



Foundations for Tiered Implementation

January 26, 2026

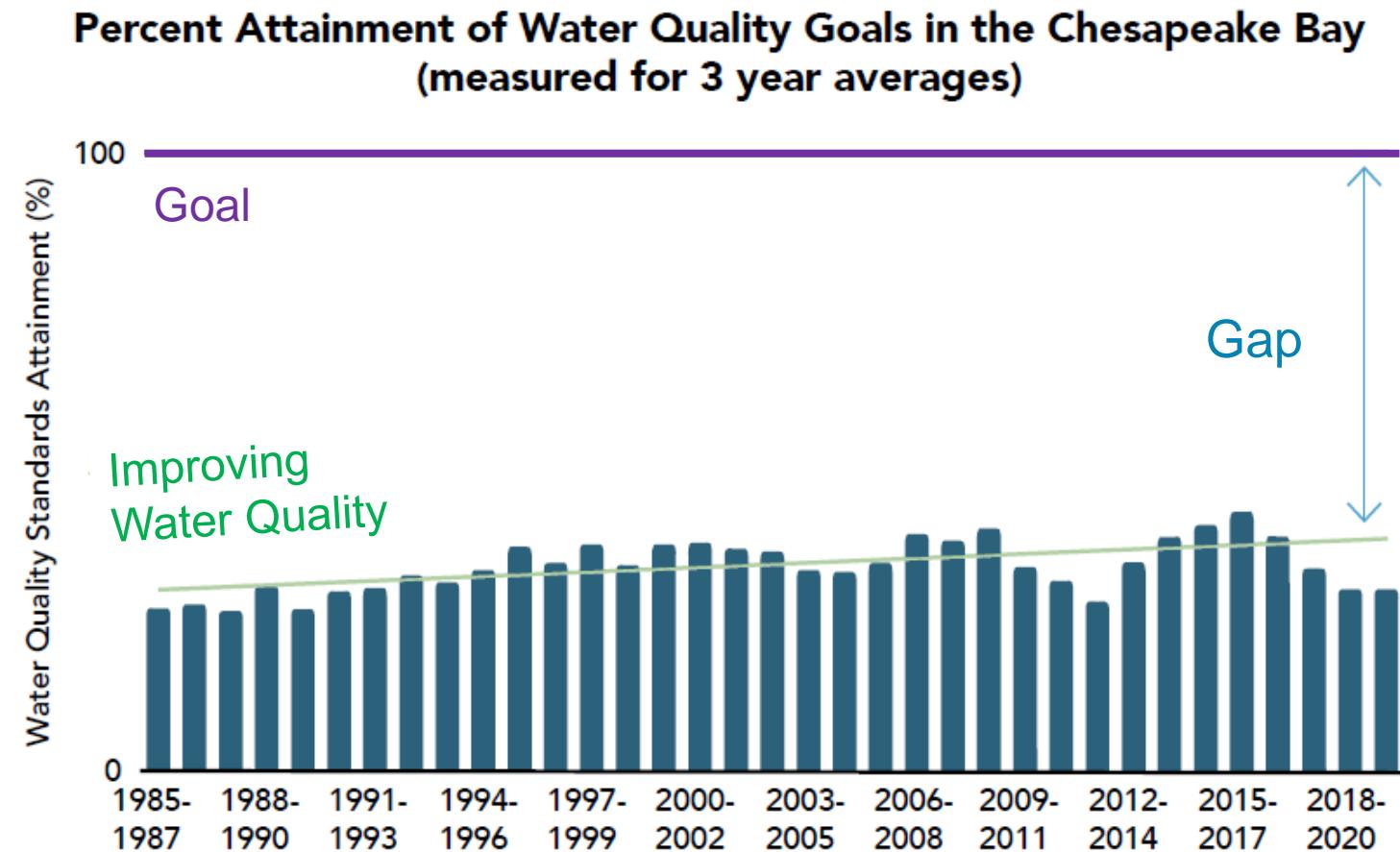
Dr. Kaylyn S. Gootman, EPA

Bruce Vogt, NOAA

WQGIT

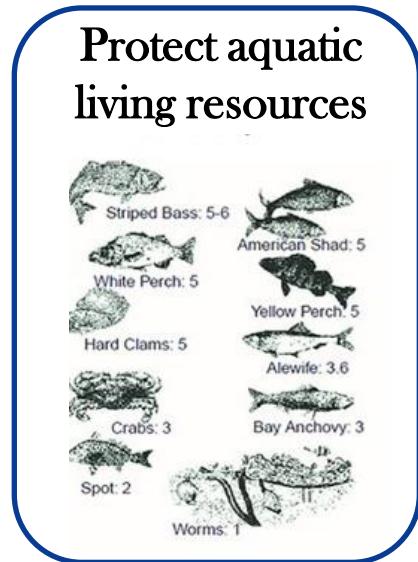
Motivation: The CESR Report

- 40+ years of Chesapeake Bay restoration
- Improvements have been made, plus value in holding the line
- Why is there a gap & how do we close it?
- What might we do differently going forward?



Chesapeake Bay Water Quality Goals

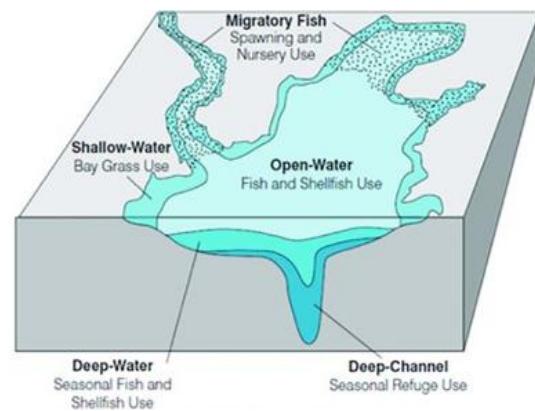
Water Quality Goal → **Measurement of the Goal** → **Achieving the Goal**



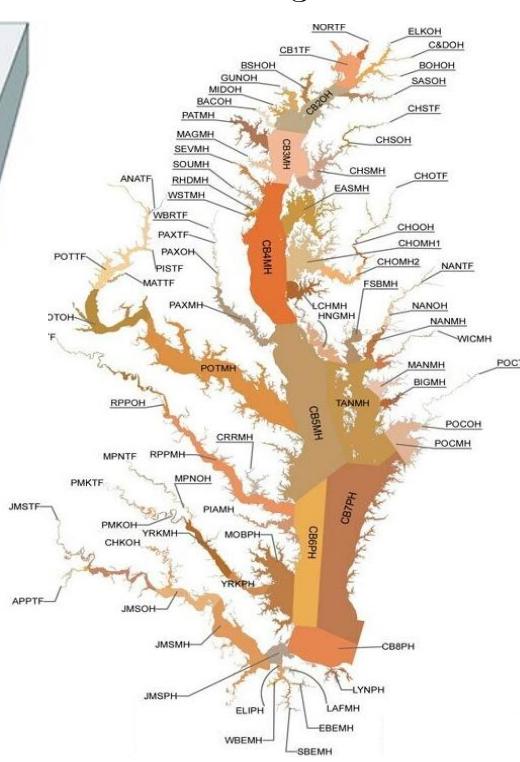
Numeric Criteria

Dissolved Oxygen Water Clarity/SAV Chlorophyll a

Across 5 habitats



in 92 Segments



TMDL

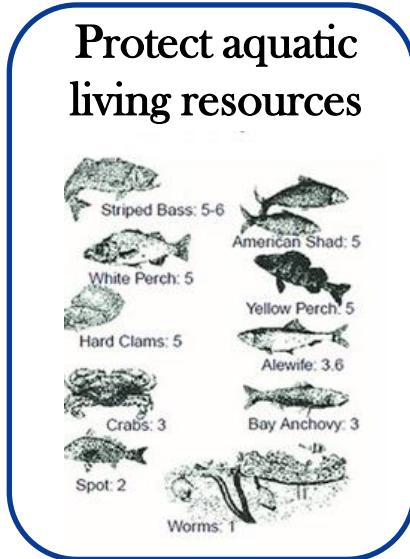
N, P, sediment targets to meet goal

Pollutant Control Programs

Accountability

Chesapeake Bay Water Quality Goals

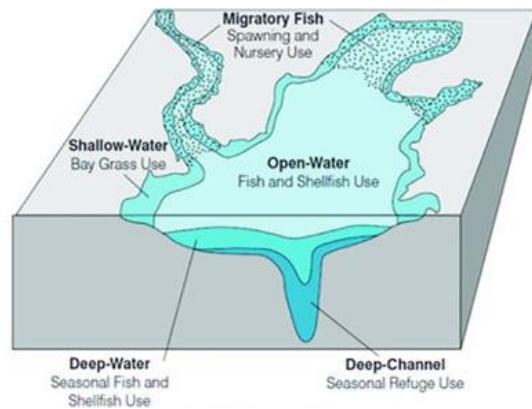
Water Quality Goal → Measurement of the Goal → Achieving the Goal



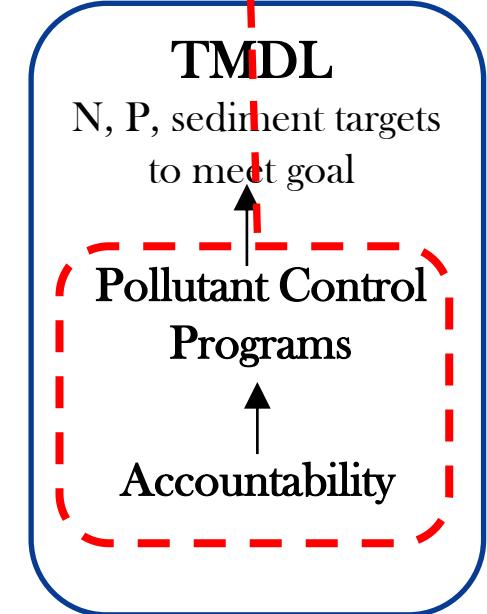
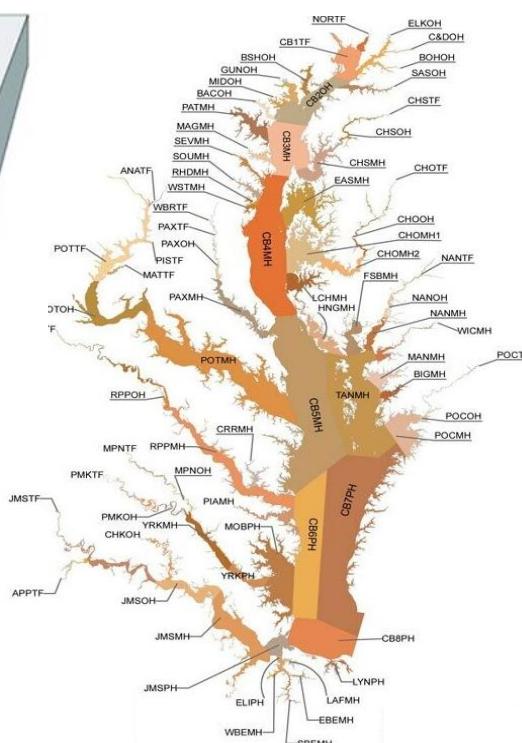
Numeric Criteria

- Dissolved Oxygen
- Water Clarity/SAV
- Chlorophyll a

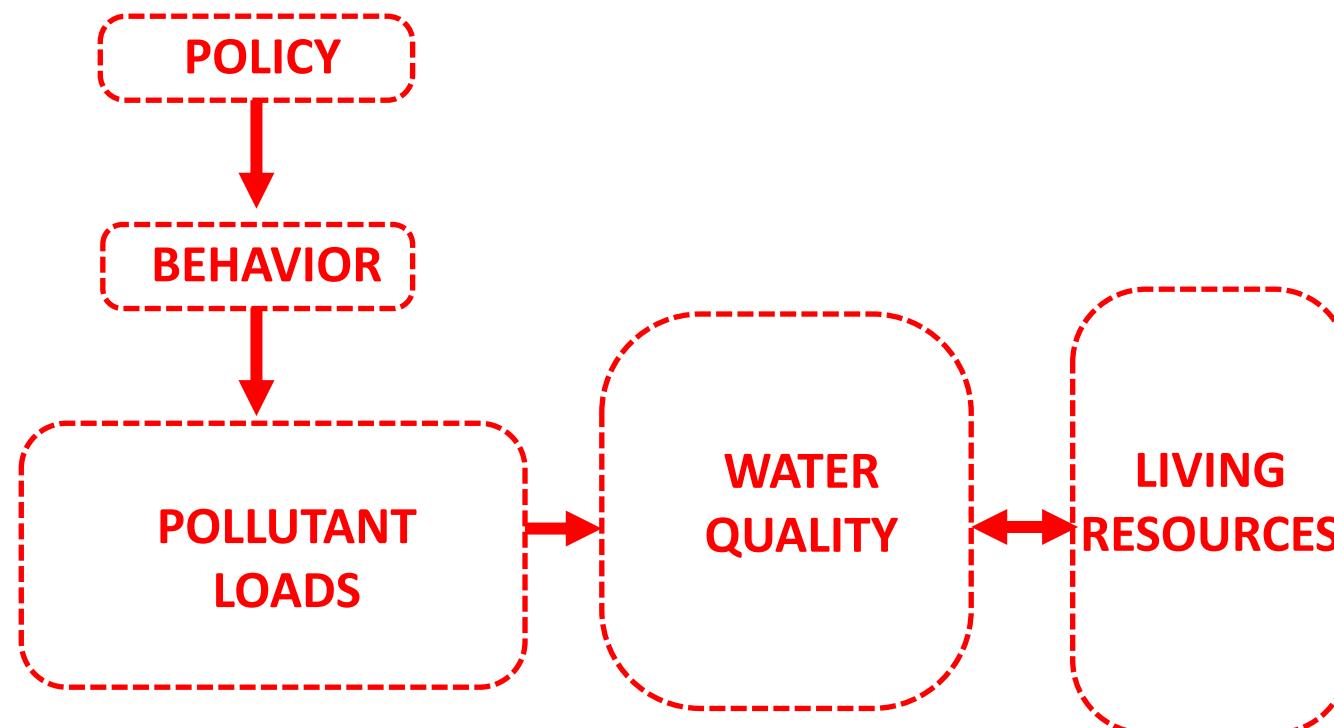
Across 5 habitats



in 92 Segments



CESR Approach



- Systemic evaluation of what has occurred
- Policy relevant framing
-  50+ volunteer scientists
- Literature synthesis & supplemental empirical work

CESR Findings: Living Resources



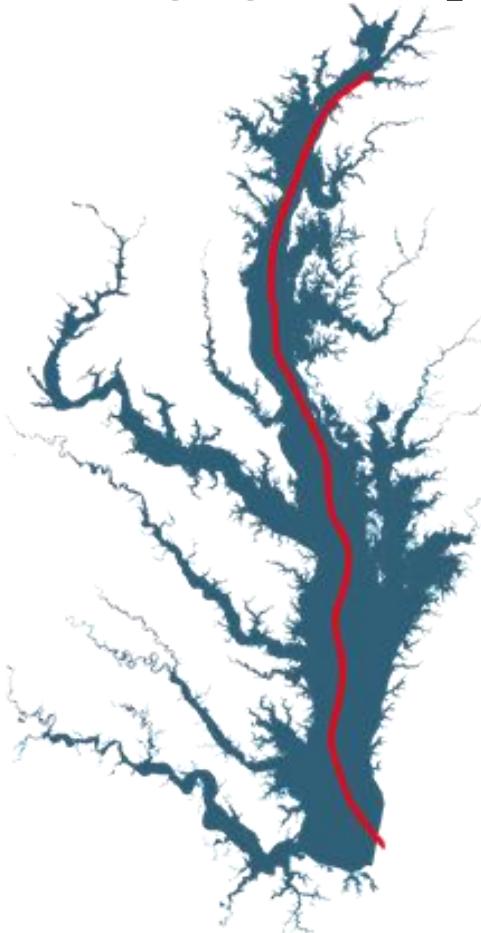
-Maryland Sea Grant

“Significant enhancement of living resources can be achieved through additional management actions without complete achievement of water quality standards across all habitats”

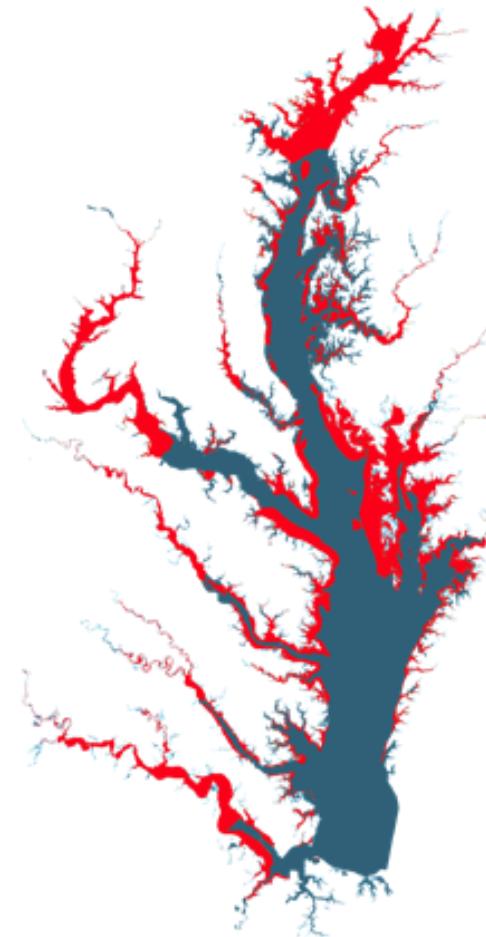
-CESR (p. viii)

Accelerating living resource response on our way to meeting overall goal

Deep water DO is most challenging water quality goal

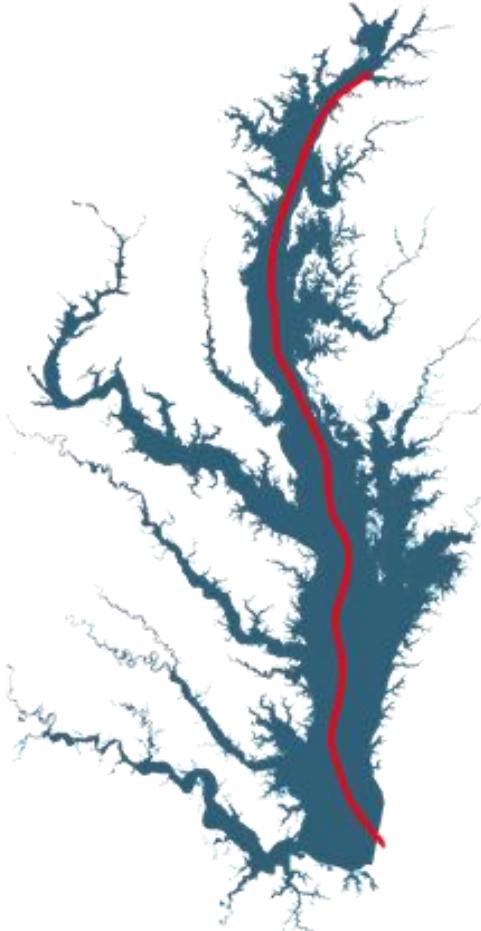


But most impactful living resource habitats are elsewhere

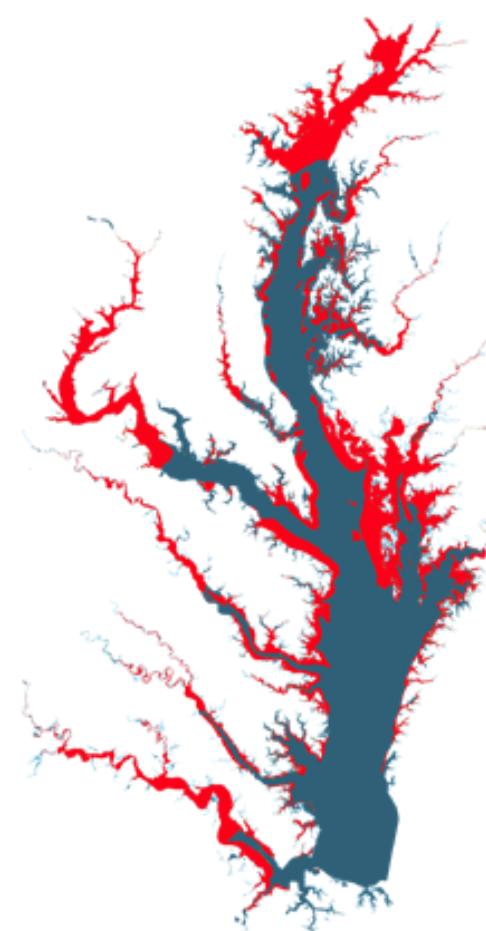


Accelerating living resource response on our way to meeting overall goal

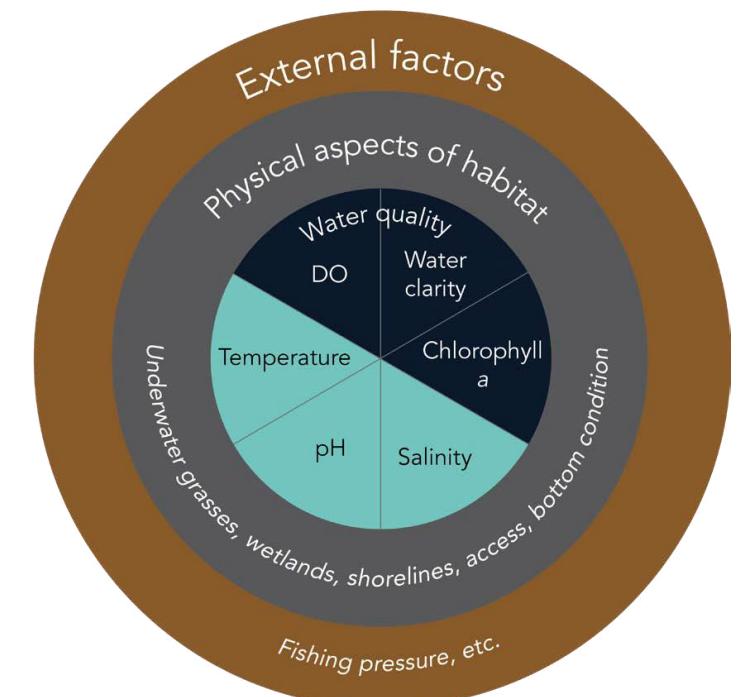
Deep water DO is most challenging water quality goal



But most impactful living resource habitats are elsewhere



Living resource habitat factors that matter



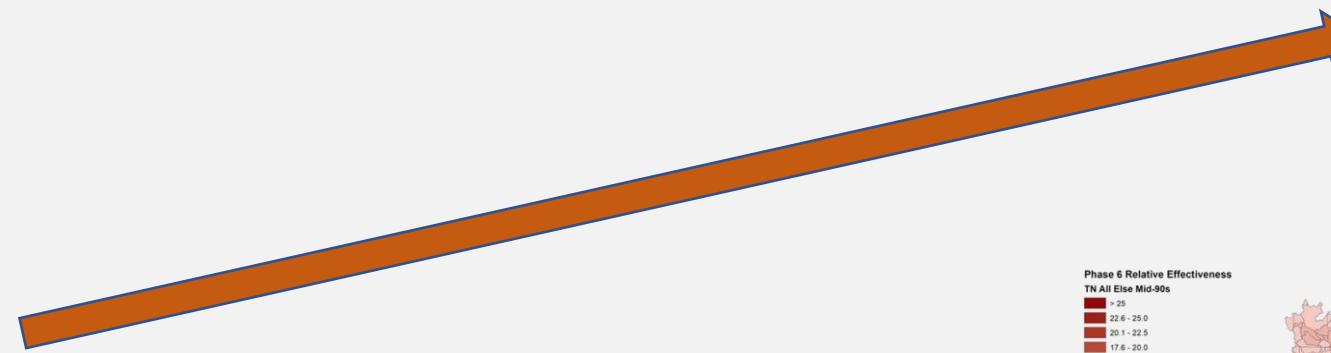
Guidelines for Planning Targets with the Default Approach

Everything
Everywhere
Everyone



↑
Effort

Increasing relationship between
Relative Effectiveness and Effort

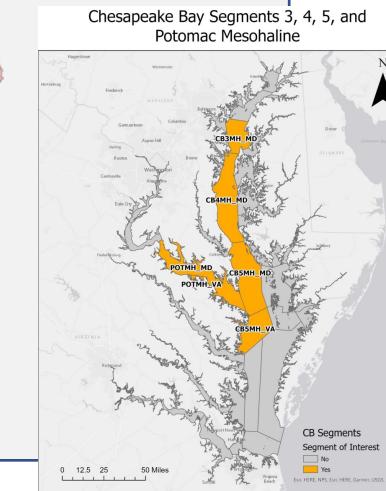
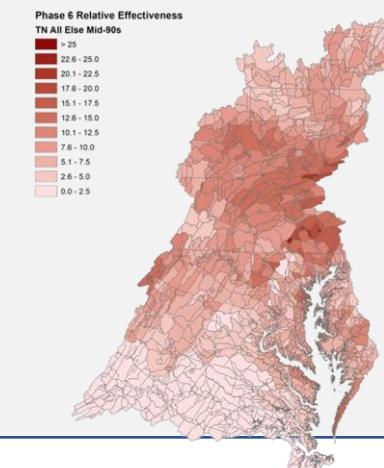


No BMPs



Effectiveness

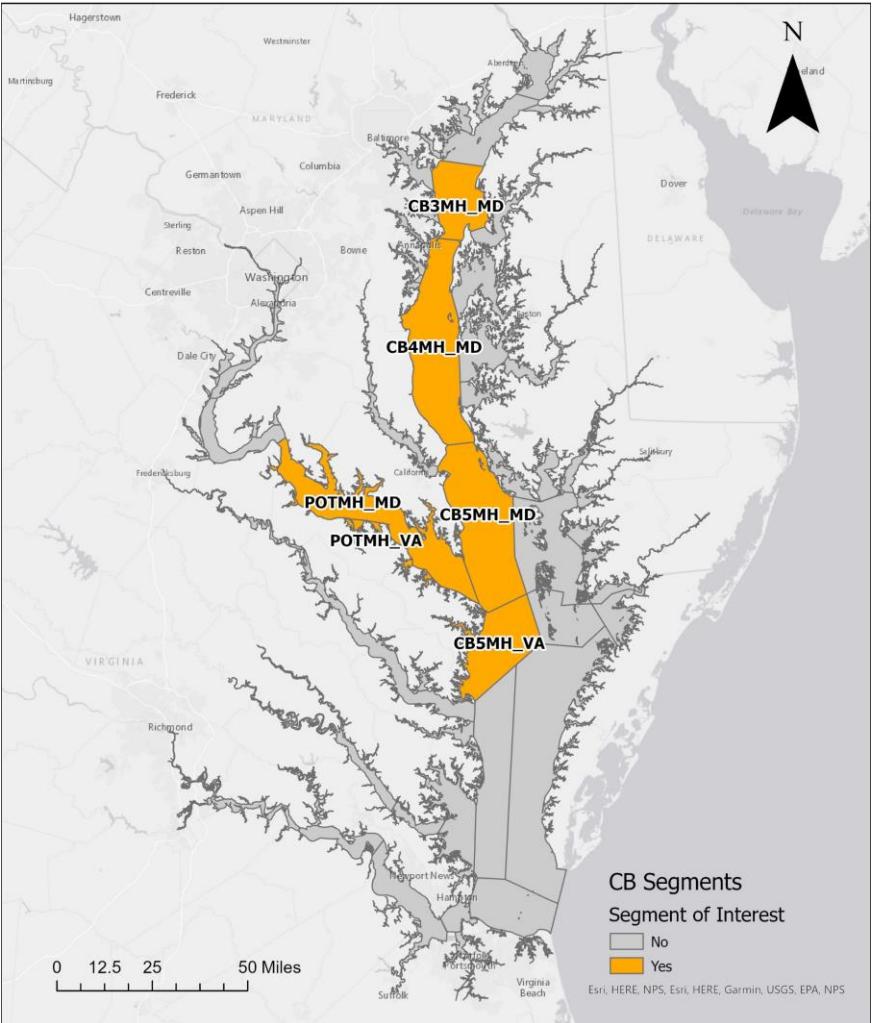
Effectiveness defined as the
deep channel and deep water



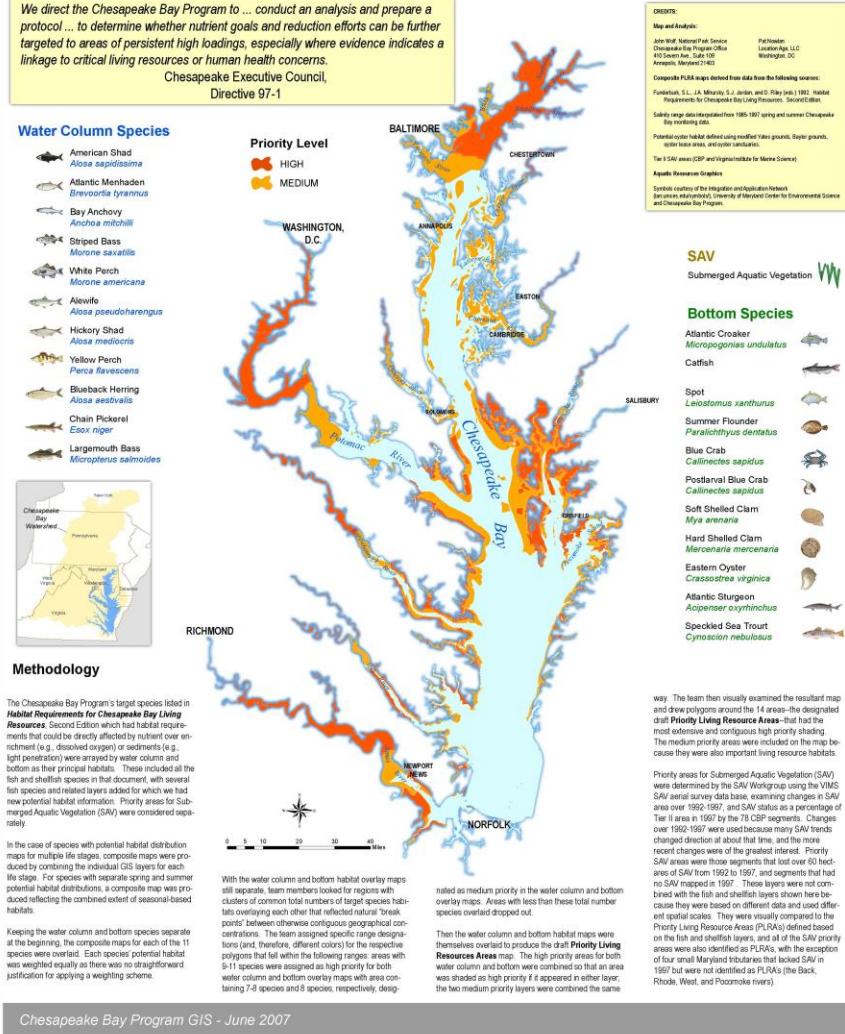
11/27/17

...but the middle of the bay is not the most important habitat

Chesapeake Bay Segments 3, 4, 5, and Potomac Mesohaline

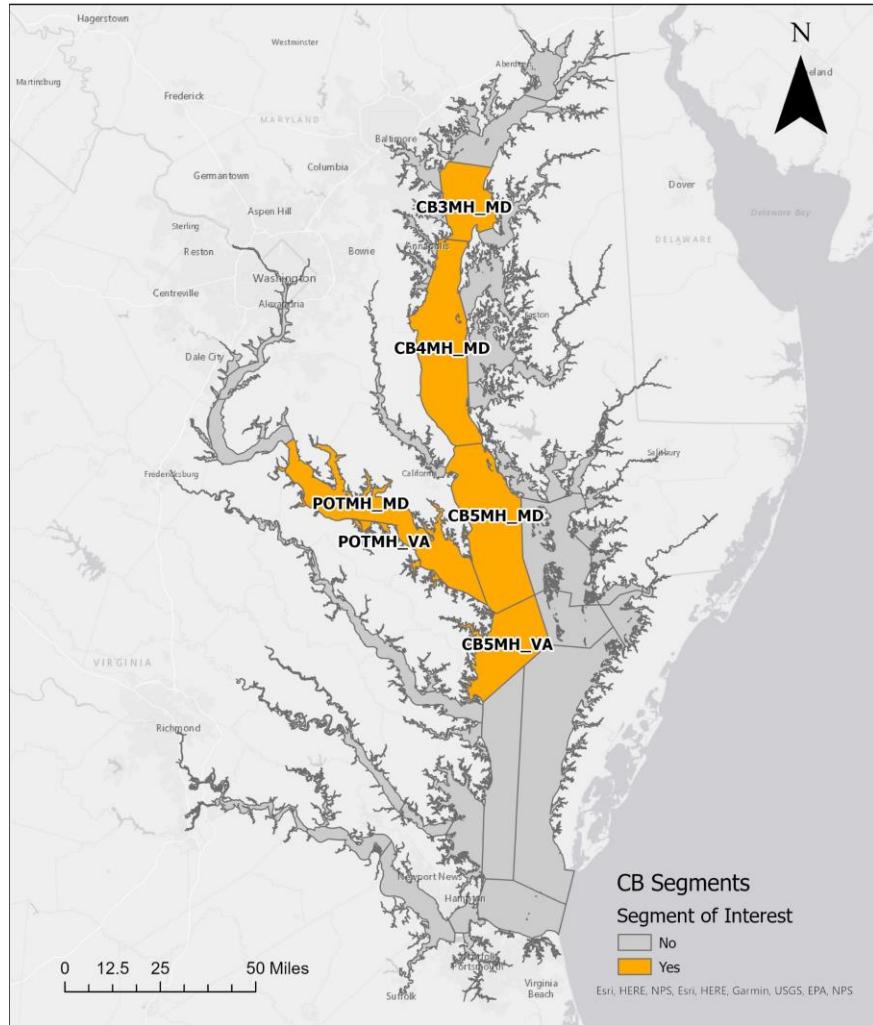


Chesapeake Bay Priority Living Resource Areas
Using GIS to Identify Habitat Hot Spots



Keep the process of distributing planning targets...

Chesapeake Bay Segments 3, 4, 5, and Potomac Mesohaline



...but do the things first that affect living resources

Chesapeake Bay Priority Living Resource Areas

Using GIS to Identify Habitat Hot Spots

We direct the Chesapeake Bay Program to ... conduct an analysis and prepare a protocol ... to determine whether nutrient goals and reduction efforts can be further targeted to areas of persistent high loadings, especially where evidence indicates a linkage to critical living resources or human health concerns.

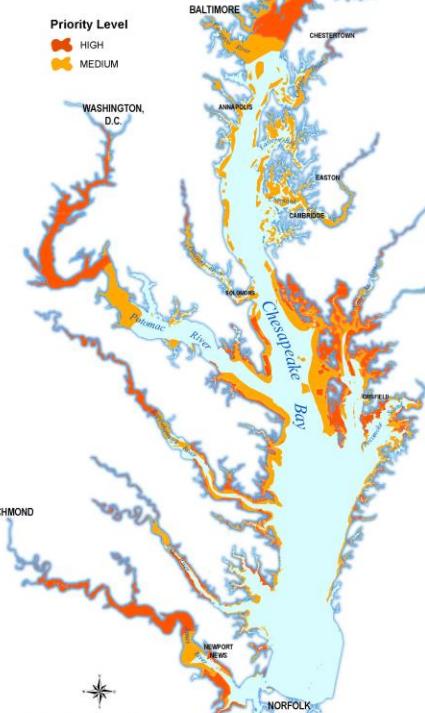
Chesapeake Executive Council,
Directive 97-1

Water Column Species

- American Shad *Alosa sapidissima*
- Atlantic Menhaden *Brevoortia tyrannus*
- Bay Anchovy *Anchoa mitchilli*
- Striped Bass *Morone saxatilis*
- White Perch *Morone americana*
- Alewife *Alosa pseudoharengus*
- Hickory Shad *Alosa mediocris*
- Yellow Perch *Perca flavescens*
- Blueback Herring *Alosa aestivalis*
- Chain Pickerel *Esox niger*
- Largemouth Bass *Micropterus salmoides*

Priority Level

- HIGH
- MEDIUM



Methodology

The Chesapeake Bay Program's target species listed in *Habitat Requirements for Chesapeake Bay Living Resources*, Second Edition which had habitat requirements that could be directly affected by nutrient over-enrichment (e.g., dissolved oxygen) or sediments (e.g., low energy habitats) were used to identify priority areas for bottom and/or principal habitats. These included all the fish and shellfish species in that document, with several fish species and related layers added for which we had new potential habitat information. Priority areas for Submerged Aquatic Vegetation (SAV) were considered separately.

In the case of species with potential habitat distribution maps for multiple life stages, composite maps were produced by combining the individual GIS layers for each life stage. For species with separate spring and summer potential habitat distributions, a composite map was produced reflecting the combined extent of seasonal-based habitats.

Keeping the water column and bottom habitat overlays maps separate, team members looked for regions with clusters of combined total numbers of target species habitats that were greater than the number of species' points' between otherwise contiguous geographical concentrations. The team assigned specific range designations (and, therefore, different colors) for the respective priority areas that fell within the following ranges of 5-11 species and 12-20 species.

With the water column and bottom habitat maps being themselves overlaid to produce the draft Priority Living Resource Areas, the high priority areas for water column and bottom habitats were those areas that were shaded as high priority if it appeared in either layer; the two medium priority layers were combined the same



Chesapeake Bay Program

A Watershed Partnership

CREDITS:
Map and Analysis:
John Wolf, National Park Service
Chesapeake Bay Program
410 Seven Ave., Suite 100
Annapolis, MD 21401
Chesapeake HAB map derived from data from the following sources:
Fontaine, G.L., J.A. Morris, C.J. Andrus and C. Rye (eds.) 1993. Habitat Requirements for Chesapeake Bay Living Resources. Seacor/Edulis.
Salinity range data/temperature for 1985-1997 spring and summer Chesapeake Bay monitoring data.
Priority areas determined using modified Tiers approach. Baywide records, priority living areas, and priority summaries.
Tier 2 areas (MD and Virginia Institute of Marine Science).
Aquatic Resource Graphics
Symbol courtesy of the Interstate and Appalachian Network (see sources acknowledged), University of Maryland Center for Environmental Science and Chesapeake Bay Program.

SAV
Submerged Aquatic Vegetation

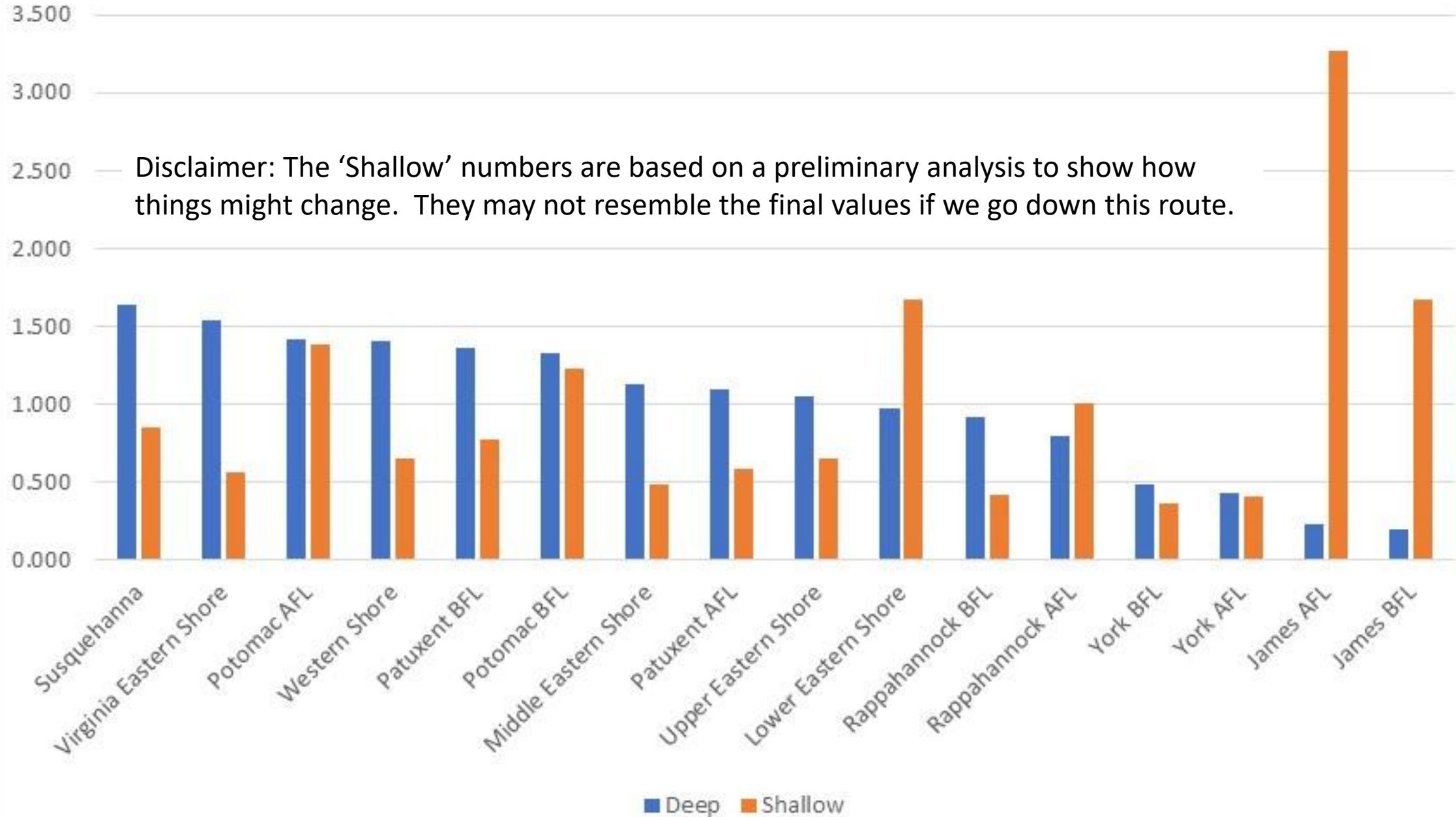
Bottom Species

- Atlantic Croaker *Micropogonias undulatus*
- Catfish
- Spot *Leiostomus xanthurus*
- Summer Flounder *Paralichthys dentatus*
- Blue Crab *Callinectes sapidus*
- Postlarval Blue Crab *Callinectes sapidus*
- Soft Shelled Clam *Mya arenaria*
- Hard Shelled Clam *Meretrix meretrix*
- Eastern Oyster *Crassostrea virginica*
- Atlantic Sturgeon *Acipenser oxyrinchus*
- Speckled Sea Trout *Cynoscion nebulosus*

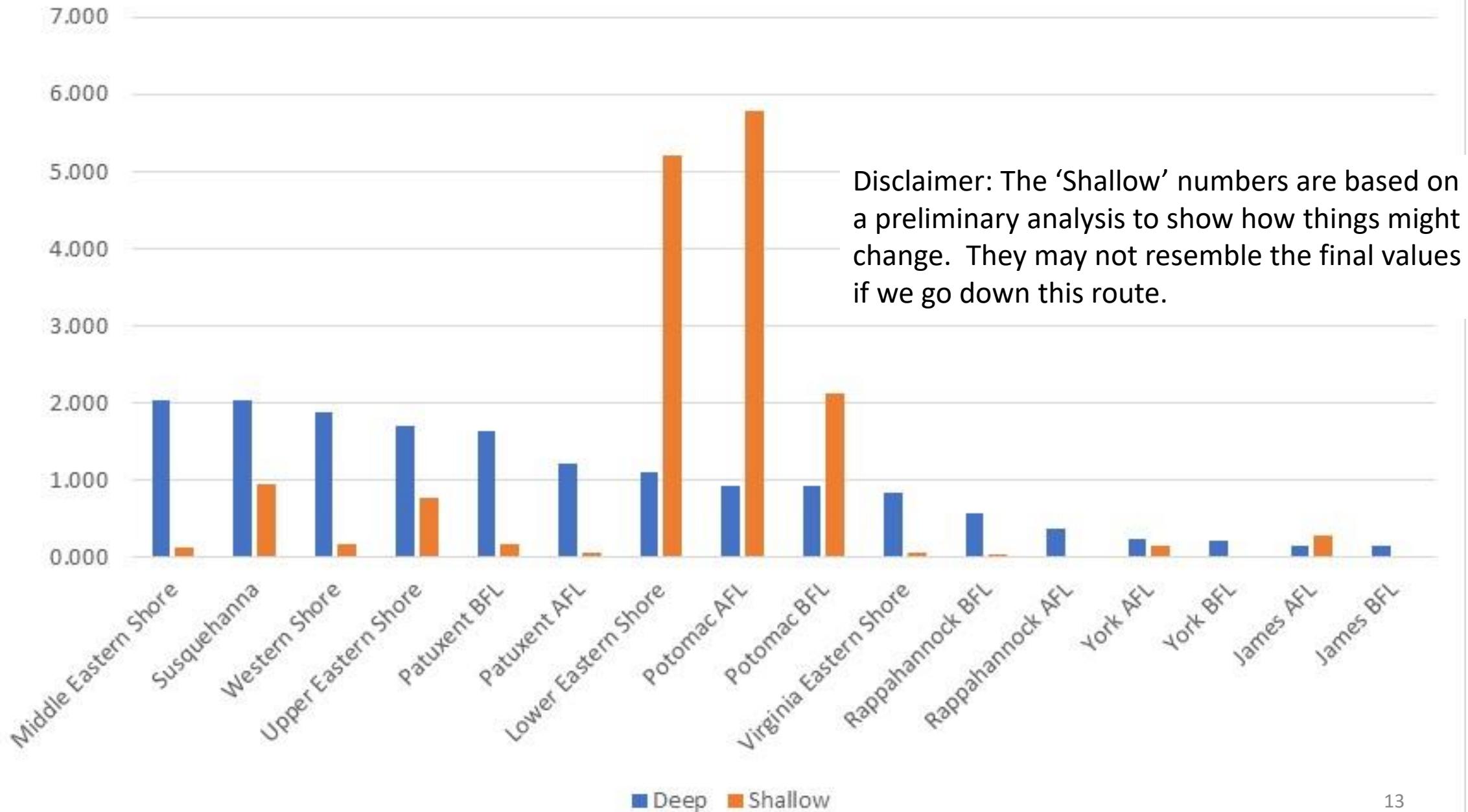
way. The team then visually examined the resultant map and new polygons around the 14 areas—the designated draft Priority Living Resource Areas—that had the most extensive and contiguous habitat requirements. The team determined which areas were included in the because they were also important living resource habitats.

Priority areas for Submerged Aquatic Vegetation (SAV) were determined by the CWP Workgroup using the VIMS SAV aerial survey data base; examining changes in SAV area over 1992-1997, and SAV status as a percentage of Tier II area in 1997 by the 78 CWP segments. Changes over 1992-1997 were used because many SAV trends change over time and the time period of the most recent changes were of the greatest interest. Priority SAV areas were those segments that lost over 60 hectares of SAV from 1992 to 1997, and segments that had no SAV in 1992. These areas were not combined with the fish and shellfish layers shown here because they were based on different data and used different spatial scales. They were visually compared to the Priority Living Resource Areas and combined based on the fish and shellfish layers, and all of the SAV priority areas were also identified as PLURAs, with the exception of four small Maryland tributaries that lacked SAV in 1997 but were not identified as PLURAs (the Back River, West, and Pocomoke rivers).

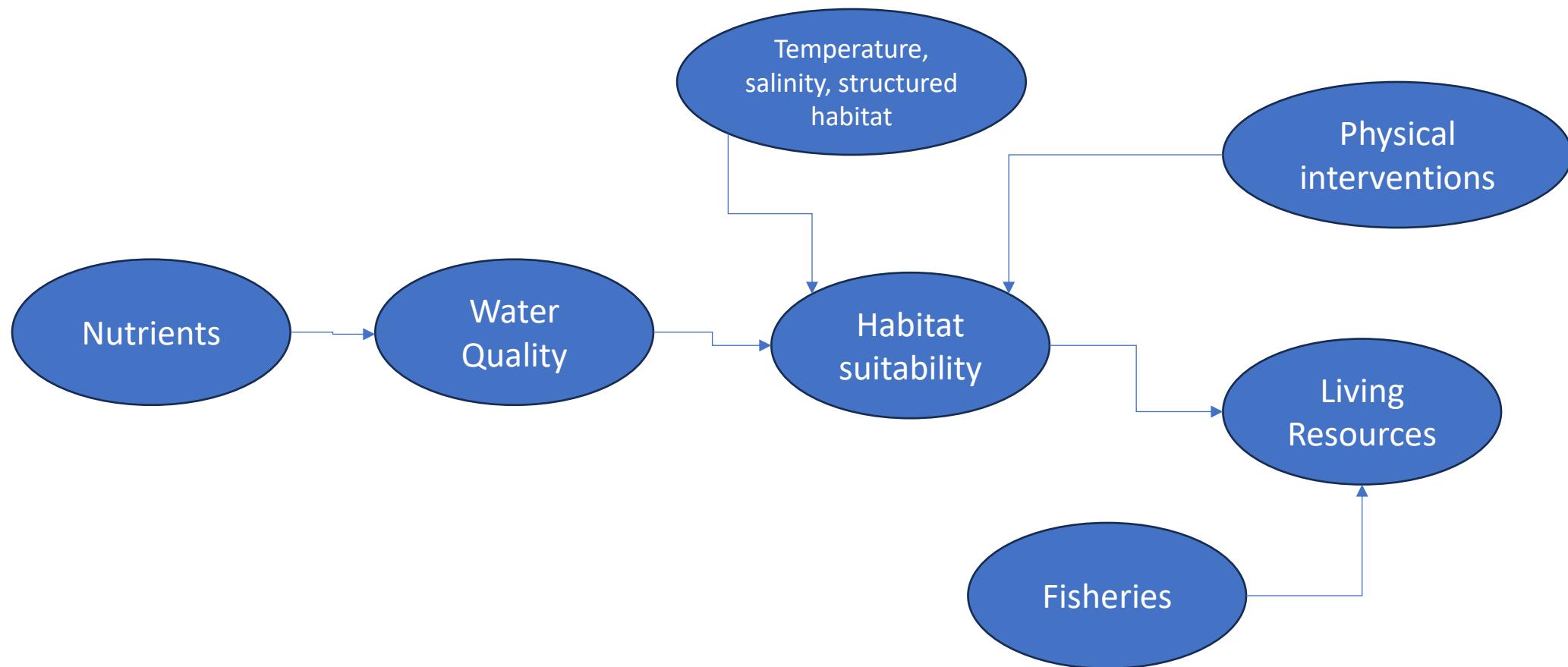
Normalized Estuarine Effectiveness Nitrogen



Normalized Estuarine Effectiveness Phosphorus



Habitat Suitability = F(Water Quality, Temp; Salinity; Structured Habitat; Physical Interventions)



Potential Overall plan

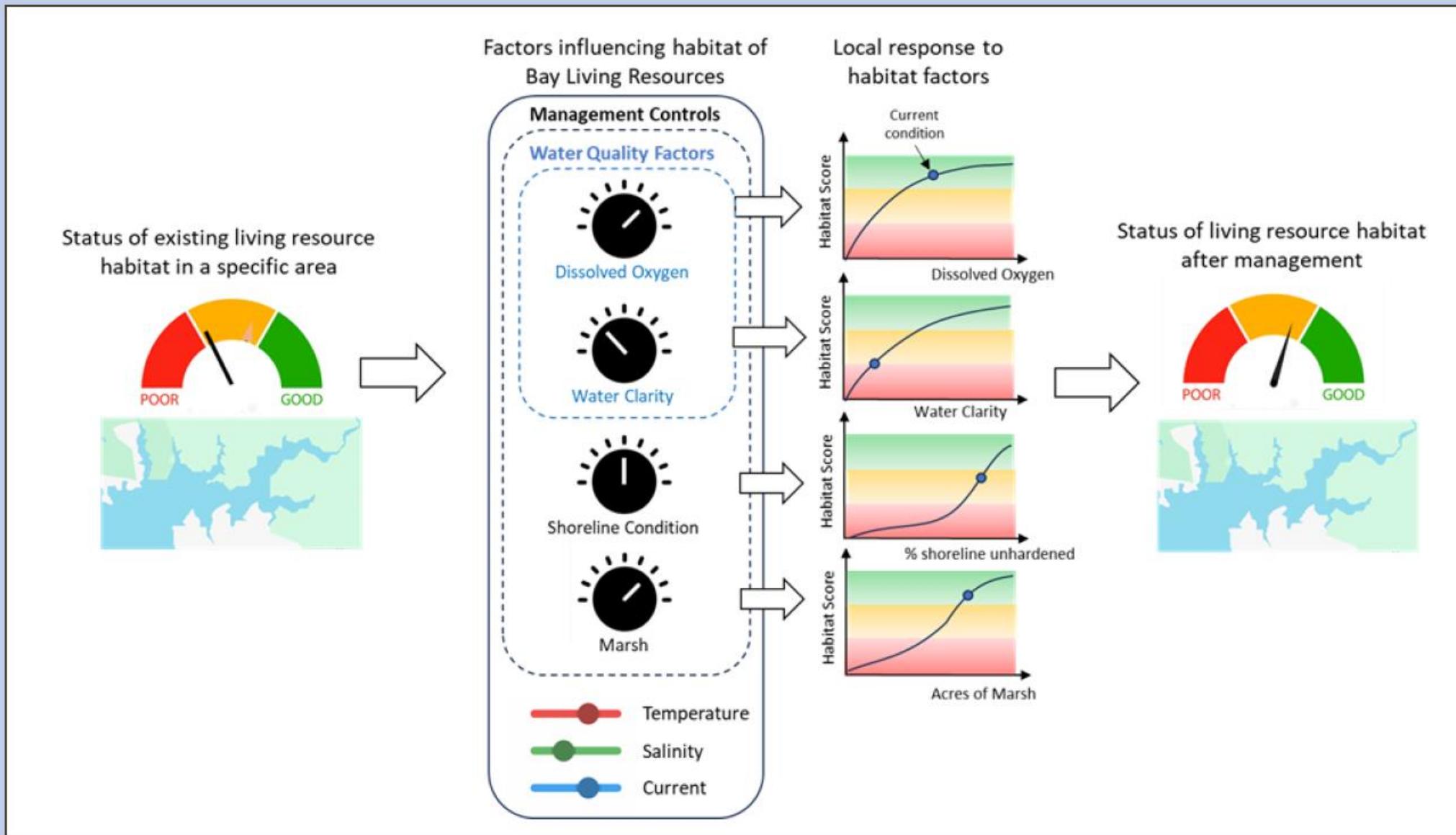
- Build 4D, MBM, MTM, Habitat suitability models
- Keep default approach as it is but prioritize in time based on LR needs (do an allocation-like exercise but use LR-relevant metrics)
 - Take care of the biggest differences first
- Develop tools that allow an organization to lookup from their Cbseg to see the best say to improve the LR
 - Numerical version of the conceptual model on the previous slide

So, How Do
Living Resources
Fit Into This
Partnership
Process?



Photo by Charlie Nick/Chesapeake Bay Program

Assessing local water quality, stressor, and habitat conditions



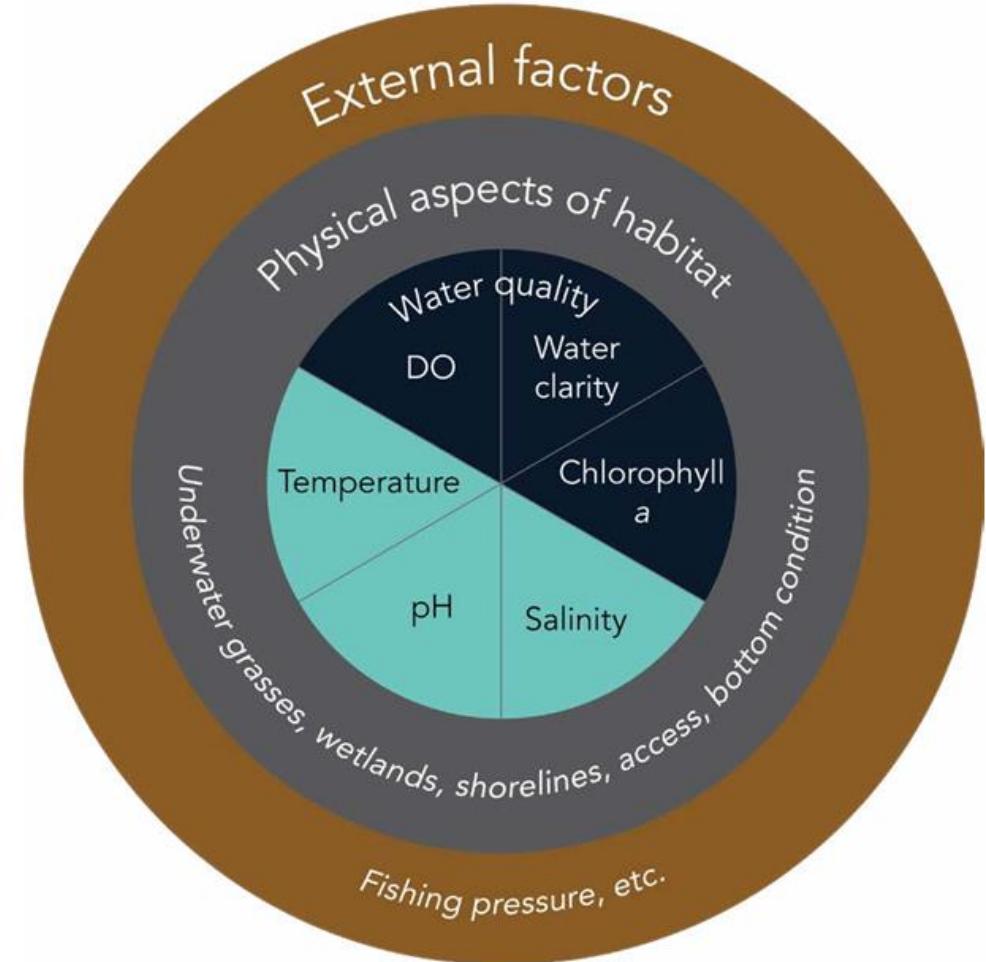
From Concept to Implementation

1. Conduct habitat suitability analysis
2. Assess living resource habitat improvement potential of various segment/habitat combinations (dials) (local conditions to response to stressors reductions)
3. Identify relative contribution of upstream and estuarine N, P and sediment on segment-habitat nutrient levels
4. Set interim N, P, and S targets based on 1-3 (policy decision).
5. A future WIP planning process that includes consideration of other factors that impact living resource habitat and that includes incentives to adapt to observable outcomes (stressor-response)



Opportunity to Link

1. Water quality management decisions
2. Potential improvements in tidal living resource responses



Big Picture View & Motivation

- Priority Living Resource Habitat Area Identification
 - Task meant to drive a result, not just to improve understanding
 - Tie to management priority, tie to water quality and improve living resource outcomes
- Fast track to complete a habitat suitability index (HSI) for the 92 tidal segments of the Chesapeake Bay
 - This project is a priority of the CBP
- Analysis is a step to:
 1. Implement recommendations of the CESR report
 2. Identify target areas for tiered implementation/targeting
 3. First step to implementing the Fish Habitat Outcome under the revised Bay Agreement
 4. Lead to prioritization and where to invest resources
 5. Identify where landscape work impacts water quality, fish habitat, and other outcomes



Remember:

Outcomes need to have the most potential for CBP partnership implementation *and be feasible*



Ability to meet management objectives, resources required, data availability, achievable within timeline, reproducible to track changes over time, includes factors CBP can control

Objective

Determine the **approach to target** and **track linked responses** of living resources, structural habitat, and water quality while considering **known constraints**, including ability of approach to meet objectives at zero cost, and **generate a workplan**, including a **timeline** and **who** is contributing to this effort.

Project Support

- Chesapeake Bay Program
 - Members on the Project Oversight Committee
- Scientific and Technical Advisory Committee (STAC)
 - Members on the Project Analysis and Implementation Team and Project Oversight Committee
 - Members coordinate external review
- Virginia Institute of Marine Science (VIMS)
 - Project Analysis and Implementation Team
 - Dissertation Committee will review Colin's work
- Chesapeake Research Consortium (CRC)
 - Coordinate the merit review
 - Help with communications
 - Coordinate the hybrid meeting of the do-ers (October or November 2025)
 - Technical editing of merit review
 - Potential infographics support via Greenfin
- Chesapeake Bay Program Data Center
 - As needed consult
- Chesapeake Bay Program Geospatial Analysis Team (GSAT)
 - Public facing viewer/tool
 - Potential Plan B doers
- Chesapeake Bay Program Communications Team
 - Develop communication pieces, webinars
- Additional analysis support from NOAA NCCOS and Chesapeake Bay Trust Chesapeake Conservation and Climate Corps

Additional Thoughts On This Work



CBP

Tiered Implementation talks starting across the partnership
Also, other uses of this information
•Collaboration and cooperation across goals and outcomes
•Ties outcomes together in one dataset
Keeping this team up to date as we go



First time NOAA and Fish GIT have direct connection to EPA WQ folks

Meets multiple needs
Novel effort for the CBP
•Builds off the CESR idea



Example of project with STAC members very collaborative with NOAA, EPA, VIMS, CBP

Only example or example in recent memory of this type of collaboration
Room for future collaborations with these groups?



Future

At some point, codify where this work lives under new structure/governance
Fold linked living resources and water quality into new way we work
Fish habitat team is a prime place to do this
Briefing/conversation/starting point for STAR
Work is starting point for other assessment

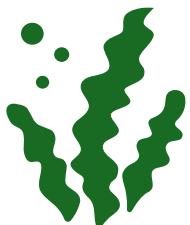
Data Sets



Fish Data

Juvenile Striped Bass
Bay Anchovy
Croaker

- *Note these three species provide excellent ecological coverage of the Bay*



Habitat Data

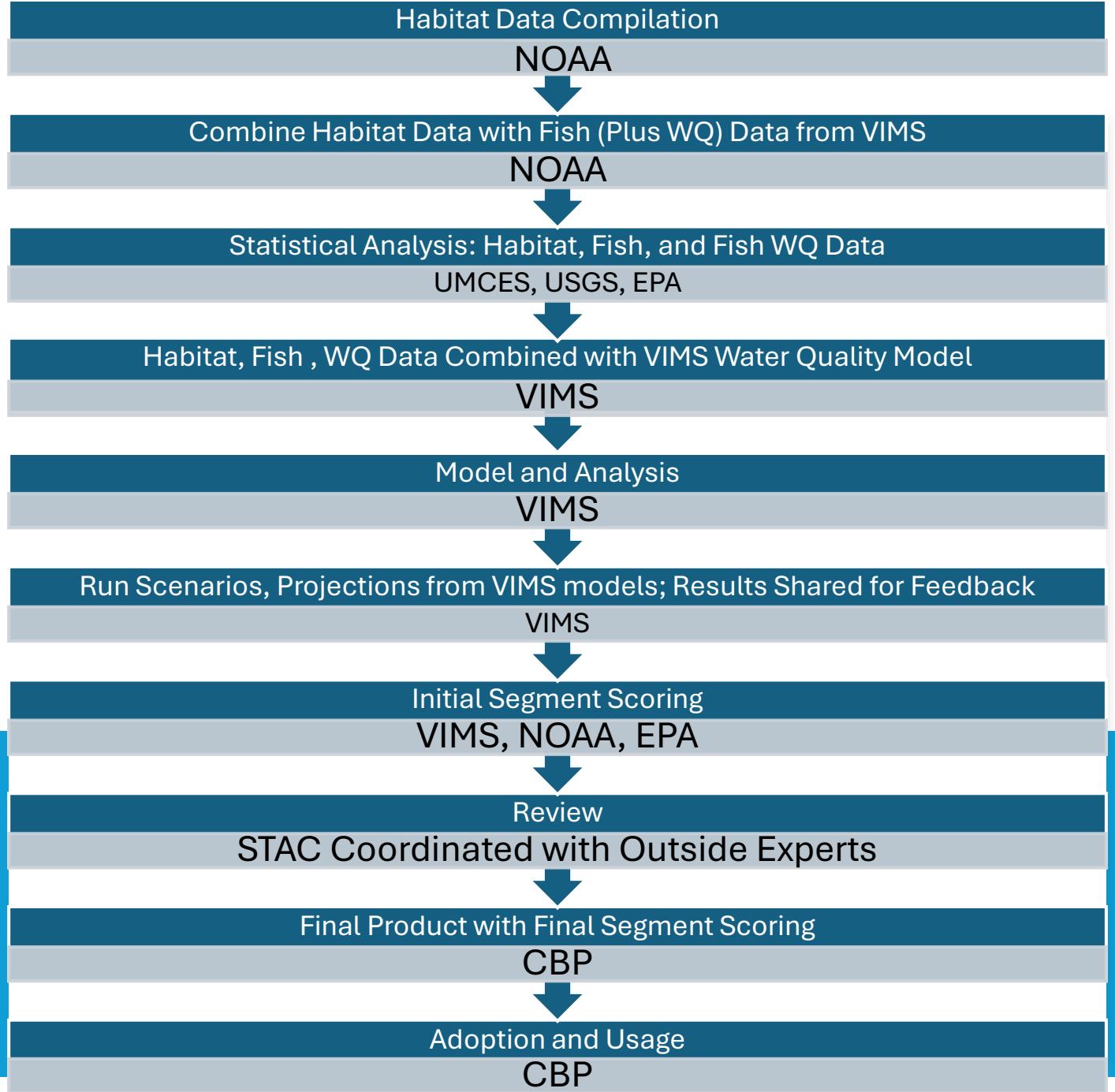
Substrate
Tidal Wetlands
SAV
Bathymetry
Oysters
Shoreline
Others



Water Quality Data

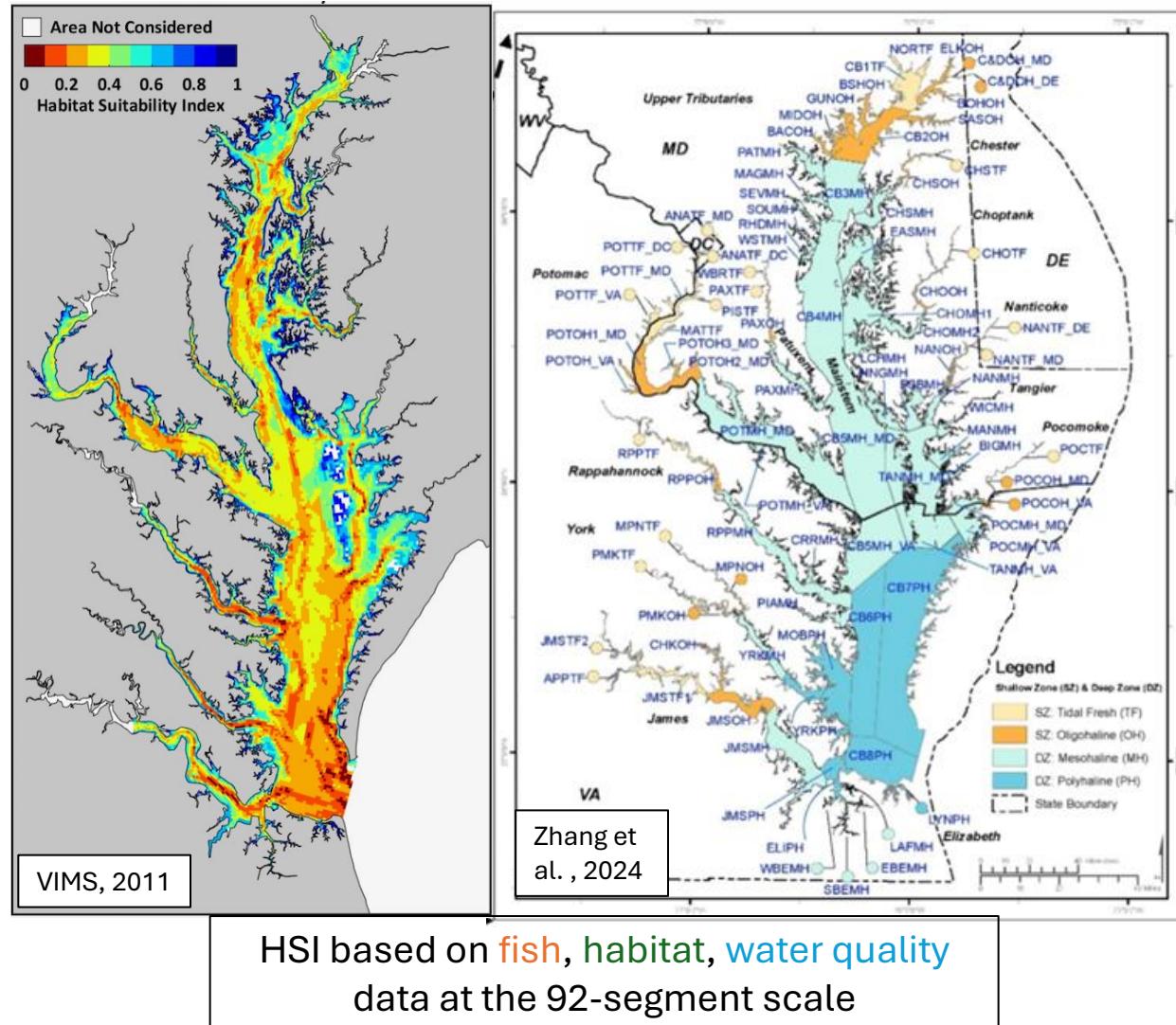
Initially from Fish Data
Then, VIMS model
(Later, Phase 7)

Workflow



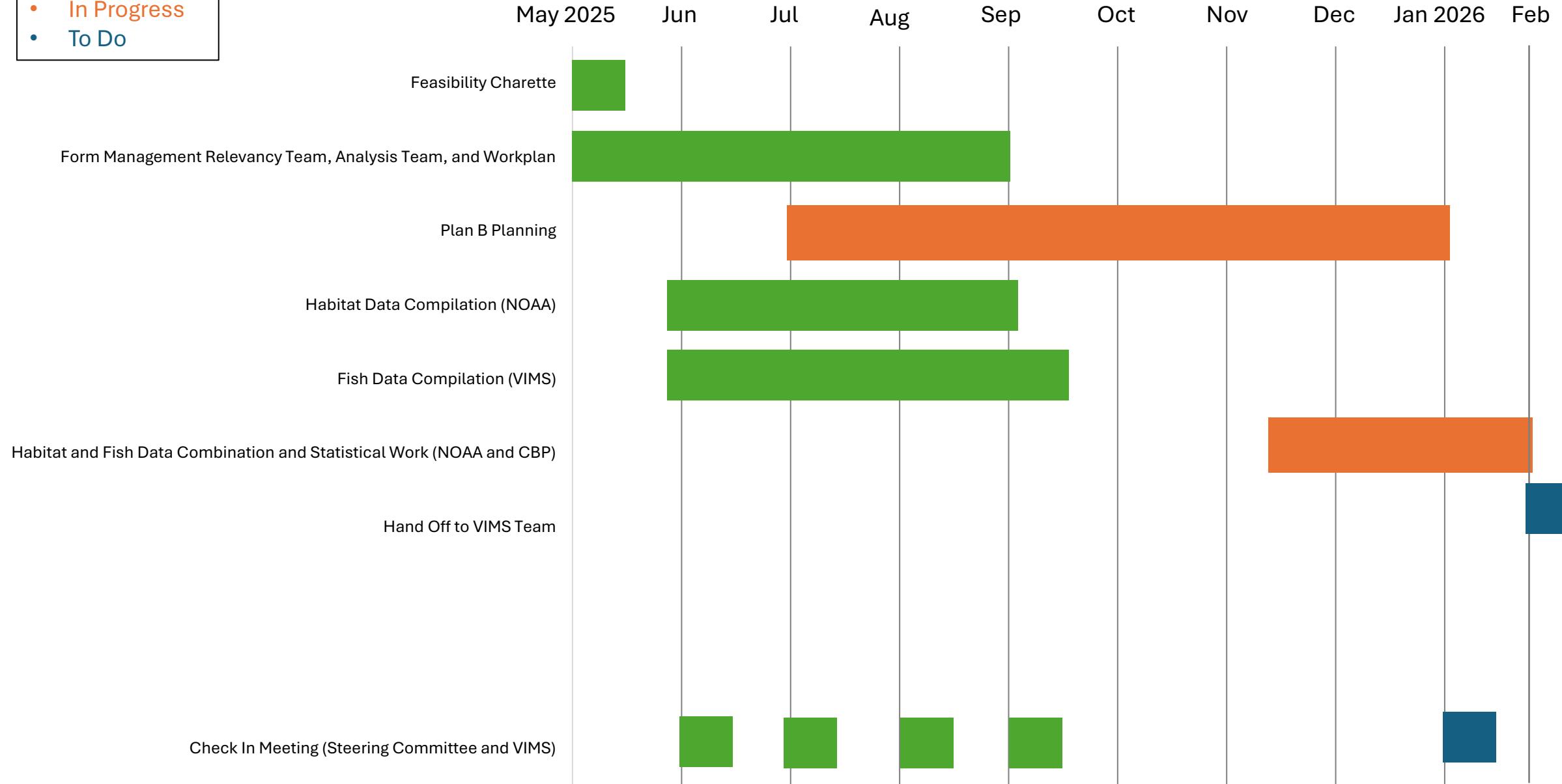
How is this going to work?

- Looking for relationships for habitat and fish data to build habitat suitability index (HSI, example on the left) for all 92 segments (map on the right)
- Recognize we don't have fish data everywhere
- Relationships evoked where data are absent, we will have the score



Legend

- Complete
- In Progress
- To Do



Legend

- Complete
- In Progress
- To Do

Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Comparing WQ Data and WQ Model Outputs



Develop Decision Tree Model For First Species



Develop Decision Tree Model For Additional Two Species



Perform Scenario Analysis and Projections



Check In Meeting (Steering Committee and VIMS)



Compile Information and Hand Back to CBP



Analysis to Quantify Shallow Water Habitat Conditions In 92 Segments



Format Outputs and Mapping with CBP GSAT



Legend

- Complete
- In Progress
- To Do

Jan 2027 Feb Mar Apr May Jun Jul Aug Sept Oct

Draft Assessment Report



STAC Merit Review



Legacy Plan and Briefing Preparation



Parallel Path

We are hopeful that this approach to score 92 tidal segments will work

- Uncertainty with it working with the fish data, as there will be many places with zeros/no data/no fish information

However, we must meet our objective

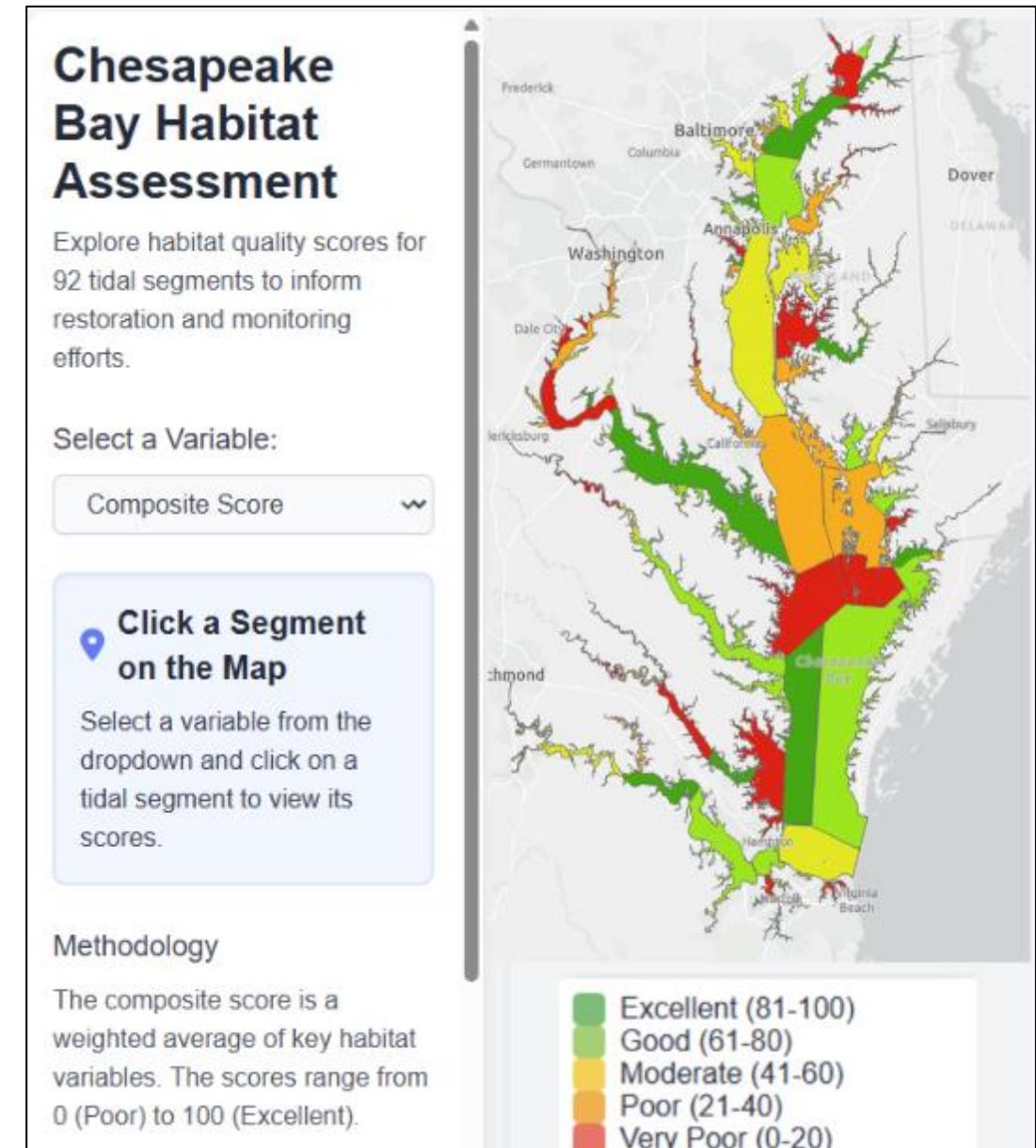
- Objective: places to focus on for tiered targeting

Plan for Parallel Path

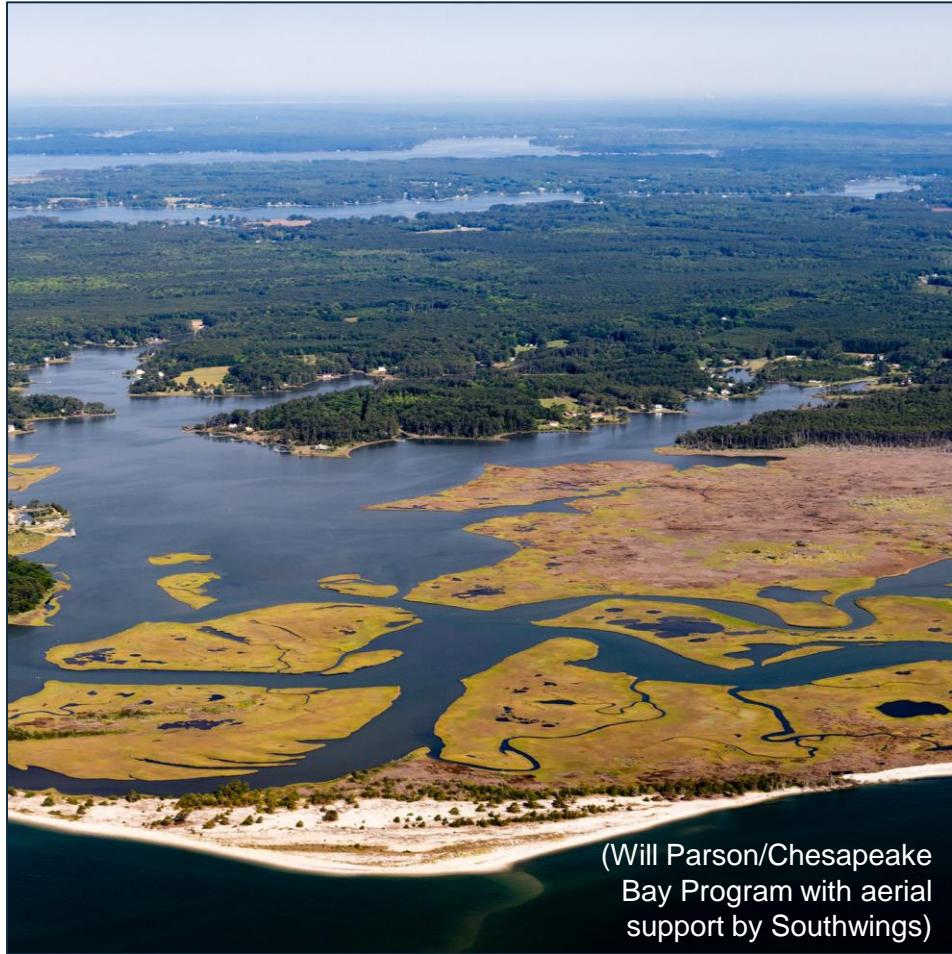
- Segment scoring based on habitat requirements, underscored by NOAA datasets
- Derived from geospatial habitat requirements and water quality data
- Composite score based on criteria weighting
- Provides a common, transparent, and scientifically-backed framework that allows all partners to work from a shared understanding of the Bay's health

Potential End Product

- Visualization of habitat assessment for each of the 92 segments
 - Potential future GIS support ask for visualization and hosting on C4 network
- Inform targeting needs to
 - Implement tiered targeting
 - Prioritize areas for habitat restoration
- Repeated at future intervals with updated data



*Note, this graphic shows an example of what a visualization might look like and includes made-up data for the mockup.



(Will Parson/Chesapeake Bay Program with aerial support by Southwings)

Thank You!

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