Climate Change and the Chesapeake TMDL

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Presentation to STAC BioChar Workshop 5/25/23

Less of This

Photos: Chesapeake Bay Program

More of This

Photos: Chesapeake Bay Program

Conceptual Model

Nutrient sources . . .

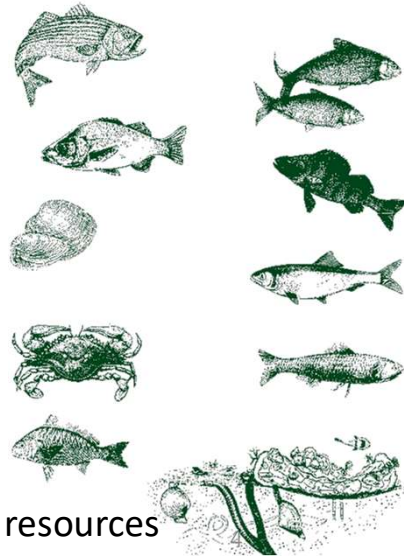
. . . acting in different landscapes . .

.

…with different management…

. . . affects oxygen…

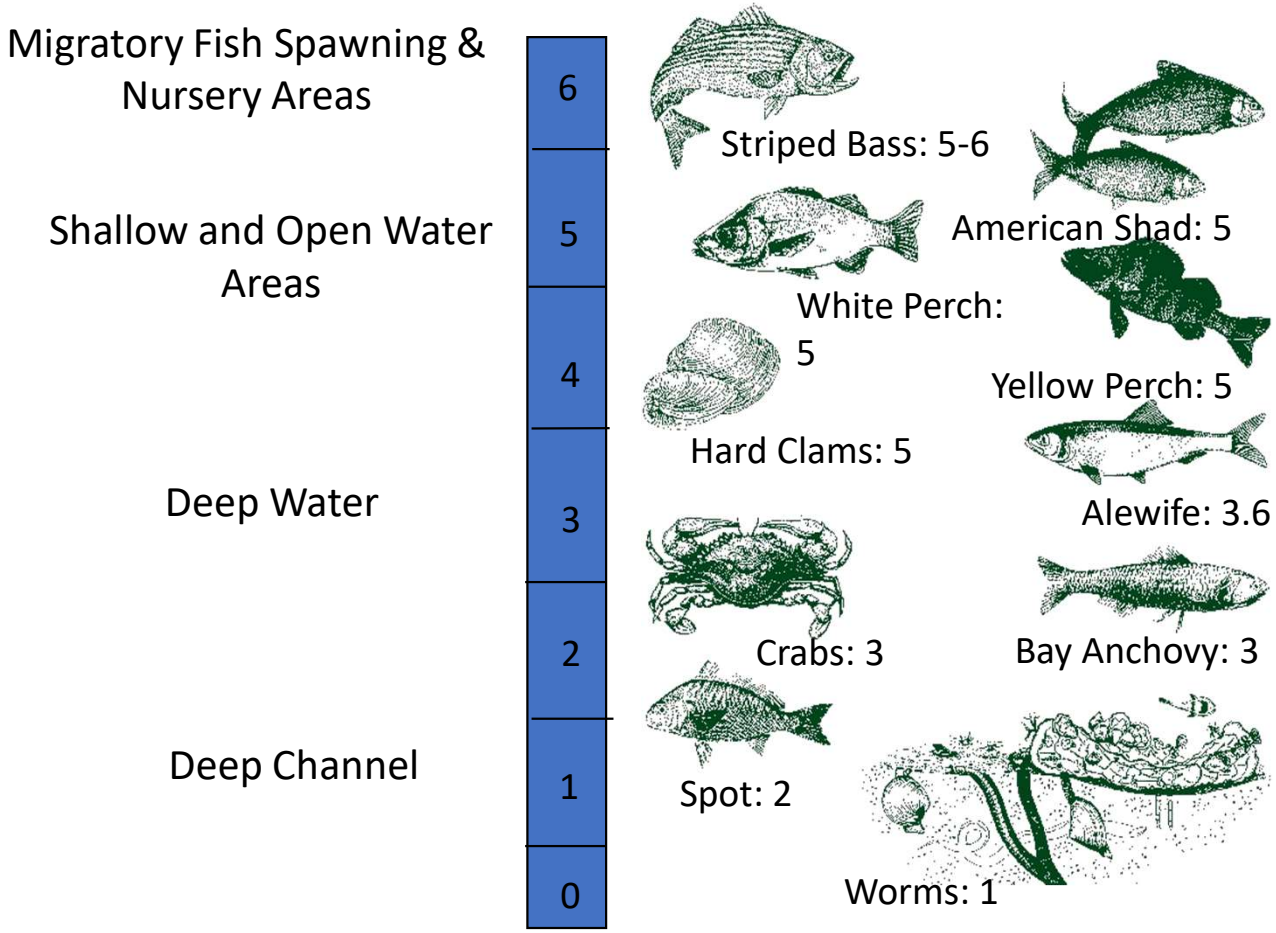
O_2



…which affects living resources

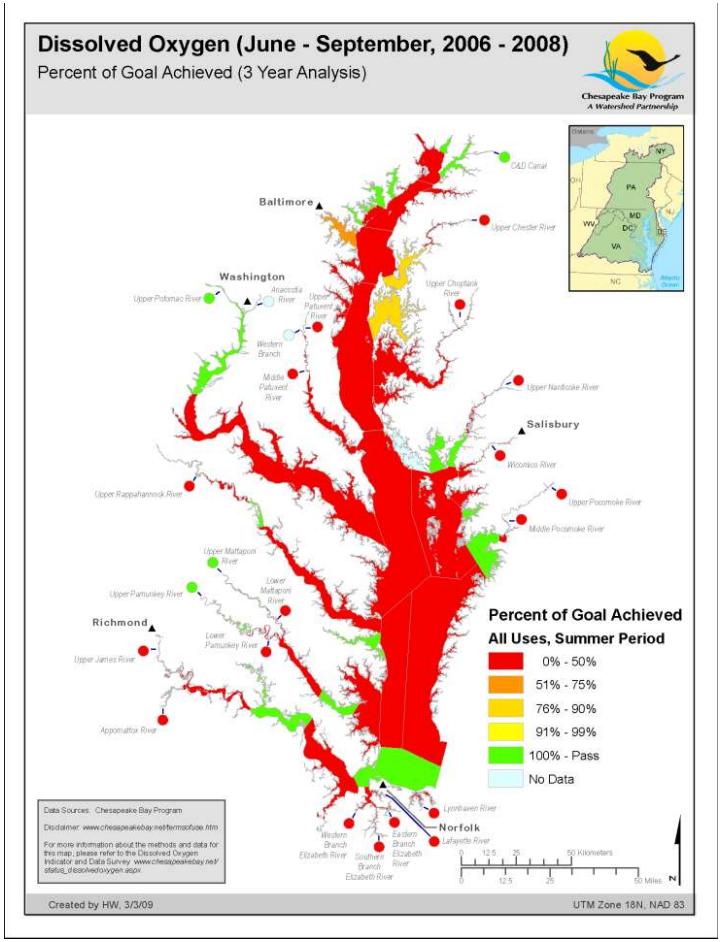
Bay Dissolved Oxygen Criteria

Minimum Amount of Oxygen (mg/L) Needed to Survive by Species



Chesapeake Bay TMDL

Necessitated by failure to meet water quality standards

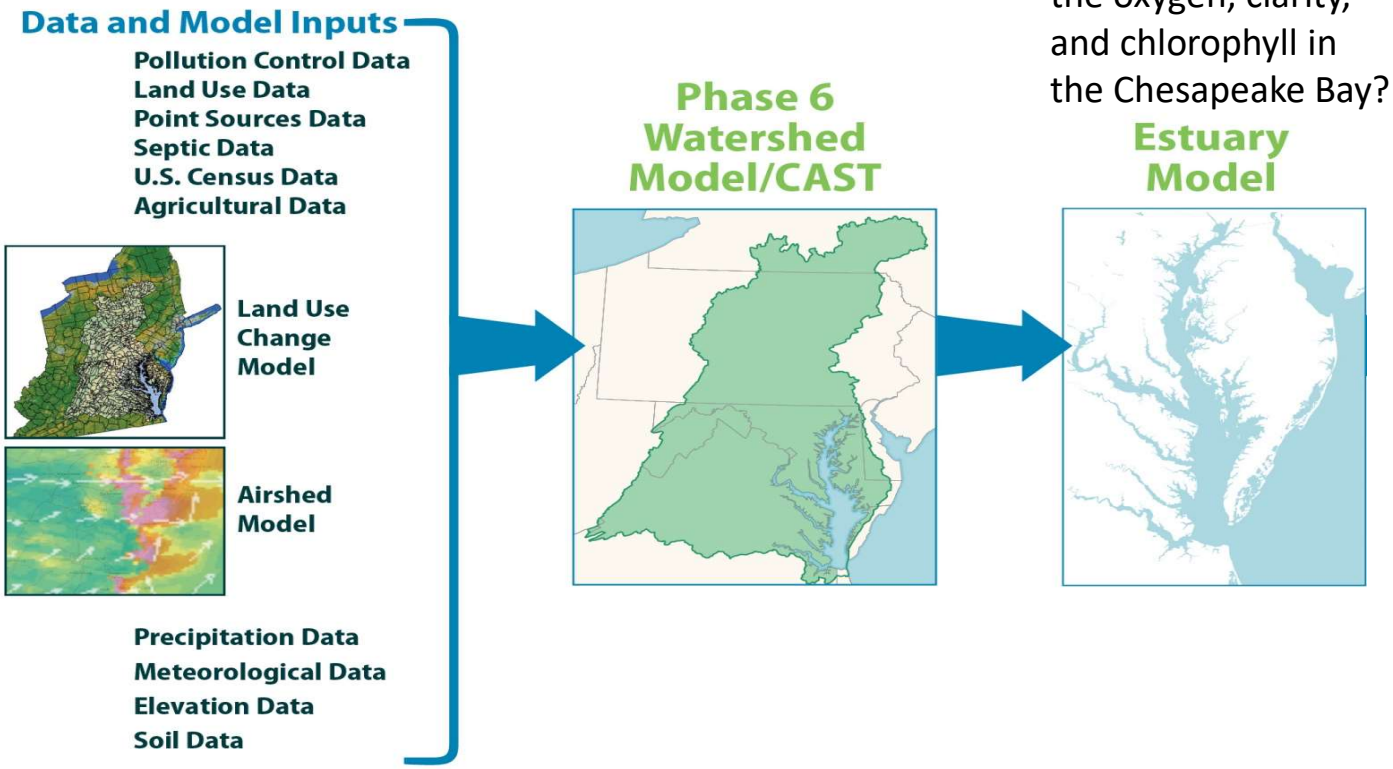


TMDL Models

If we change what we do on the landscape…

…how will that change nitrogen, phosphorus, and sediment?

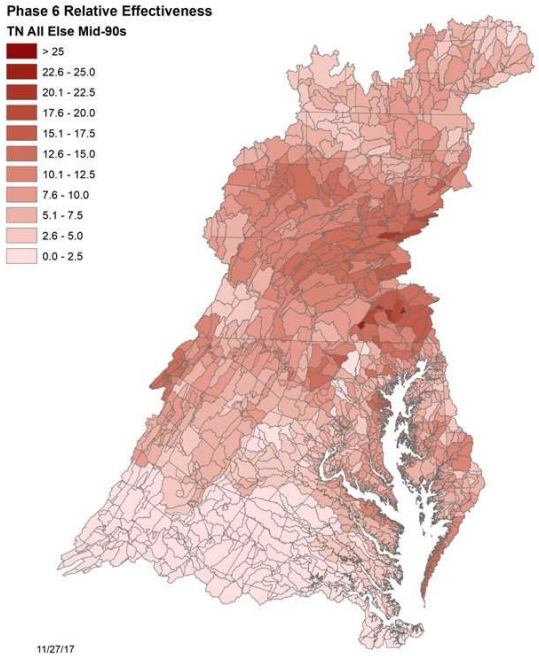
…and what will be the oxygen, clarity, and chlorophyll in the Chesapeake Bay?



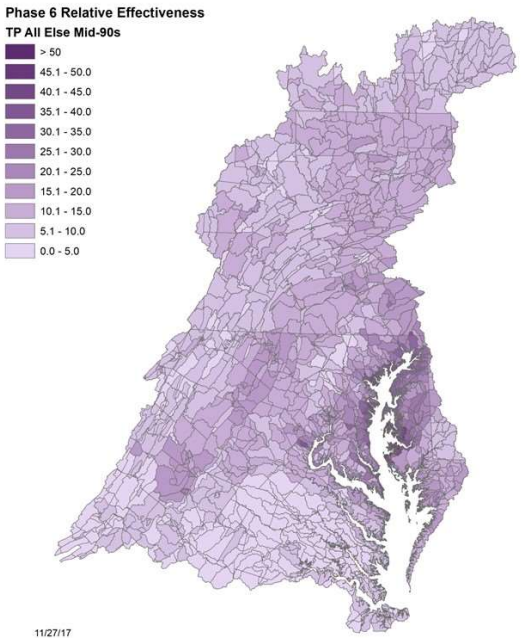
Dissolved Oxygen effect per pound of nutrient released in the watershed

Dividing up the effort: More Impact, Do More

Nitrogen

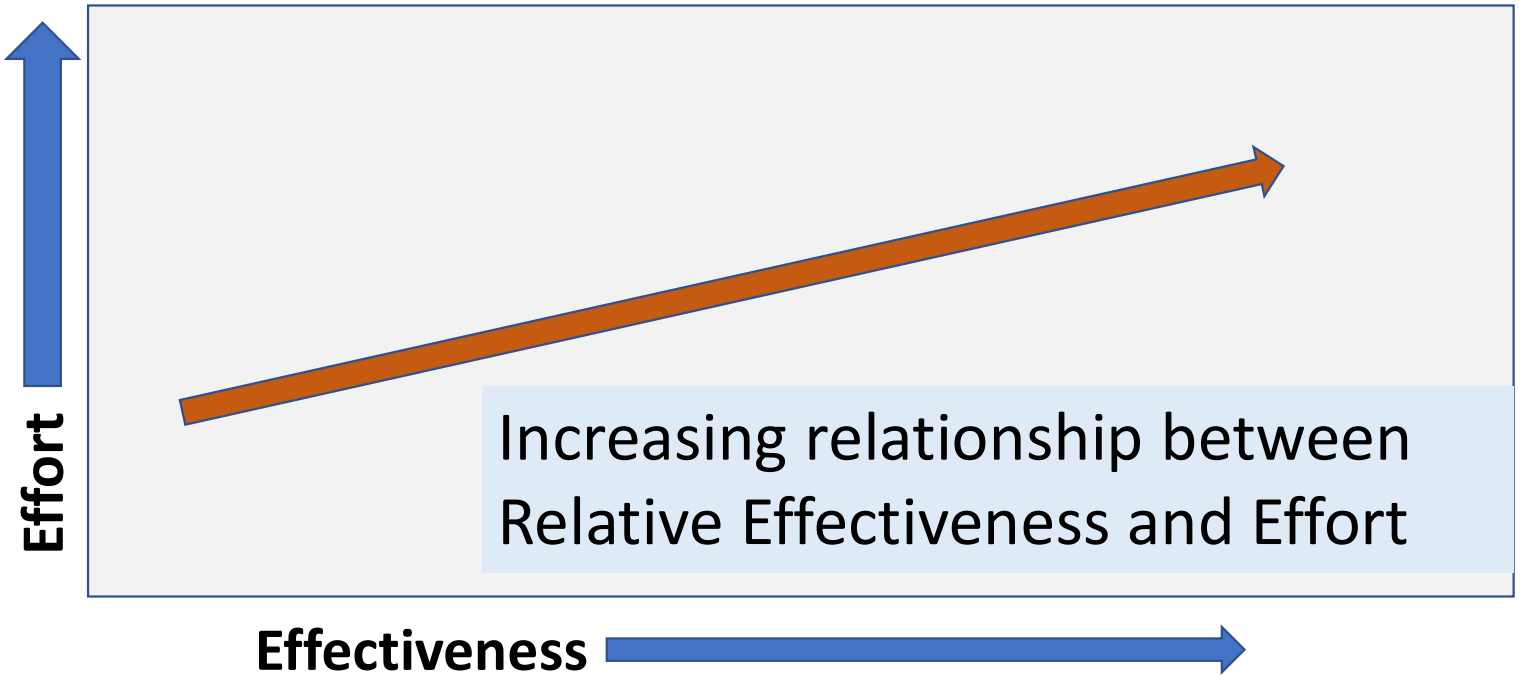


Phase 6 Phosphorus



Guidelines for Reduction Goals

- Areas that contribute the most to the problem must do the most to resolve the problem.

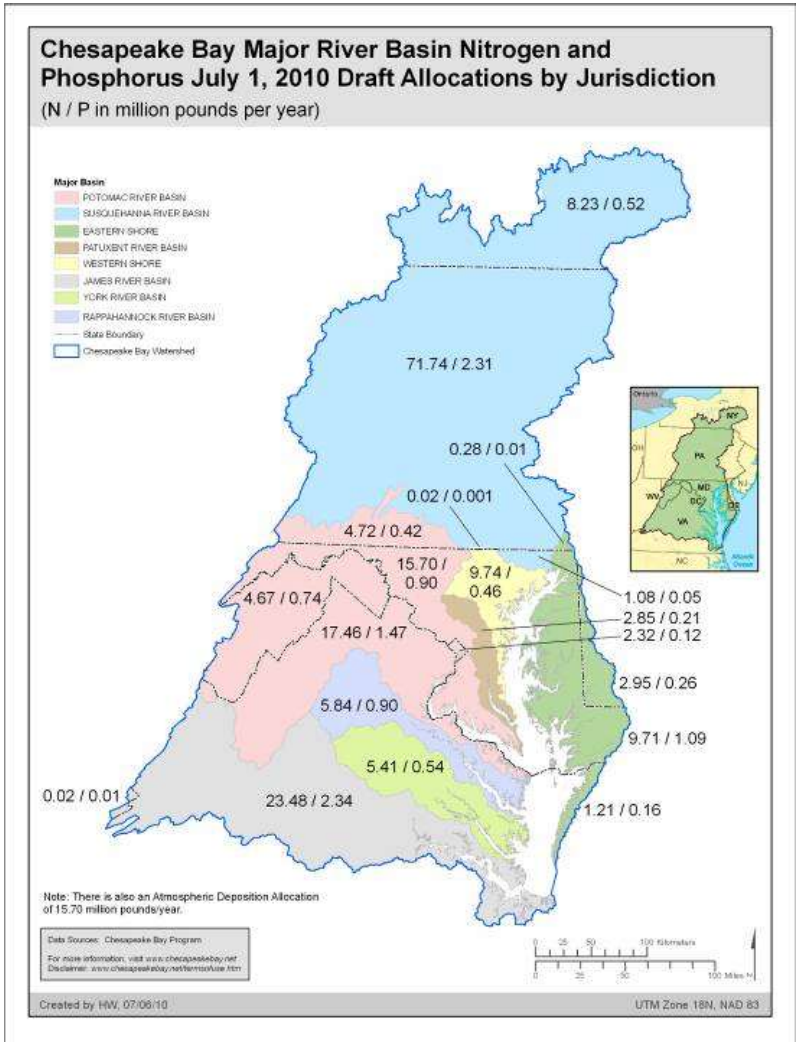


TMDL Decision

State-basin allocations

Nitrogen, Phosphorus, and Sediment

Sufficient to meet oxygen, clarity, and chlorophyll water quality standards



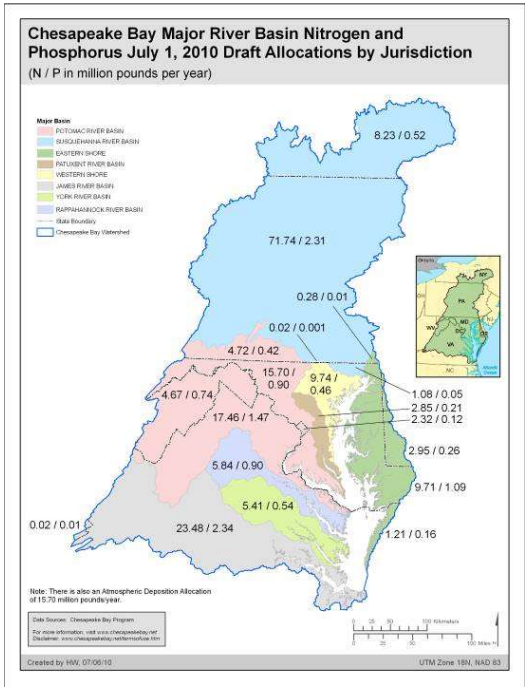
Watershed Implementation Plans (WIPs)

Reduce sources…

. . . Protect landscapes . . .

…install management practices…

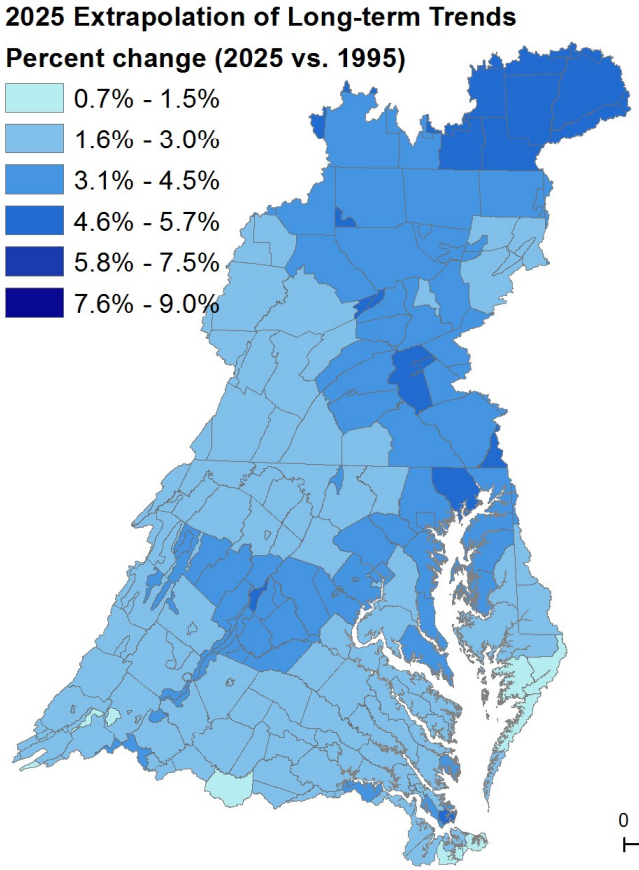
… to hit nutrient targets



TMDL is a continuation of previous goals

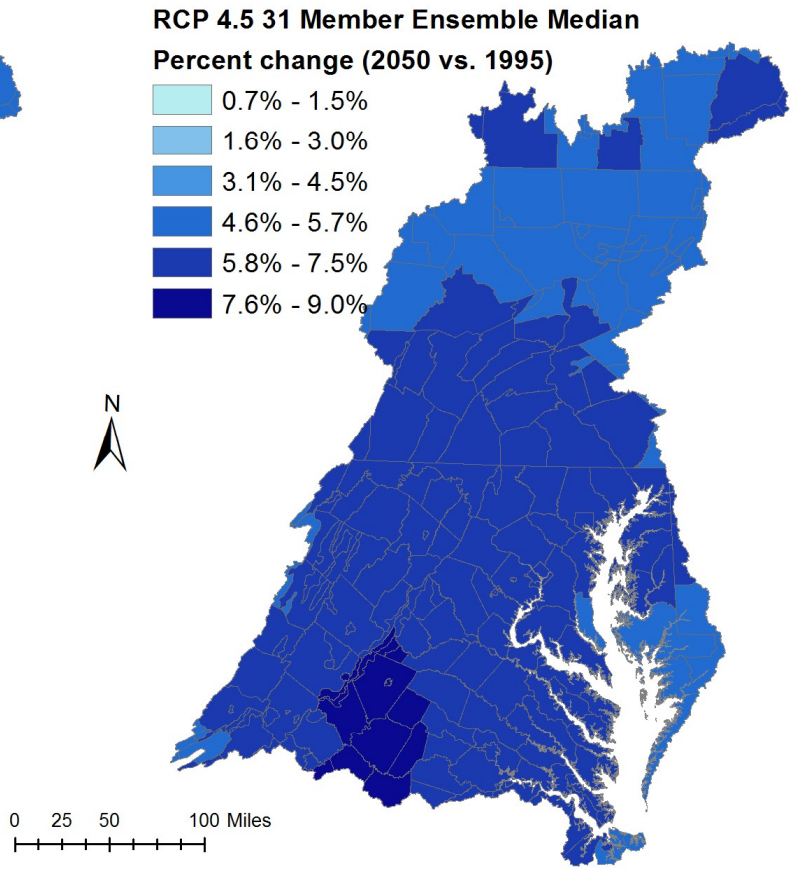
Year	Phase	Goal
• 1987	0	40% reduction (Watershed & Bay models unlinked)
• 1992	2	40% of controllable loads (forest, air, NY, DE, WV unincluded)
• 1997	4.1	Added VA Tribs. (Rappahannock, York, & James with controls)
• 2003	4.3	Reallocation of Tributary Strategies
• 2010	5.3.0	2010 Chesapeake TMDL
• 2011	5.3.2	Phase 2 WIP targets
• **2017**	**6**	**Phase 3 WIP targets (You are here!)**
• 2028	7	TBD

YEAR 2025



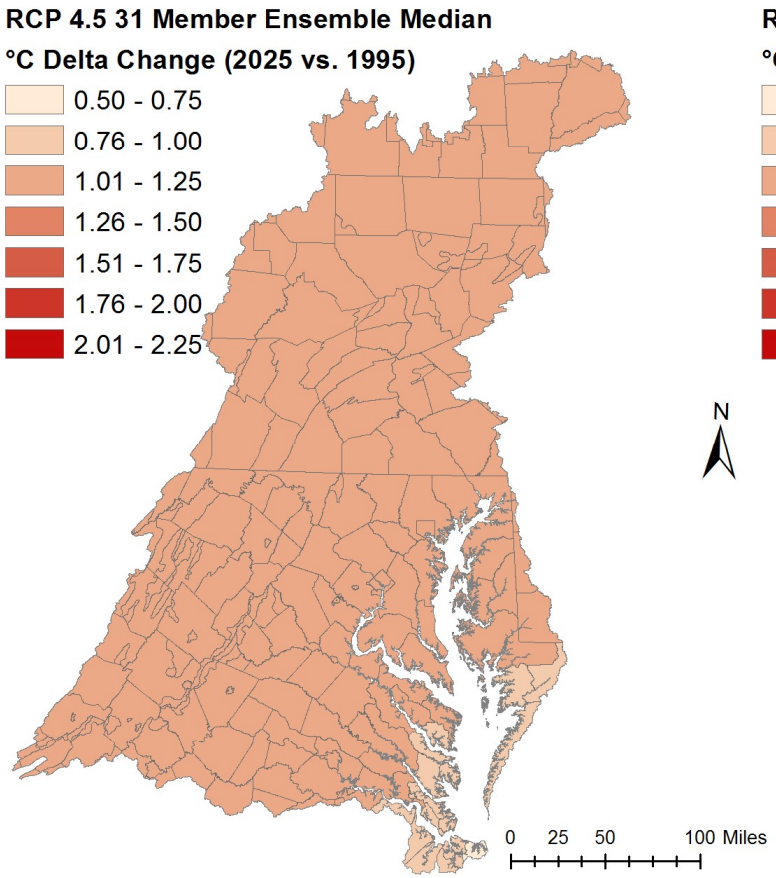
3.11% increase in average annual rainfall volume

YEAR 2050



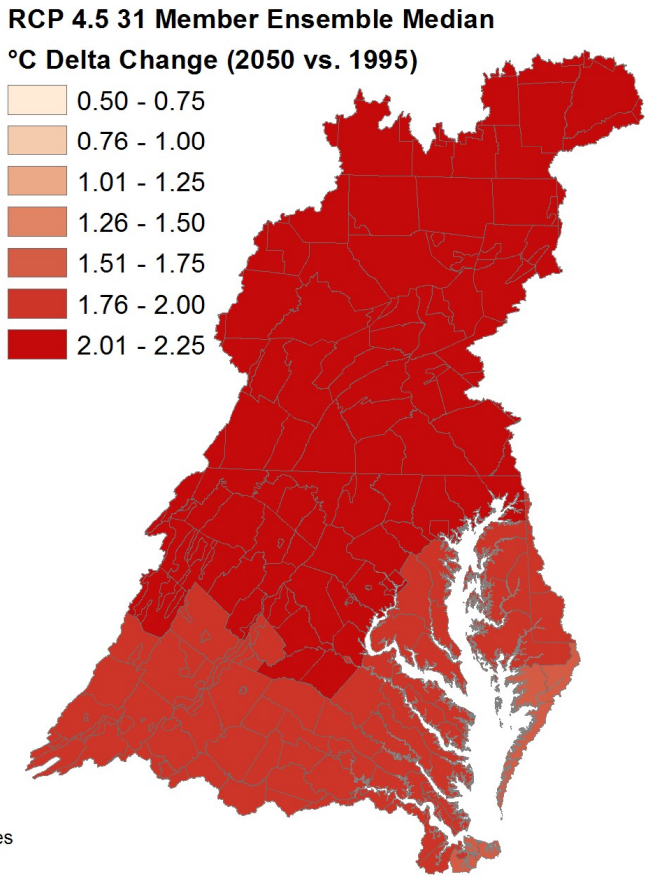
6.28% increase in average annual rainfall volume

YEAR 2025



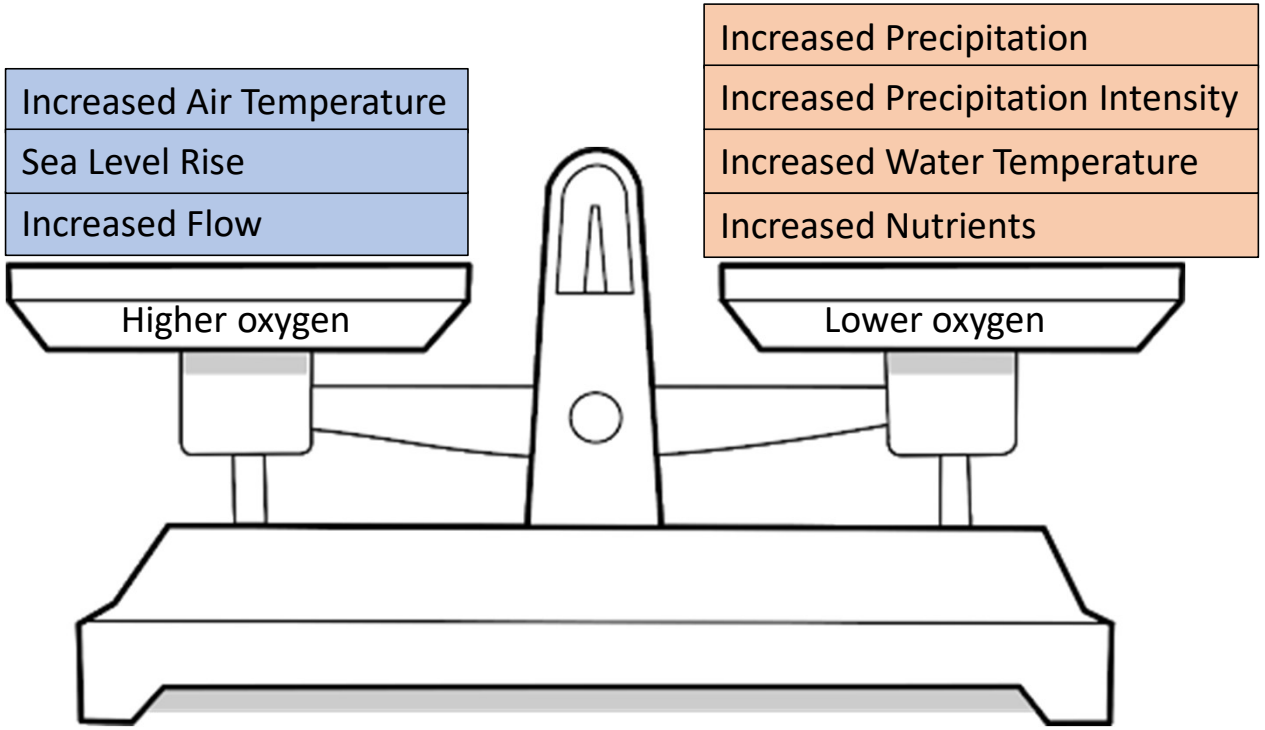
1.12°C increase in average annual temperature

YEAR 2050



2.03°C increase in average annual temperature

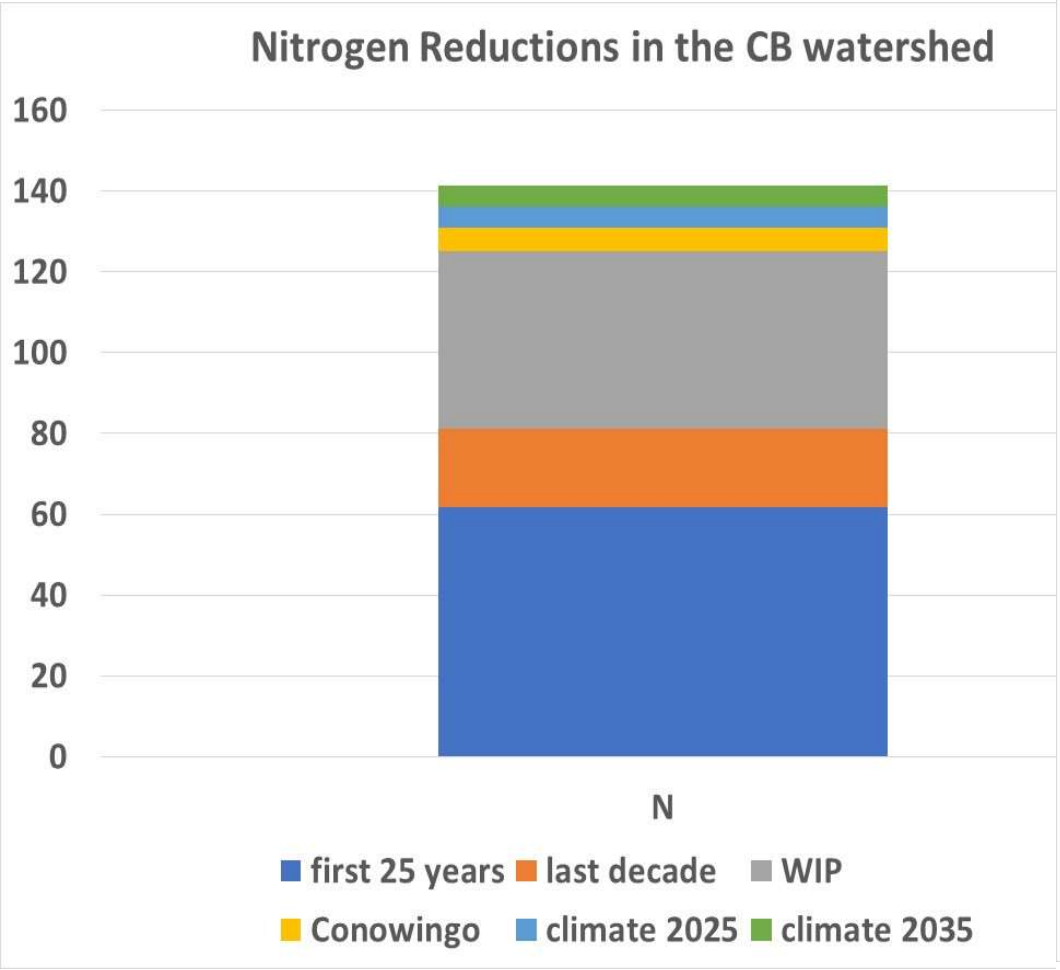
Balance of effects – Science Question

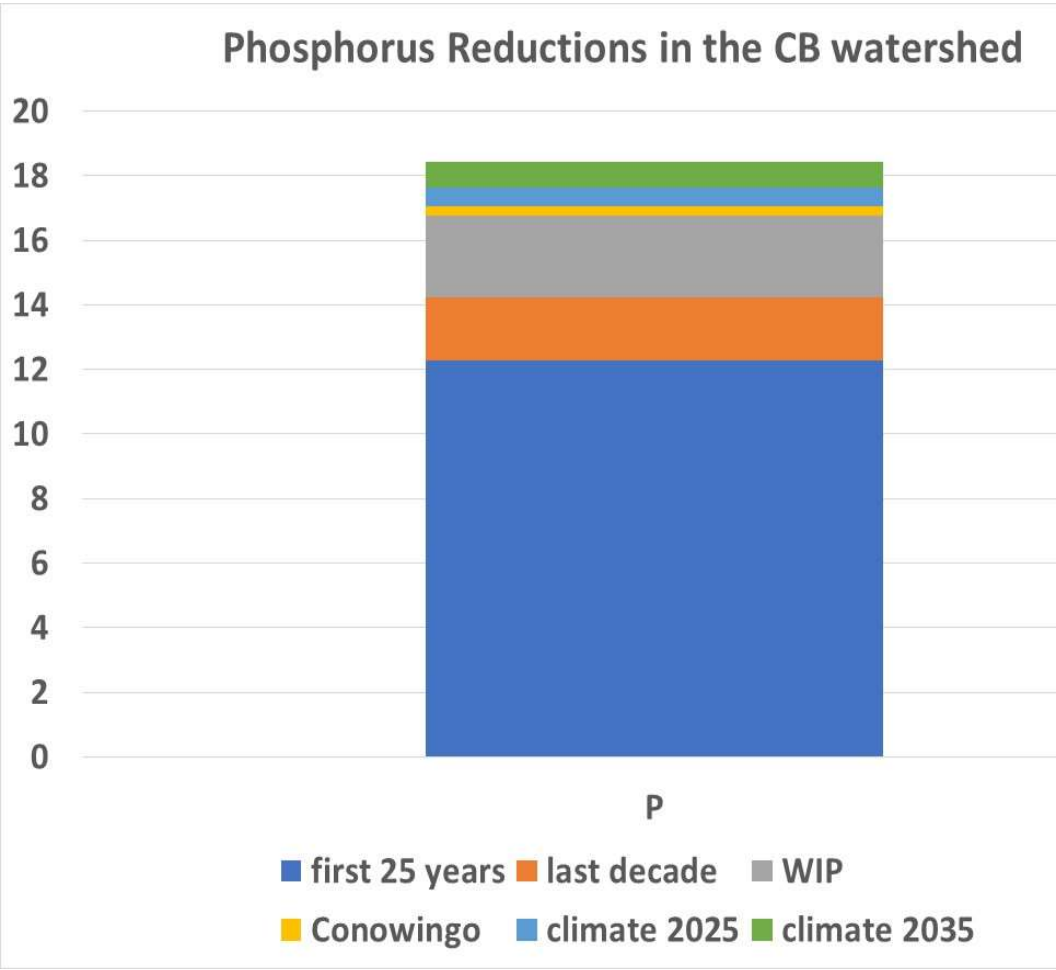


CBP studied 21 different effects producing an overall lower level of oxygen

Climate effects in perspective

Modeled load reductions from CAST-2019
(current version of the CBP watershed model)

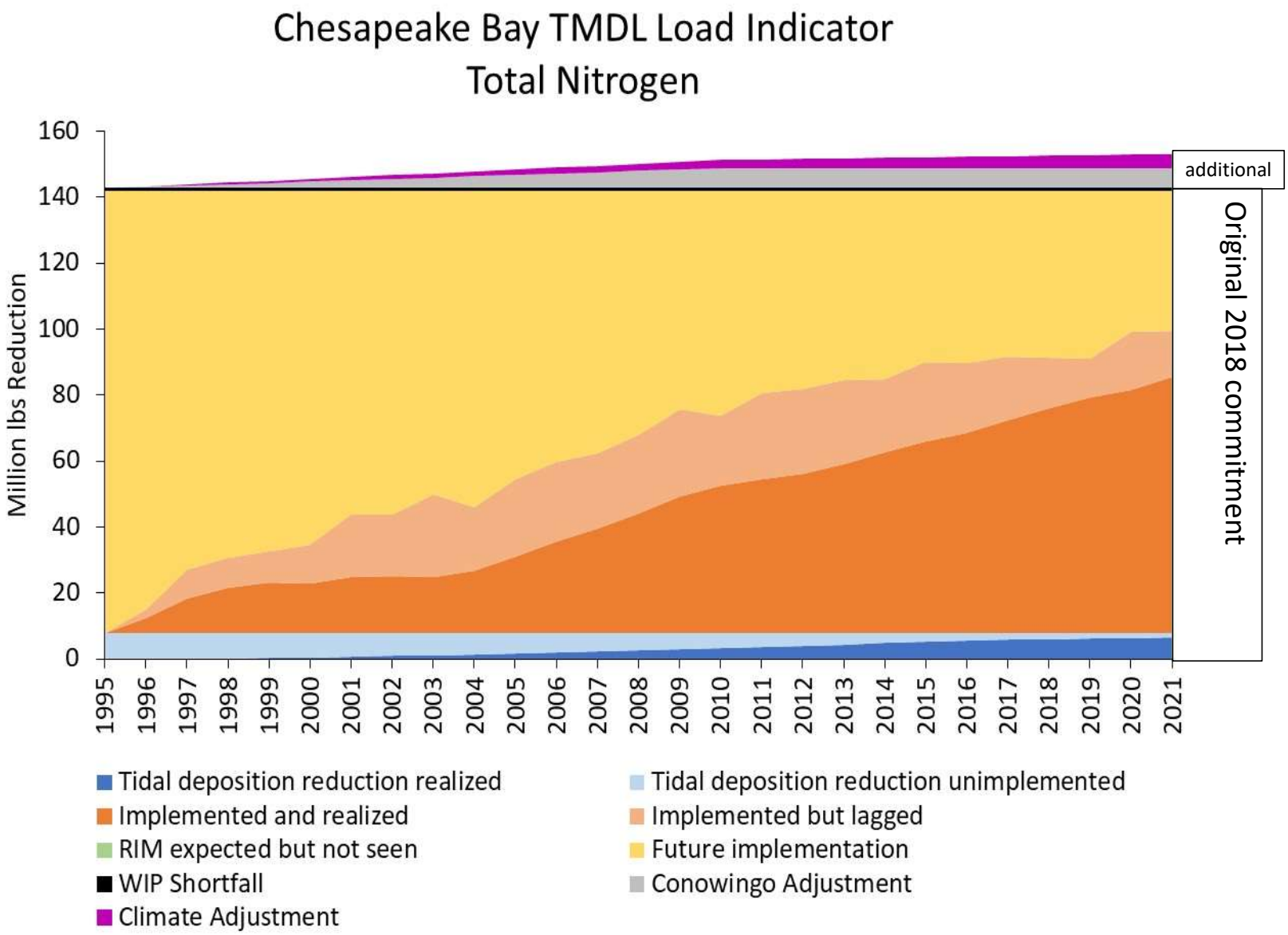




Public Indicator

Updated Annually

Web team will reformat
Including addressing accessibility



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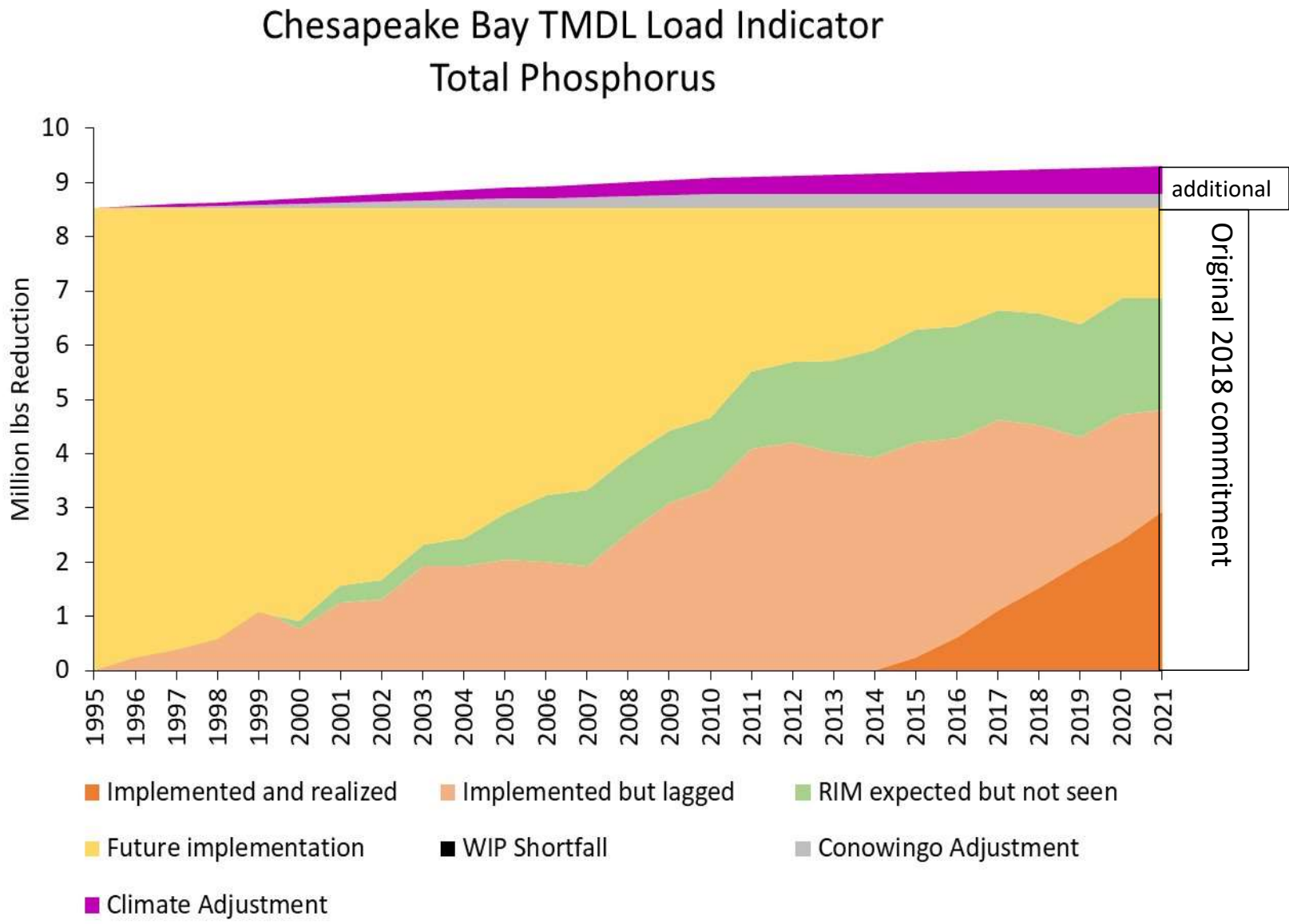


CAST Structure

CAST is a simple model

Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)

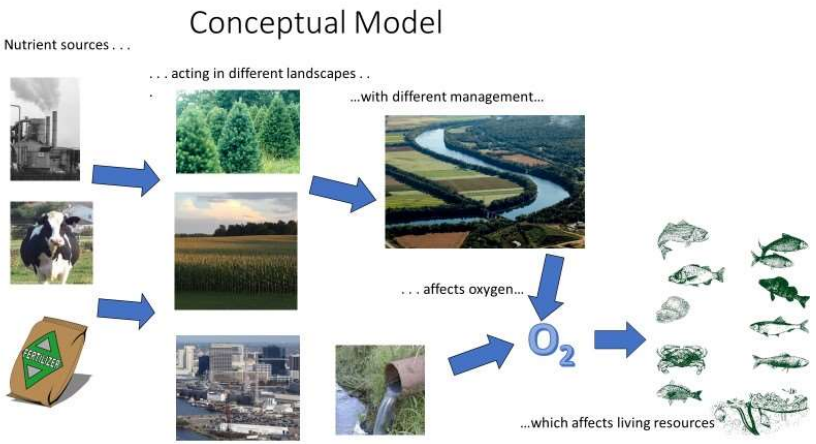
*

Land management

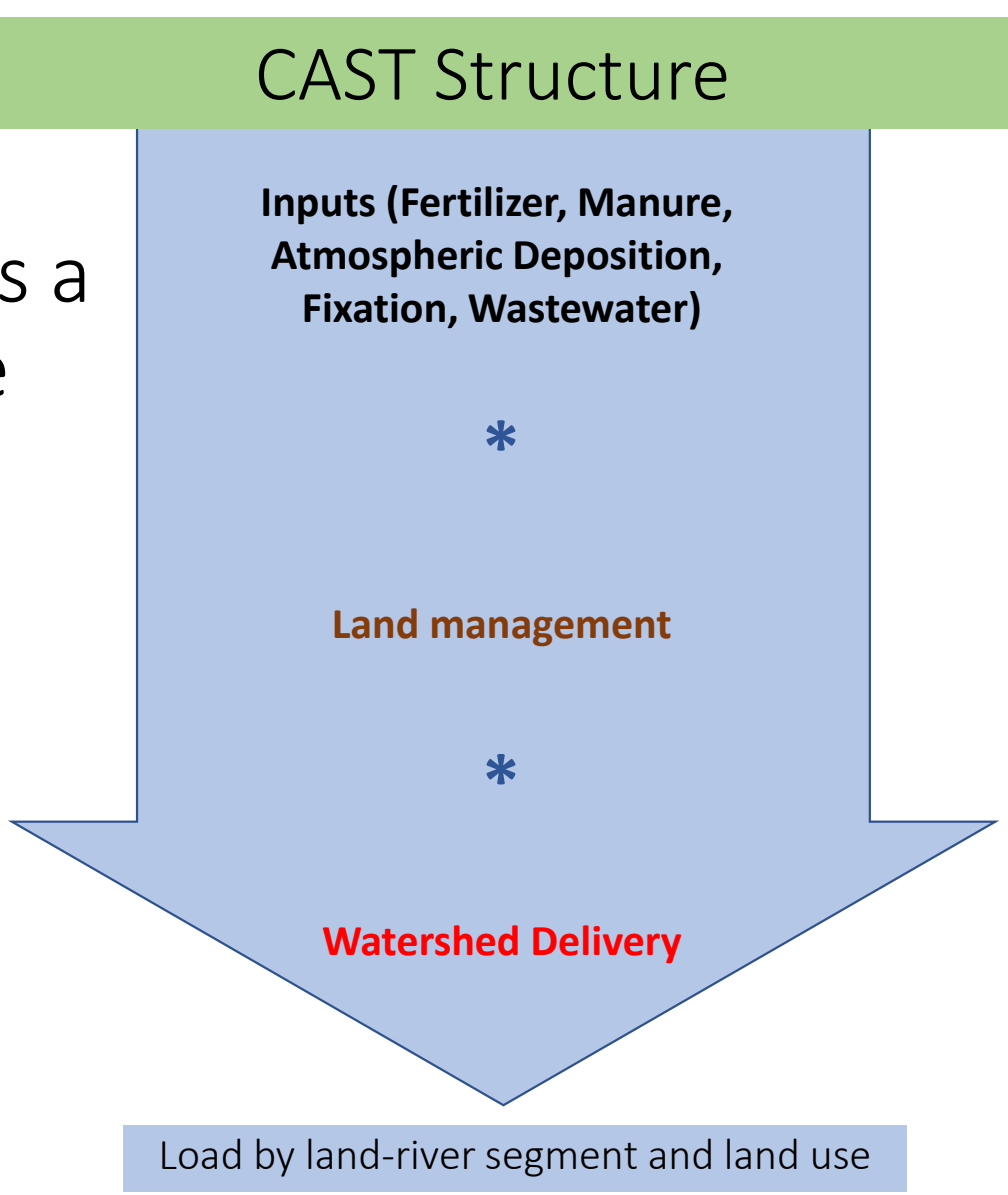
*

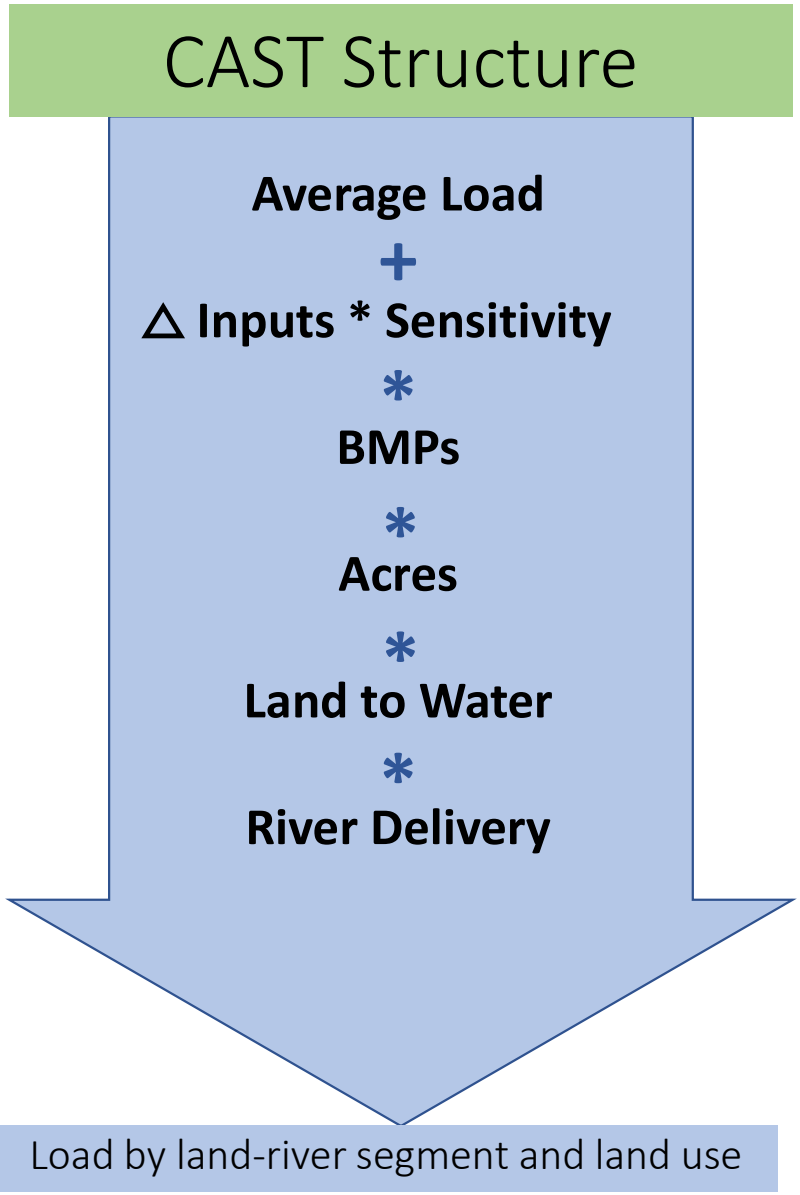
Watershed Delivery

Load by land-river segment and land use



CAST is a simple model





Keep it Simple

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

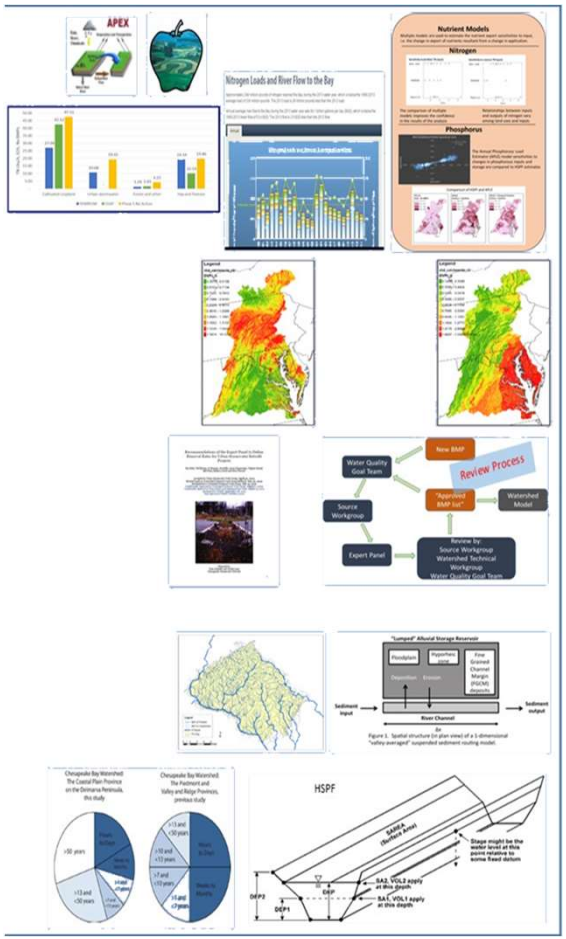
Land to Water

*****

River Delivery

Load by land-river segment and land use

Include Everything



Keep it Simple

Biochar

Average Load

+

Δ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

Load by land-river segment and land use

Biochar's ability to reduce nitrogen runoff was also shown in a recent study by University of California Merced[6]. The researcher investigated biochar additions to dairy manure and found a 79% reduction in methane emissions after adding one ton of biochar per 15 tons of manure (about 6% biochar on a wet basis) or 0.9 tons of biochar per 3.37 dry tons of manure (nearly 20% biochar on a dry basis), they found. In addition to creating a more nitrogen rich compost, it also reduced greenhouse gas emissions.

Biochar

Metal	Initial concentration ug/L	Post biochar filter ug/L	% removed
Total Copper	54.2	7.88	71.1%
Total Zinc	1,018	39.0	92.6%

Thank you

Photos: Chesapeake Bay Program