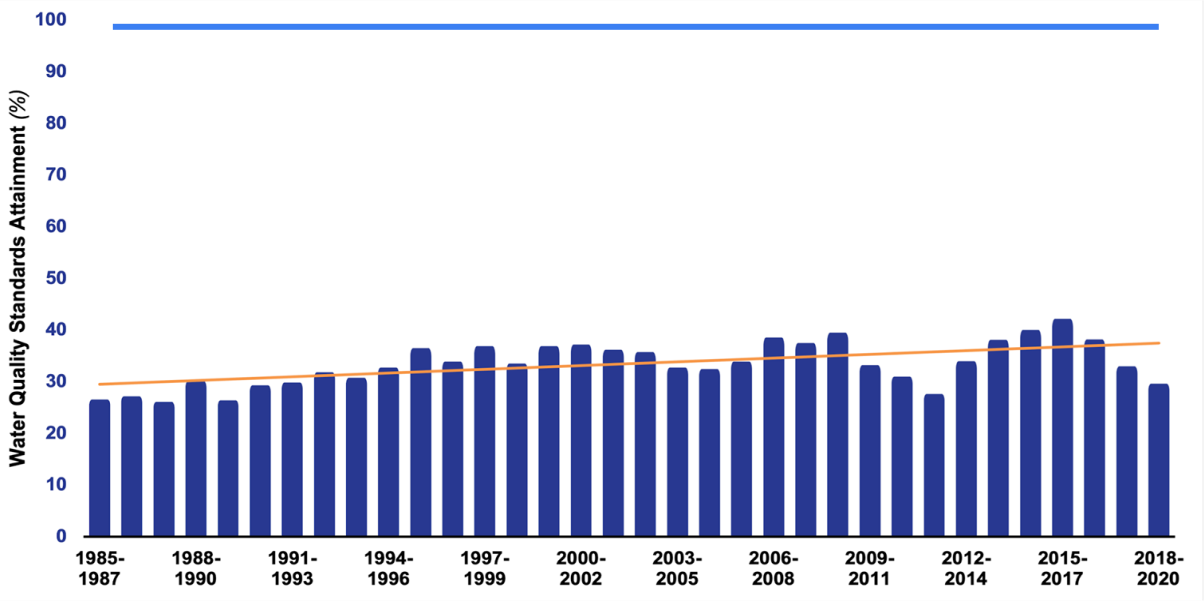
Partially compensate for cost => a pattern of participation and adoption

Compensate for outcomes => different pattern of participation and adoption?

CESR Actionable Items

1. Accounting for Outcomes
2. Mass Balance
3. Target Investments
4. Pay for Success/performance
5. Tiered Implementation of the TMDL

Overall CESR Finding



"Additional nutrient reductions will improve water quality, but water quality criteria may be unattainable in some regions of the Bay" (CESR p. viii)

"The slow rate of water quality change in the estuary suggests that achievement of WQS in the Bay is uncertain and remains in the distant future" (CESR, p. 76)

CESR Suggestion: Tiered Implementation of TMDL

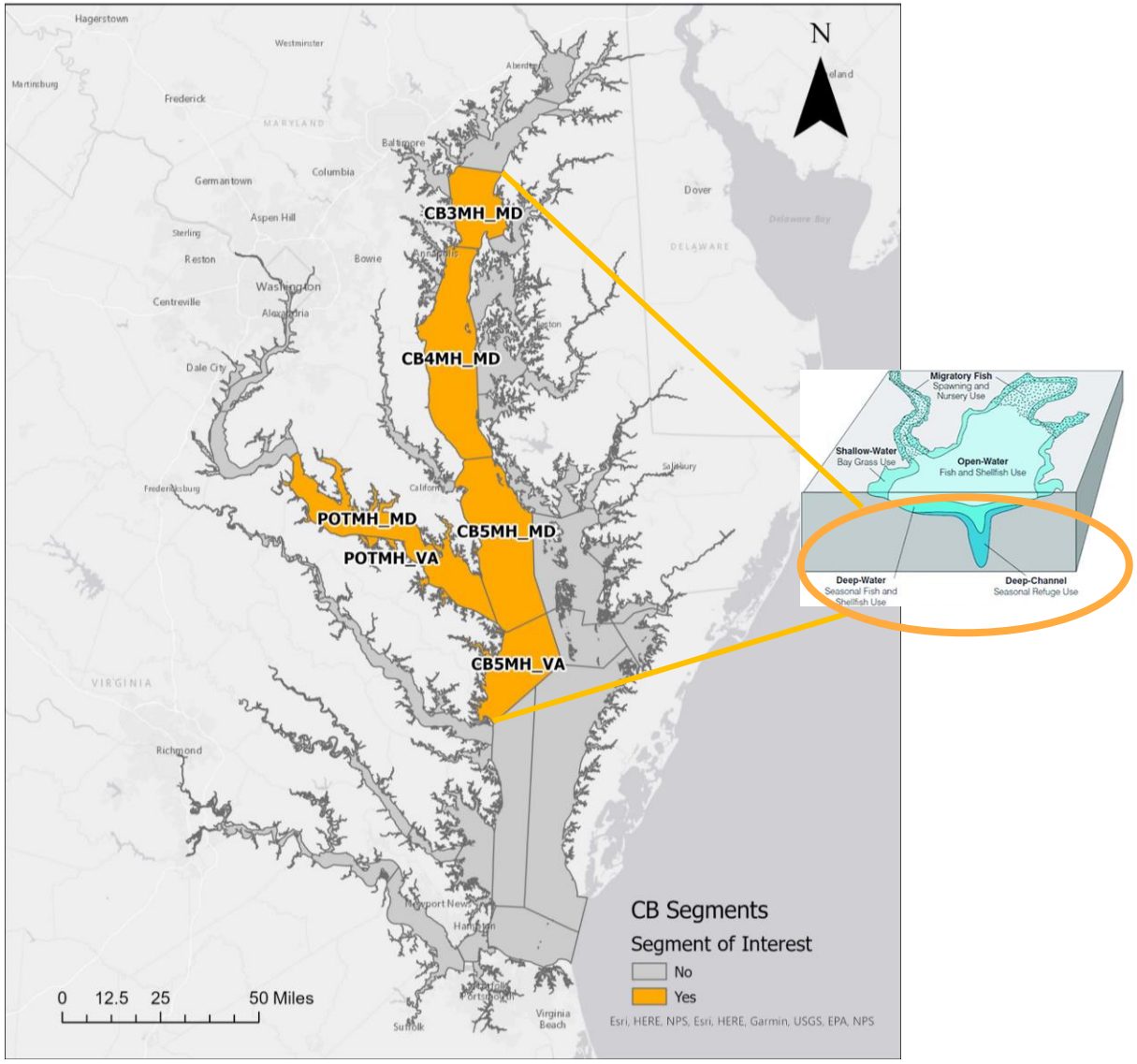
Maintain bay water quality goals and TMDL,

but “tier” implementation based on:

- Staggered timelines
- Intermediate nutrient goals that achieve WQ improvements in areas that have largest living resources impact.

(CESR, p 82-83)

Existing Approach



Timeline

15 year deadline (with milestones) to meet all of TMDL load reductions

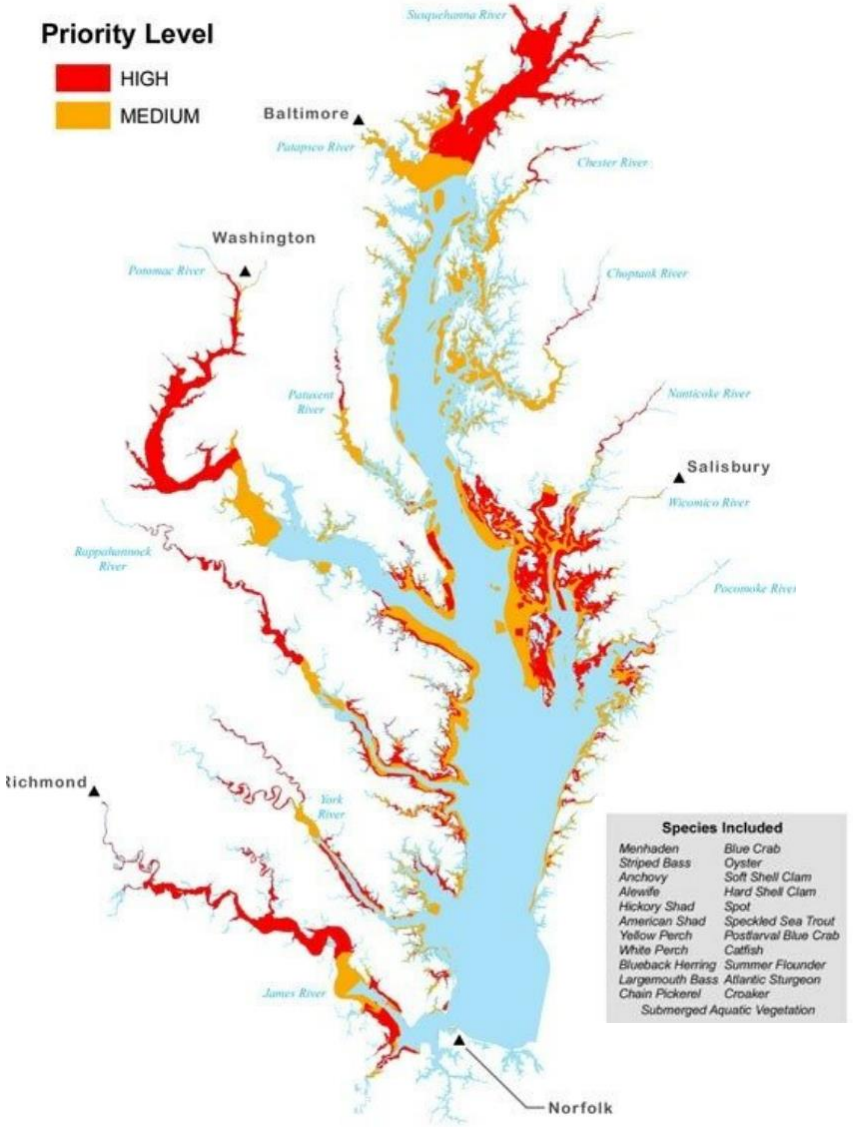
Approach

Nutrient load targets set to 100% WQS, focus on most challenging to achieve: DO criteria in deep water habitats in 4 segments (orange, left).

Nutrient effectiveness across watershed set based on DO impact in deep water main channel (water quality “currency”)

Tiered Approach to Implementation

Example of Prioritization based on potential living resource impact (Source: Chesapeake Bay Program, 2009)



Timeline

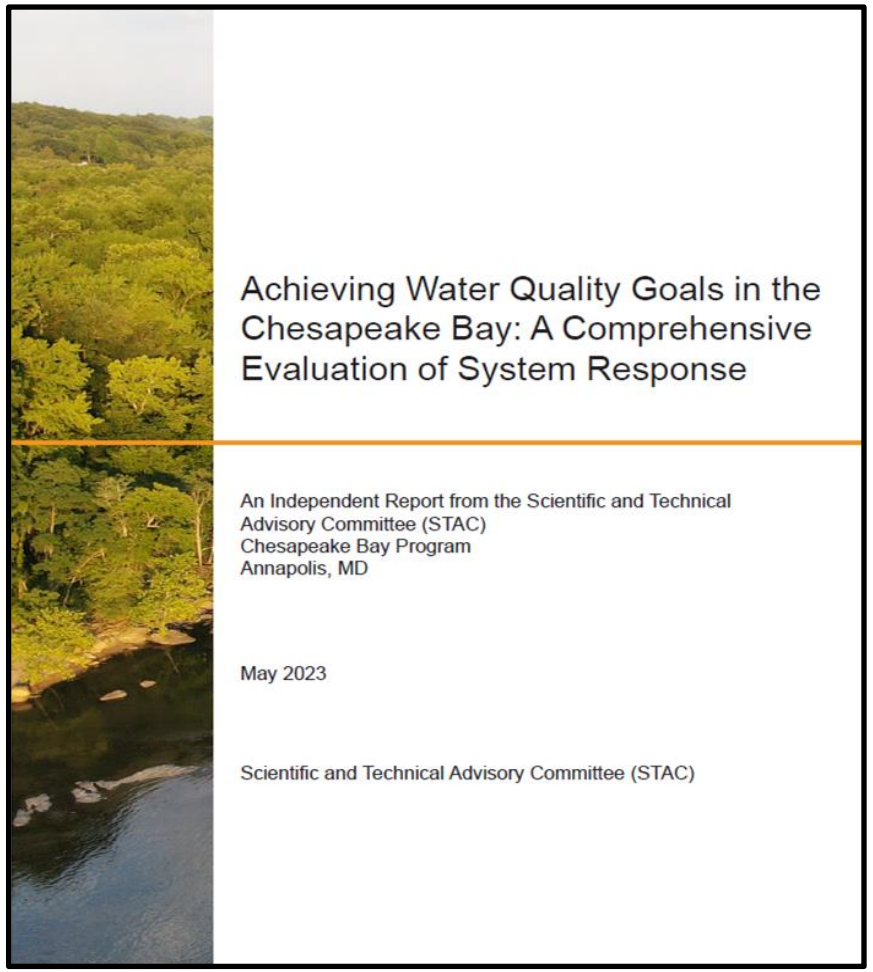
Intermediate goal: ex. 10-15 years

Approach

Intermediate nutrient targets based on living resource potential, while acknowledging:

- interdependence across areas (including progress in main channel);
- importance of local, non-WQ living resource factors/stressors.

Thank you

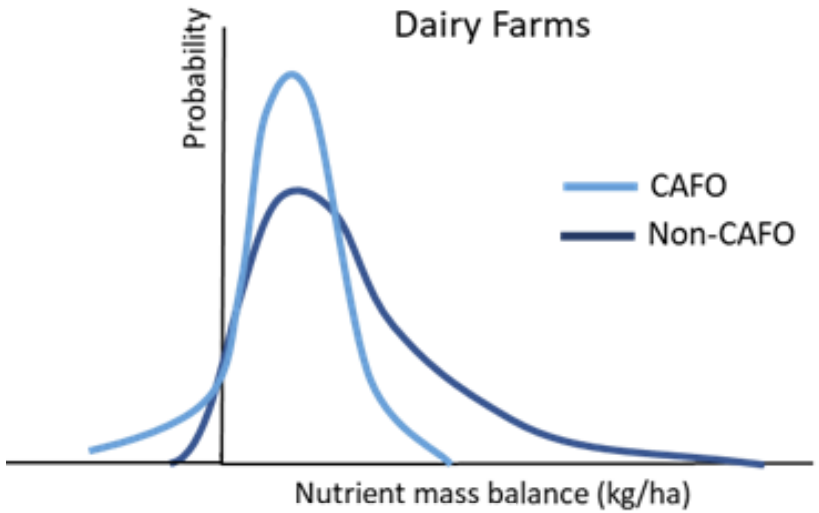


https://www.chesapeake.org/stac/cesr/

Nutrient loads also vary across land managers

Total Phosphorus Balance Across 58 Dairy Farms in Shenandoah Valley Virginia, 2018

Quartile	Total P balance (kg/ha)
Minimum	-30.9
1st Quartile	1.5
Median	12.4
3rd Quartile	18.7
Maximum	97.6



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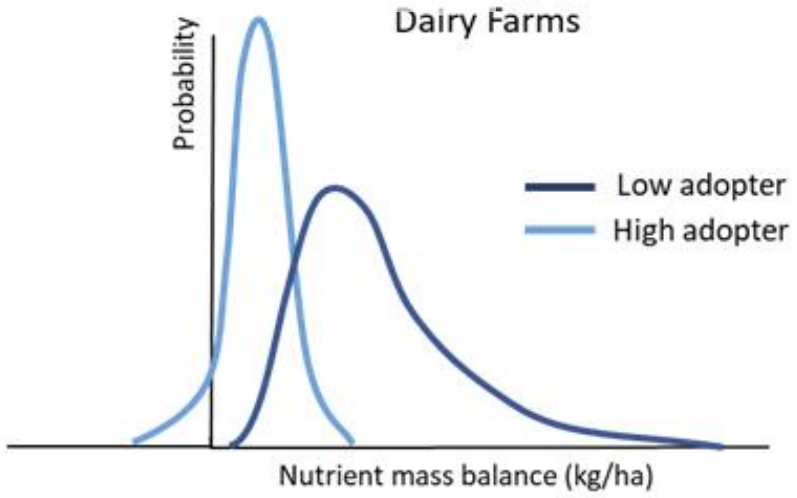
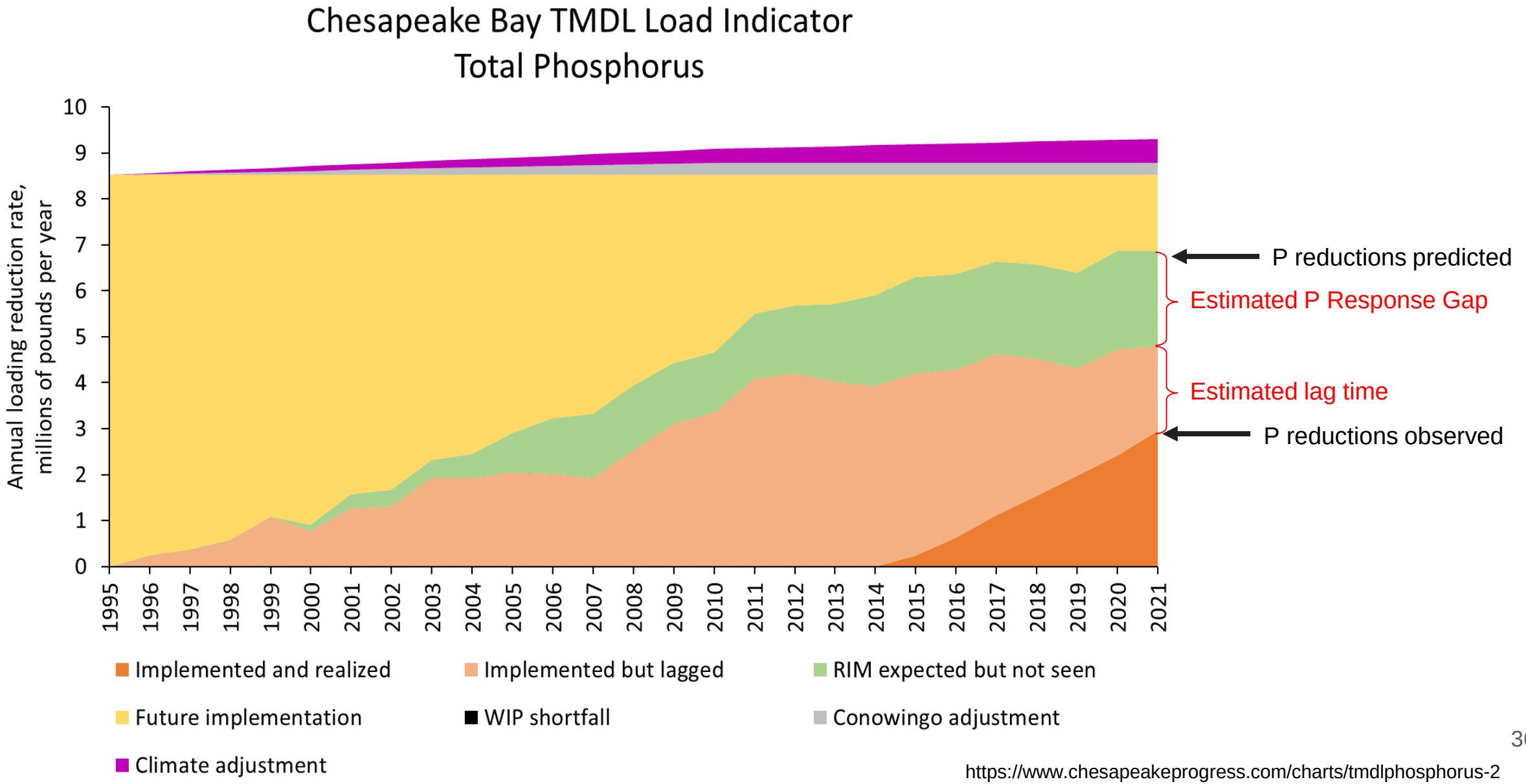


Pearce & Maguire 2020

Phosphorus Response Gap



https://www.chesapeakeprogress.com/charts/tmdlphosphorus-2