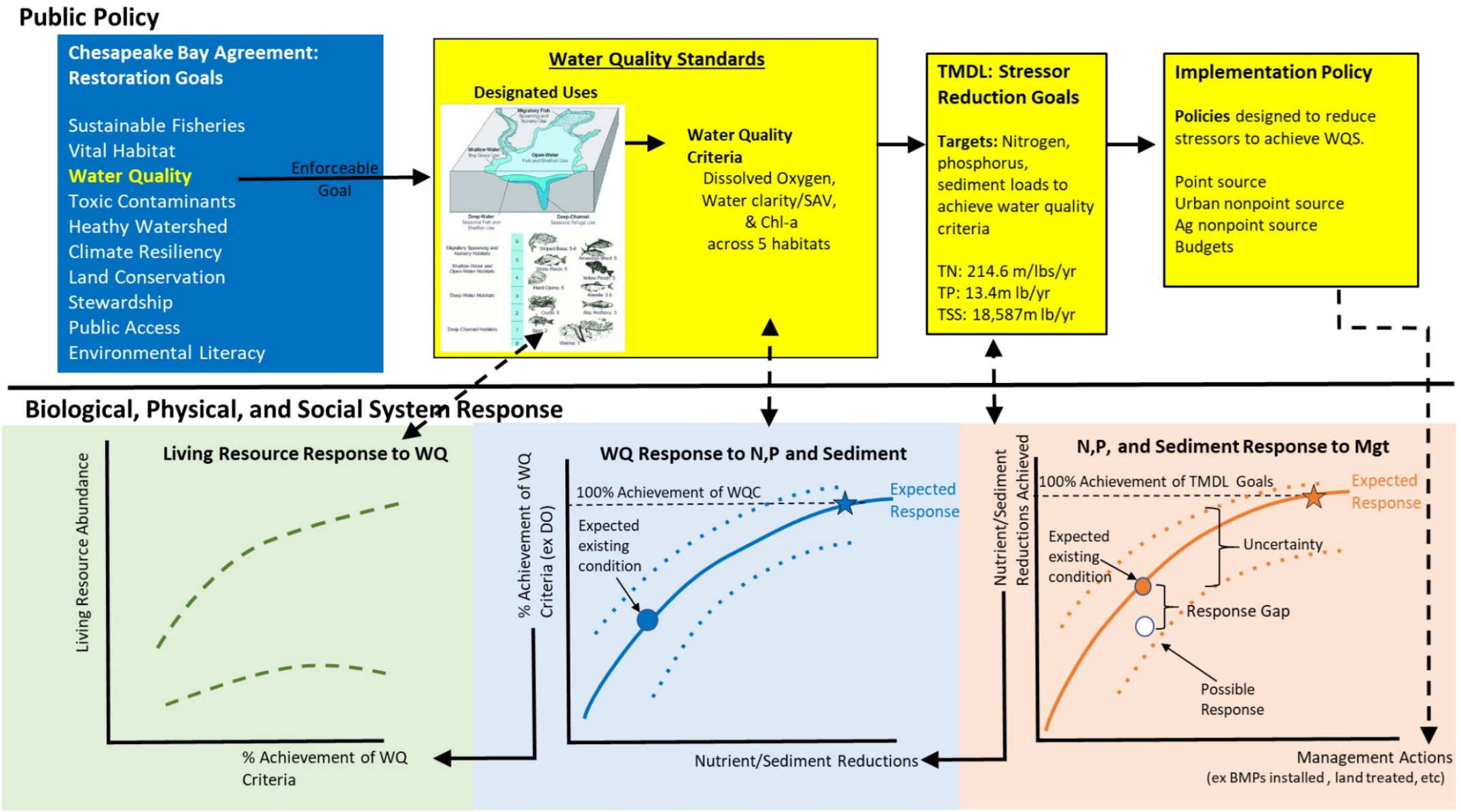
OBJECTIVES FOR TODAY

- Are we on the right track for Sections 3-5? What should we pay attention to as editors?
- Set a date for the receipt and resolution of individual comments
- Design next steps for review of Implications

CESR REPORT OBJECTIVES

- Identify gaps and uncertainties in system response —physical, chemical, biological, and socioeconomic— that impact efforts designed to attain WQS.
- Identify recent scientific developments that can shed light on the gaps and uncertainties in system response to advance efforts to attain WQS, and
- Recommend research strategies that improve understanding of system response to support informed decision making to attain WQS.
- Recommend strategies for integrating scientific and technical analysis with active adaptive management in order to aid decision-making under uncertainty (to achieve WQS).

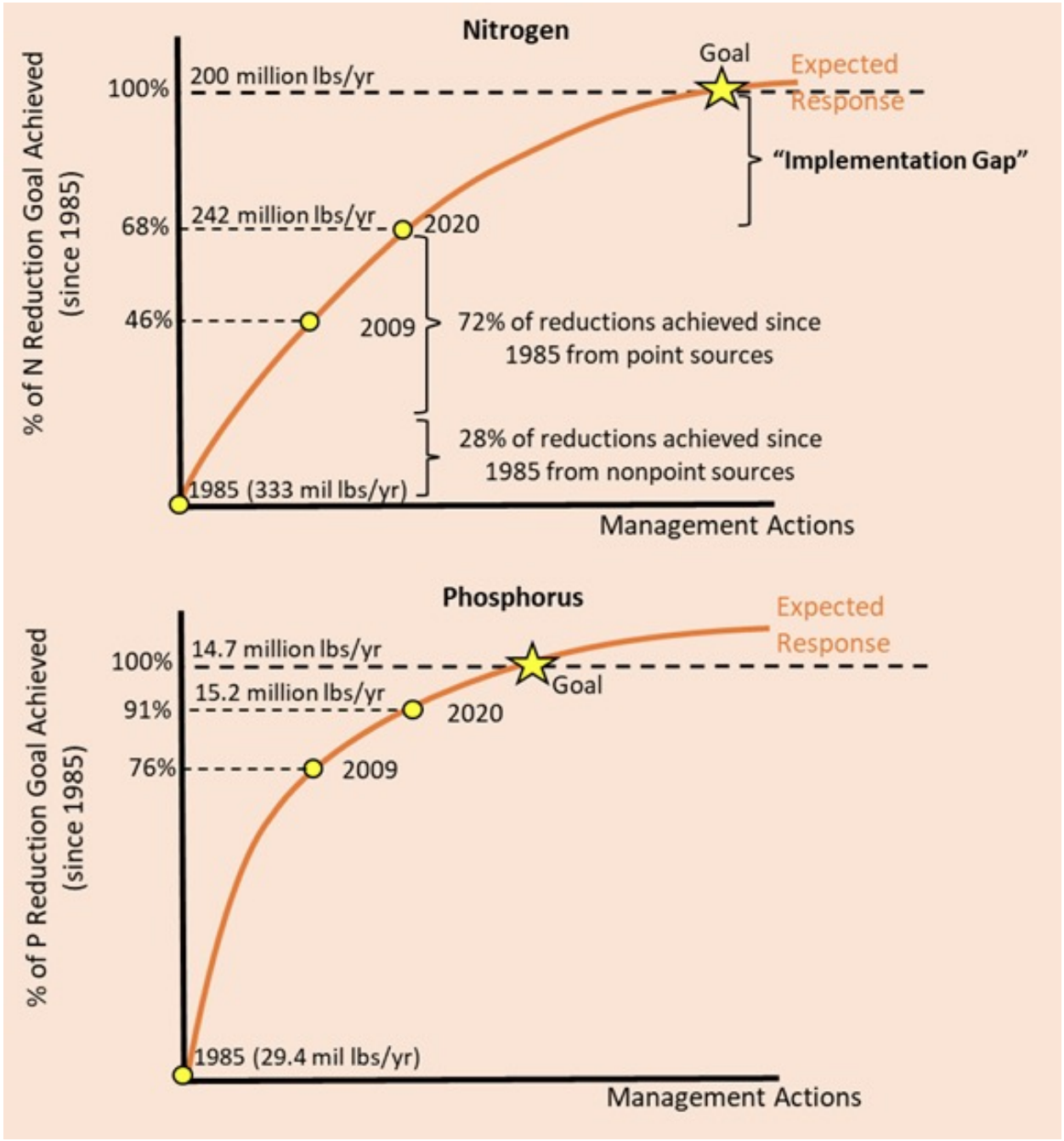
Section 2: Policy Context and Report Organization



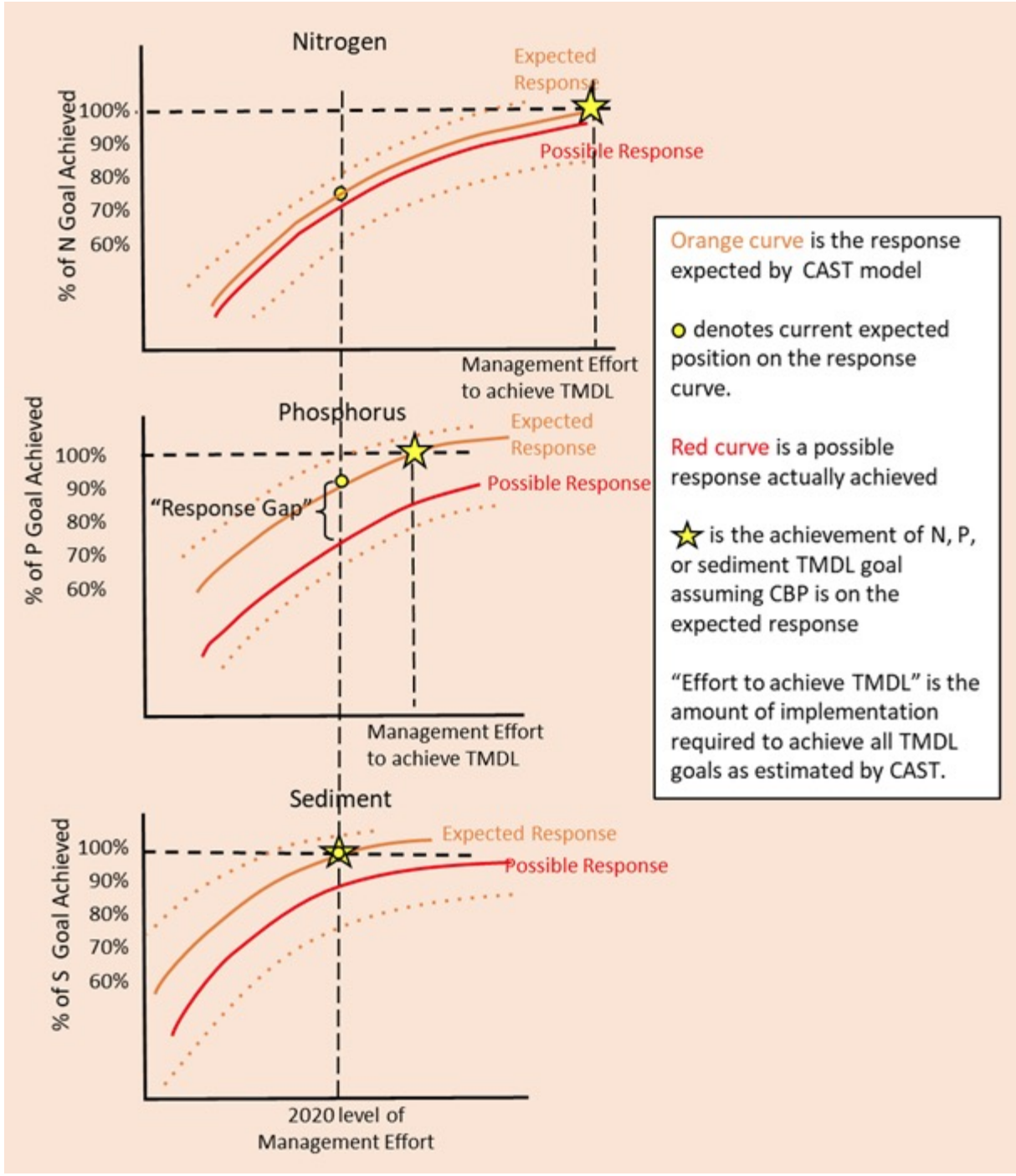
Section 3: Nutrient and Sediment Response to Management Efforts

- The Nonpoint Source Issue
- Nonpoint Source Policies
- Nonpoint Source Response to TMDL Implementation Policy
    - Implementation Gap
    - Response Gap
- Gaps and Uncertainties in Effort to Reduce NPS Loads
    - Lag times
    - NPS Response Gaps
        - Behavior
        - BMP Effectiveness
        - Monitoring and Data
    - Implementation Gaps
        - Mass Balance
        - Behavioral Response (sufficient scale)
        - Targeting NPS
        - Spatial Distribution and TMDL Accounting of BMPs
        - Incentives to Improve WQ outcomes
        - Climate Change
- Conclusions

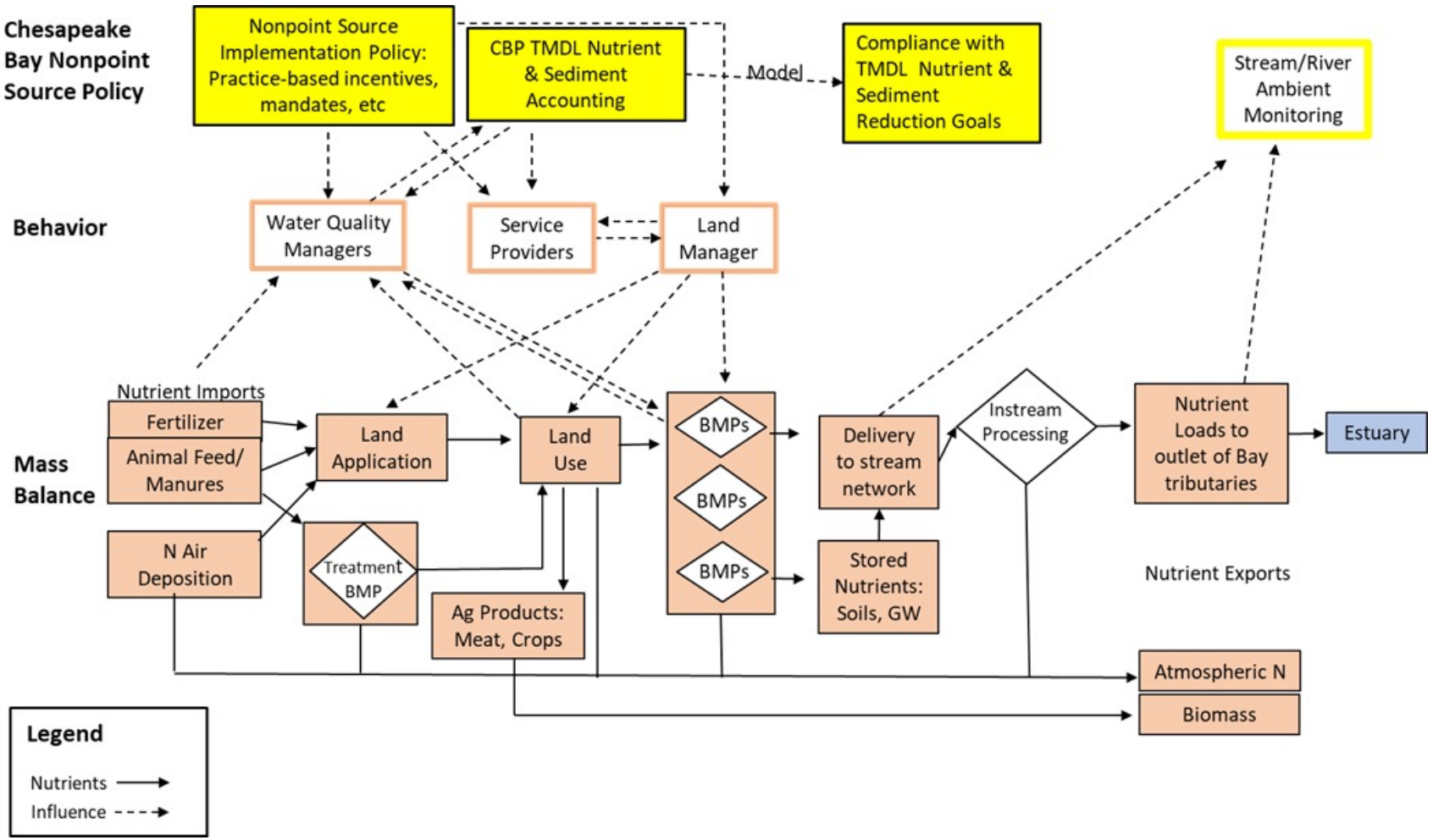
Implementation Gap



Response Gap

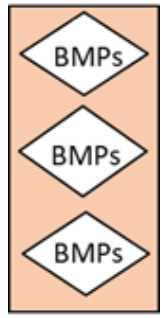


Organizing System Diagram

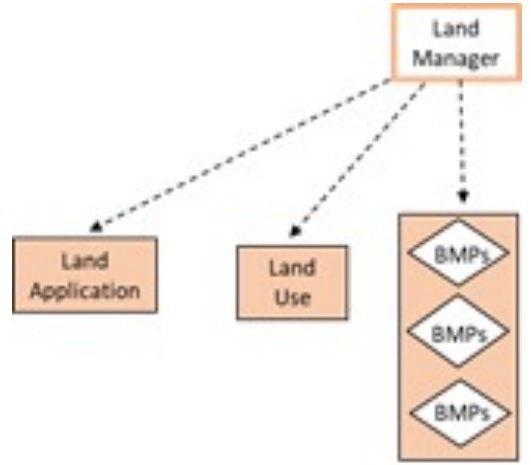


Assessing the Gaps and Uncertainties in System Response: *Response Gap Examples*

BMP may not be as effective as predicted



May systematically overestimating behavioral response



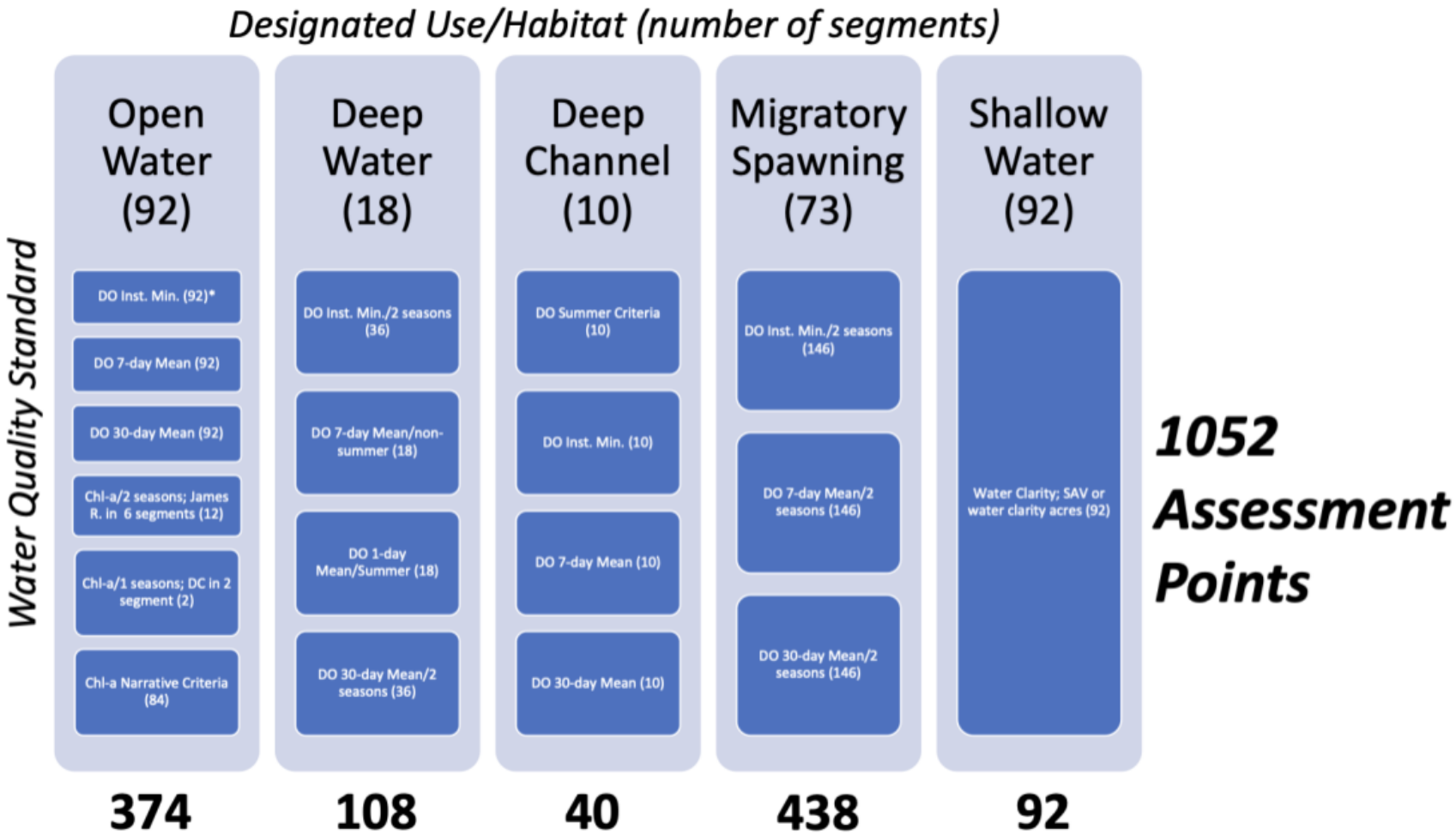
Section 4: Water Quality Response to Nutrient and Sediment Reductions

Water Quality Criteria and Conditions for Attainment

Estuary Response to Realized Nutrient and Sediment Loads

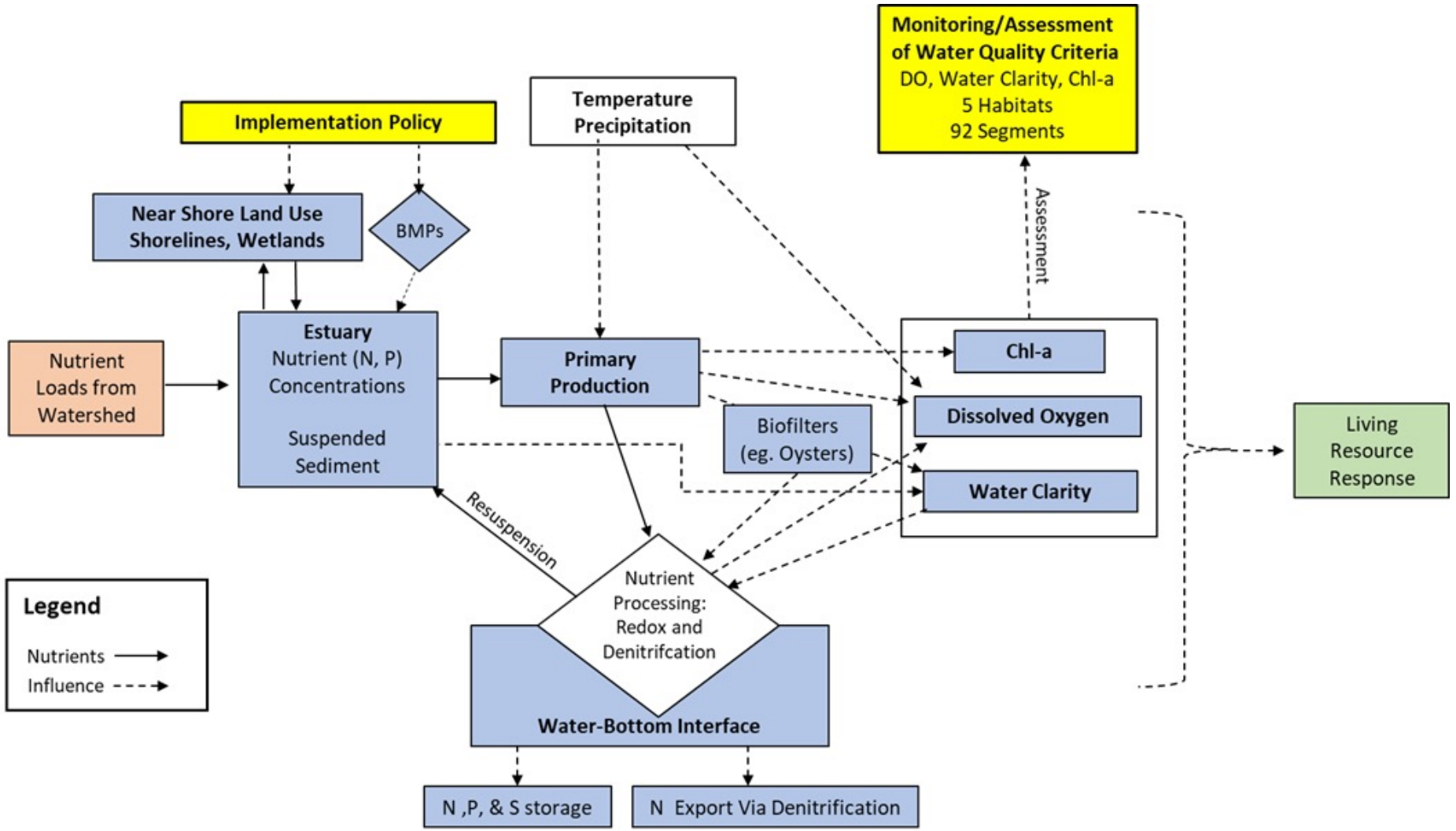
Uncertainties in the Attainment of WQS

- Ability to Assess Attainment
- Ability to Estimate or Measure Loads
- Confounding Factors/Non-linear Interactions
- Climate Change



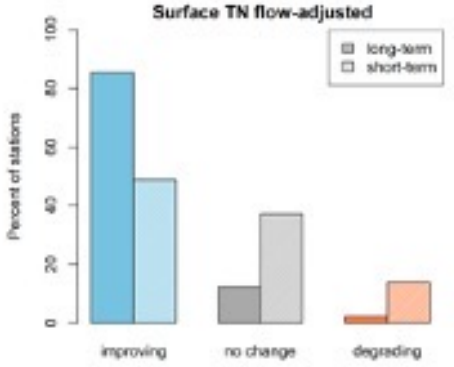
*If criteria is exceeded (i.e., lower DO than minimum), temperature evaluation is made and a lower criterion may apply for protection of sturgeon

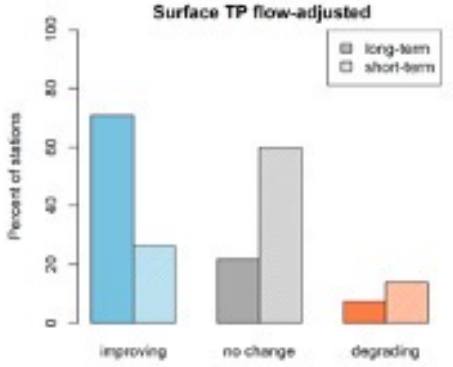
Organizing System Diagram

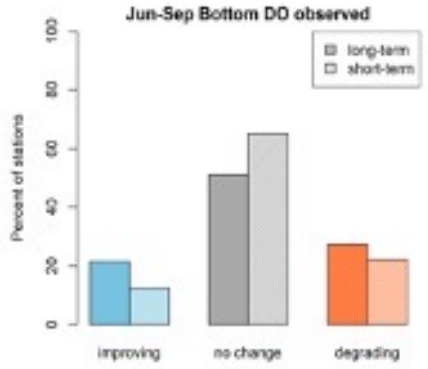


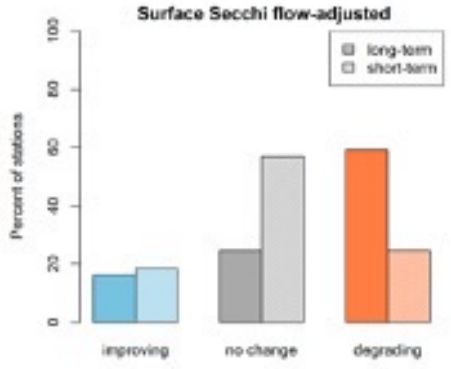
Estuary Nutrient Response & WQ Response

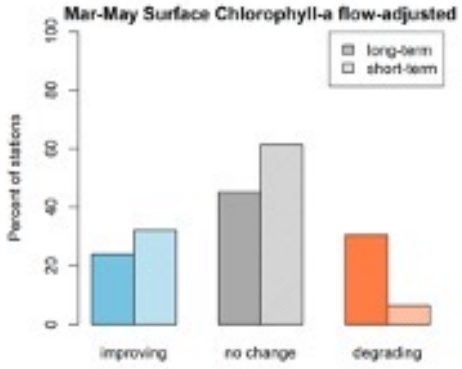
Percent of stations with improving, degrading, and no change for long- and short-term periods in: a) flow-adjusted annual total nitrogen in the surface layer; b) flow-adjusted annual total phosphorus in the surface layer; c) dissolved oxygen in the bottom layer during the summer season ; d) flow-adjusted annual Secchi depth; and e) flow-adjusted spring chlorophyll-a in the surface layer.



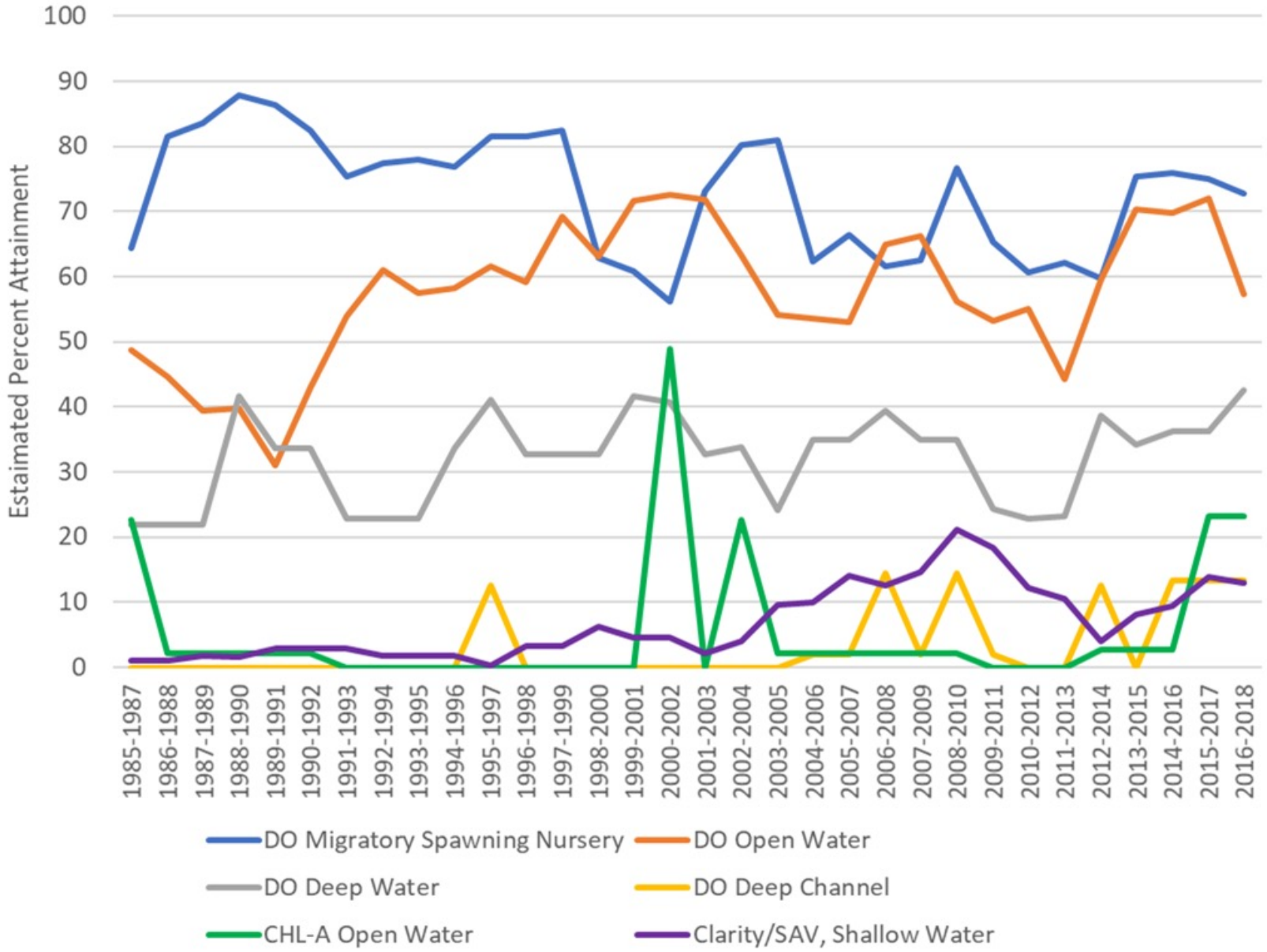




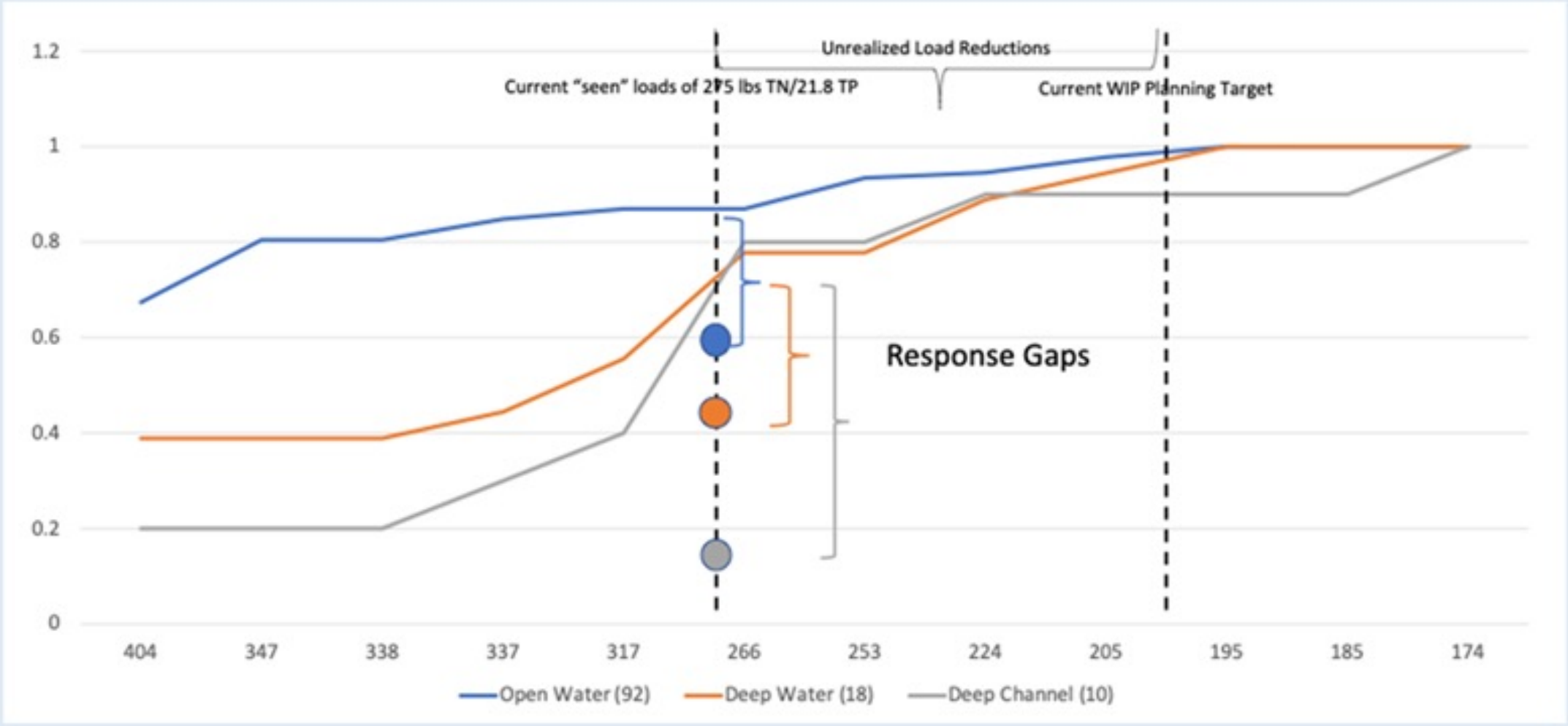




Attainment Status

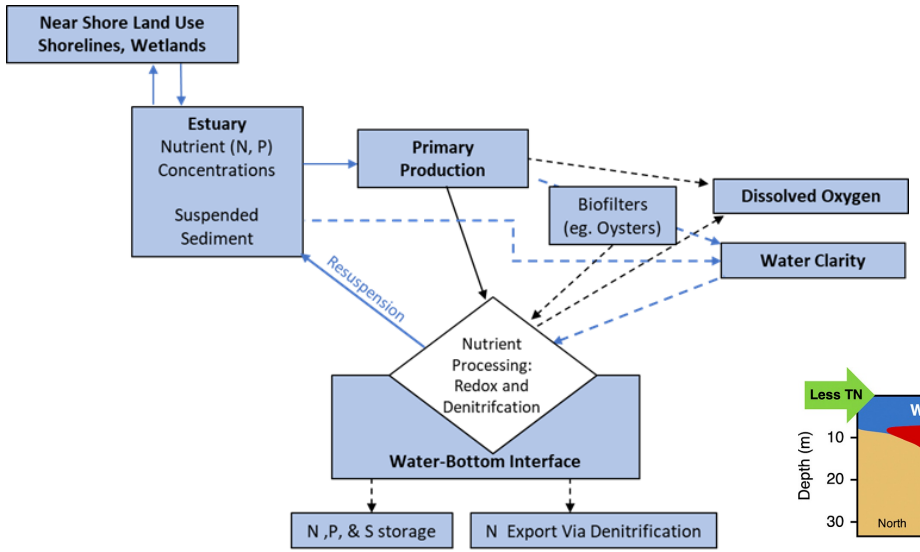


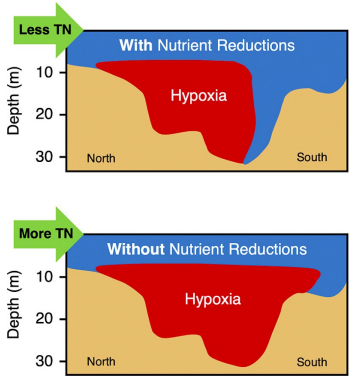
Possible Response Gaps



Assessing the Uncertainties in System Response: *Illustrations*

Nonlinear, cofounding interactions

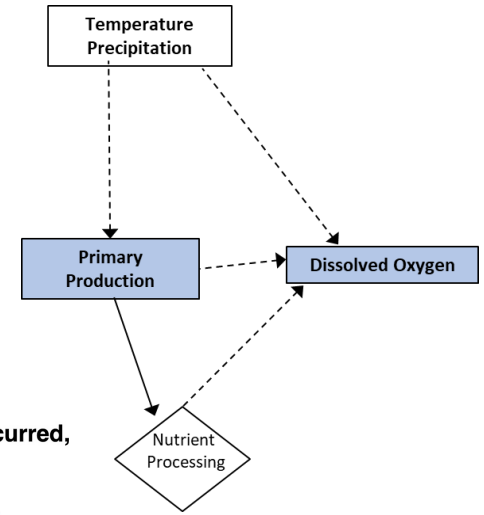




If 35 years of nutrient reductions had not occurred, hypoxia would have:

- Been **20-120% larger** for $O_2 < 3$ mg L^{-1}
- Been **30-280% larger** for $O_2 < 1$ mg L^{-1}
- Extended **further south** in the Bay
- Lasted **longer** during dry years

Climate change



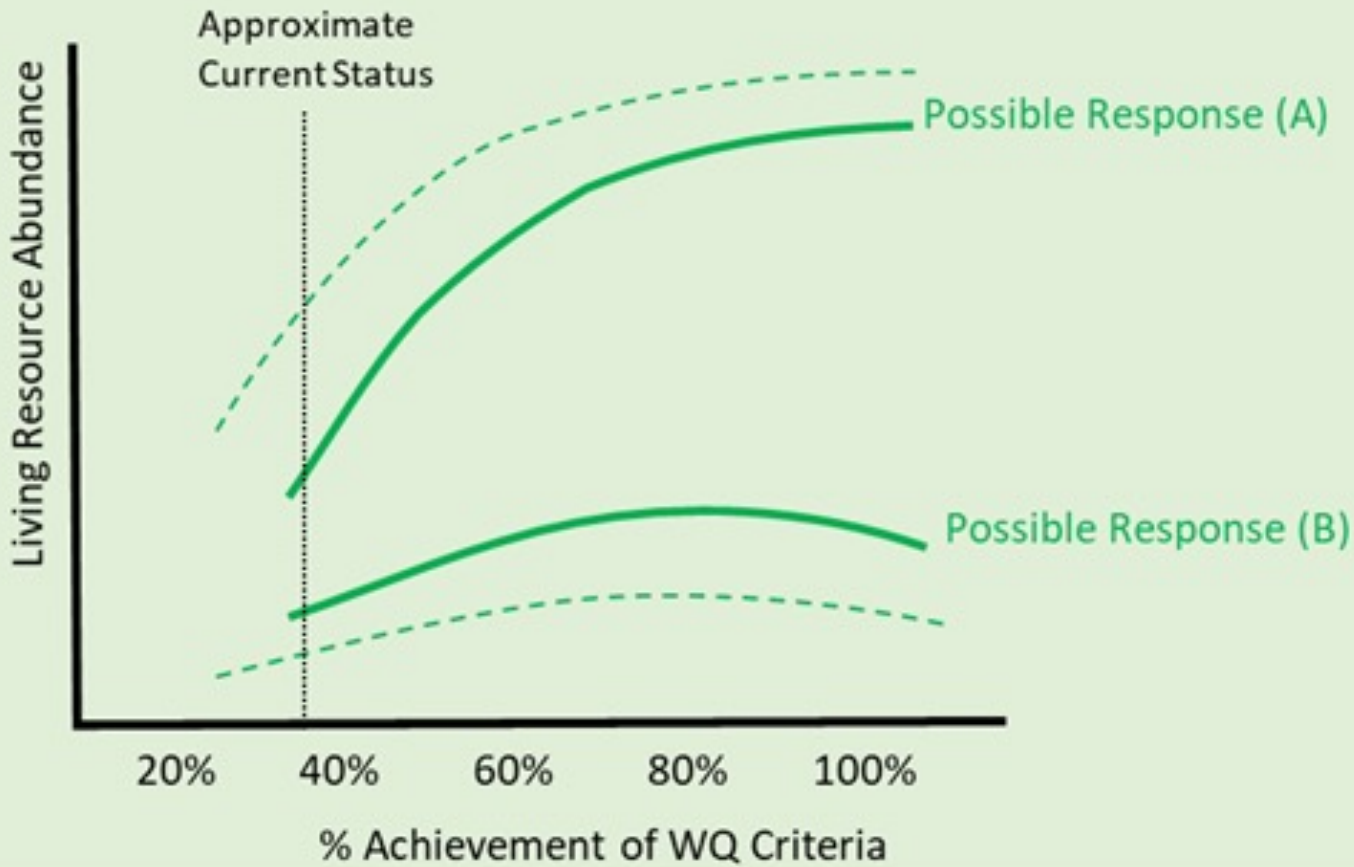
Section 5: Living Resource Response to Water Quality Conditions

Introduction

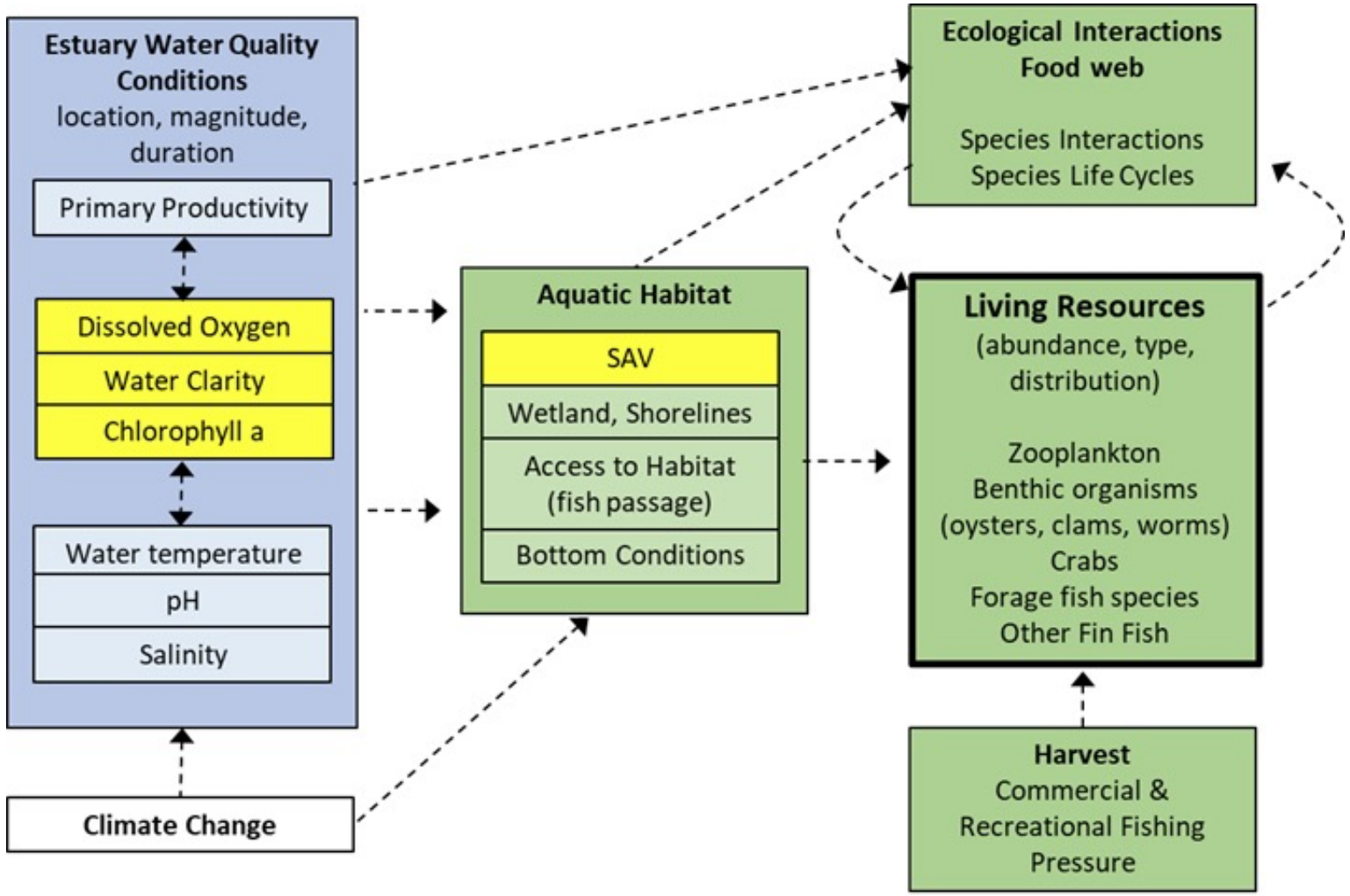
Living Resource Response to Water Quality Conditions

Evidence and Analysis of Water Quality Impact on Living Resources in Chesapeake Bay

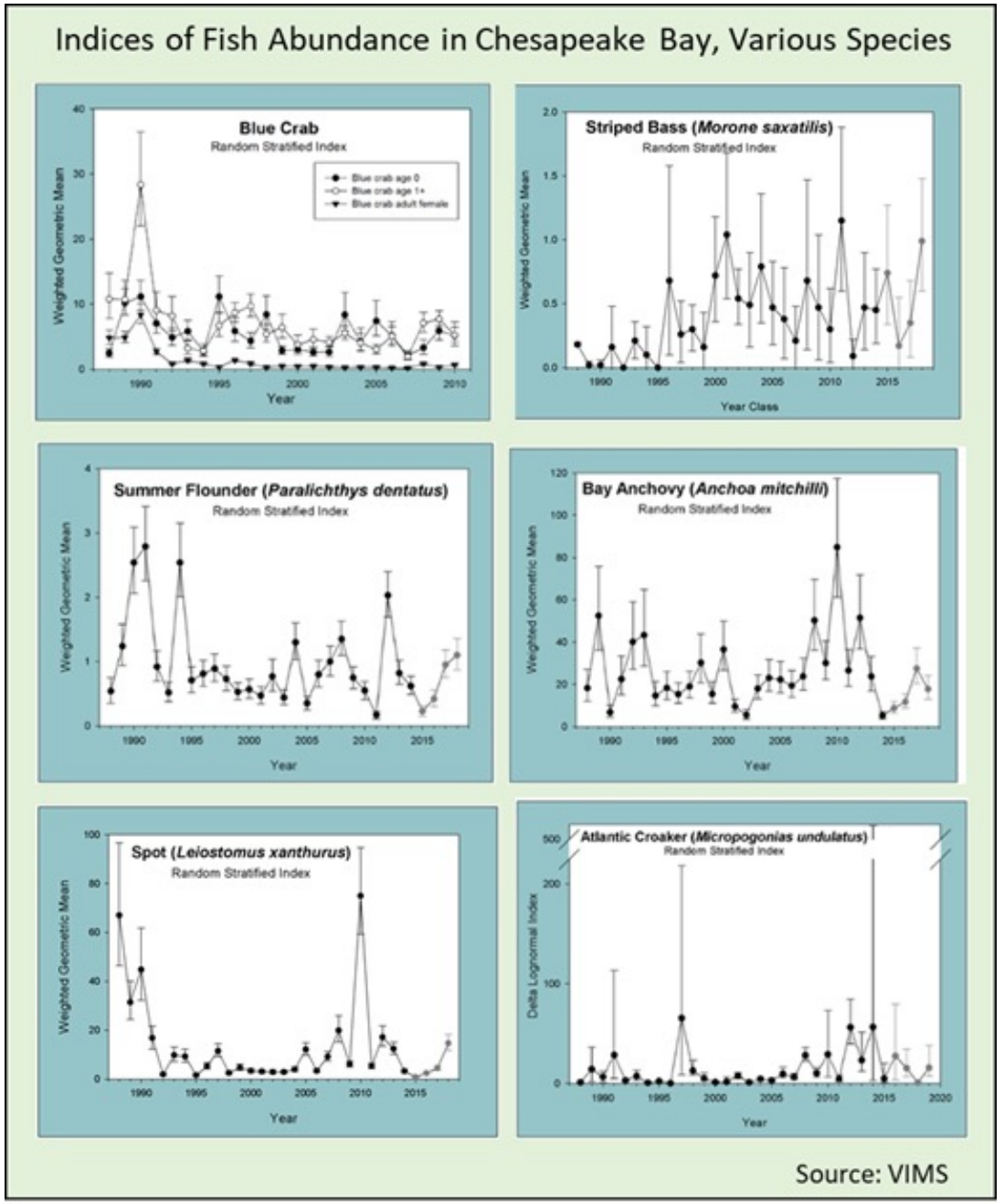
Possible Living Resource Responses to Existing Water Quality Standards



Organizing System Diagram



Evidence and Effort to Explain Observed Patterns



ADD OTHER SLIDES

SUMMARY OF FINDINGS

- ***Overall, the rate of progress in ambient water quality outcomes suggests that achievement of existing water quality criteria is uncertain and remains in the distant future.***
- ***Improving water quality alone, as measured by existing Bay water quality criteria, may be insufficient to generate desired changes in the composition and abundance of Bay living resources.***
- ***Nonpoint source reductions are necessary to achieve TMDL. Existing water quality planning and programs likely to be insufficient to achieve the nonpoint source reductions*. Additional funding *and* program changes will be needed.**
- ***While the system is characterized by variability and uncertainty, the current management system is based on the premise of perfect knowledge and no variability). Not well suited for next phase of CBP WQ efforts***

IF WE ARE TO INCREASE PROGRAM EFFECTIVENESS, A SHIFT IN FOCUS TO OUTCOMES IS NECESSARY

Shift in focus from actions to load reductions

Shift in focus from attainment of WQS to Living Resources

IMPLICATIONS

- **Evaluate Tradeoffs/Allocate Resources Appropriately**. *The TMDL operates in the context of a larger set of goals and a future of changing conditions; this implies that success will involve both a reflection on our goals as well as how we design our approach.*
- **Rethink Criteria**. *Given what we've learned and the changing stressors on the Bay, it will be necessary to reconsider desired endpoints and/or reevaluate how they are defined.* ***Defining*** *and assessing criteria must be tightly linked.*
- **More Effective Implementation.** *Both physical (BMP effectiveness) and social (behavioral change) aspects of implementation need revision to make substantial progress in reducing nonpoint source nutrient/sediment loads.*
- **Expand Adaptive Governance/Management**. *The attainment of WQS will only get costlier and the effectiveness of nutrient/sediment investments more uncertain; therefore, the program must evolve beyond its current adaptive management approach.*

FOUR CRITICAL QUESTIONS CONFRONTING THE CBP

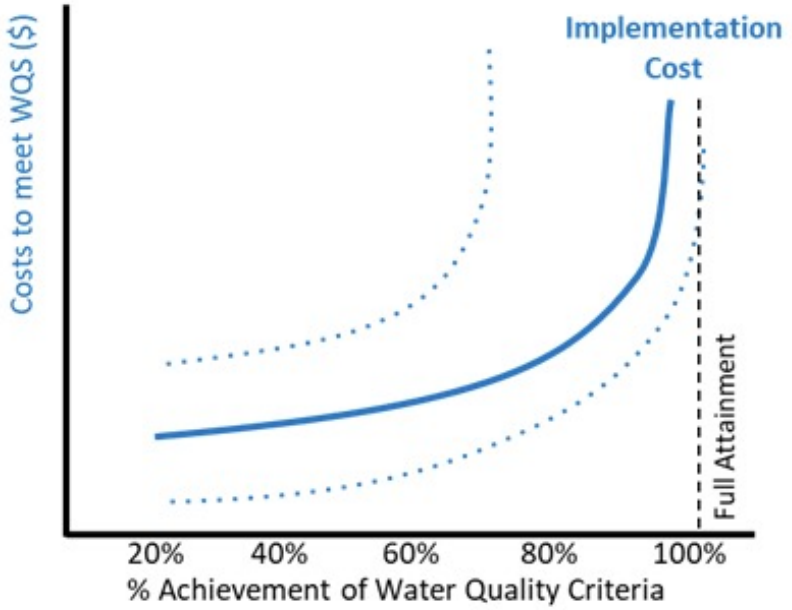
1. How do we evaluate tradeoffs and allocate resources appropriately to advance living resource goals for the Chesapeake Bay? The WQS and the TMDL operates in the context of a larger set of goals and a future of changing conditions; this implies that success will involve both a reflection on our goals as well as how we design our approach.
2. How do we responsibly re-examine our water quality criteria and how we monitor its achievement? Given what we've learned and the changing stressors on the Bay, it will be necessary to reexamine desired endpoints and/or reevaluate how they are defined. Defining and assessing criteria must be tightly linked.
3. How do we increase effective implementation so that the desired additional load reductions can be achieved? The existing nonpoint source programs will be insufficient to meet TMDL goals. Both physical (BMP effectiveness) and social (behavioral change) aspects of implementation need revision to make substantial progress in reducing nonpoint source nutrient/sediment loads.
4. How do we expand adaptive governance and management in order to maximize learning? The attainment of WQS will only get costlier and the effectiveness of nutrient/sediment investments more uncertain; therefore, the program must evolve beyond its current adaptive management approach.

EVALUATE TRADEOFFS/ALLOCATE RESOURCES APPROPRIATELY. *THE TMDL OPERATES IN THE CONTEXT OF A LARGER SET OF GOALS AND A FUTURE OF CHANGING CONDITIONS; THIS IMPLIES THAT SUCCESS WILL INVOLVE BOTH A REFLECTION ON OUR GOALS AS WELL AS HOW WE DESIGN OUR APPROACH:*

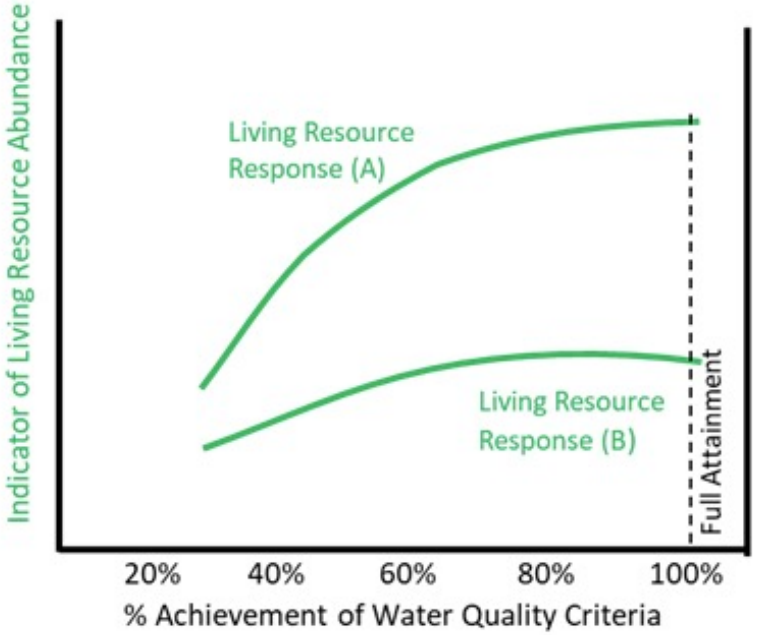
- In considering water quality criteria (definition, location, criteria), recognize tradeoffs between cost/attainability and potential gains in living resource response from WQ improvements.
- Consider that the existing WQ endpoints that have been chosen may not be necessary to achieve the broader range of goals identified in the Agreement.
- As written, the TMDL needs to (and can) be better aligned with those broader Agreement goals.
- It will be important to more directly assess response of LR to water quality criteria, beyond capacity or realized habitat.
- The achievement of WQS is dependent on several larger system drivers (e.g., temperature, salinity) that are outside of the control of the Partnership. More importantly, LR will be more responsive to some of these larger system drivers than they are to management efforts to control NPS. In order to better isolate the relationship between WQS and LR, we need to expand the list of highly monitored variables (in additional to the 3 WQs) to include temperature, salinity, and others associated with climate change.

- Sandboxing
- Mass balance, who owns the manure
- Payment for Performance
- Yield insurance
- Phased TMDL

Panel A: Costs of Achieving TMDL and Water Quality Criteria



Panel B: Possible Living Resource Response



RETHINK CRITERIA. *GIVEN WHAT WE'VE LEARNED AND THE CHANGING STRESSORS ON THE BAY, IT WILL BE NECESSARY TO RECONSIDER DESIRED ENDPOINTS AND/OR REEVALUATE HOW THEY ARE DEFINED.* ***DEFINING*** *AND ASSESSING CRITERIA MUST BE TIGHTLY LINKED; RECOMMENDATIONS UNDER EACH ARE AS FOLLOWS:*

- Utilize a structured process to directly link WQS to the Living Resources (LR) of importance. Four revisions to the WQS could emerge: 1) a revision to the existing criteria (DO, Chl-a, water clarity), which could include changing a) the value of the criteria (e.g., 3 mg/l to 2 mg/l), b) the mode of expression of any given value (e.g., probabilistic vs deterministic), c) where and how criteria is measured (30 day, 7 day, 1 day avg, or d) where the criteria are measured; 2) the addition of variables on which to base criteria; 3) the clear distinction of potential vs realized LR; and 4) a new definition of the Living Resources of importance.
- Identify which criteria should be articulated and managed in terms of variation and not by central tendency (means).
- Stop utilizing the deep trench DO as the ultimate determiner of management actions and the measure of success. While it is an integrator of conditions and easy to measure, it is slow to respond to management actions and will likely be the most challenging criteria to attain.
- Expand monitoring to include habitats where written criteria are not being adequately assessed for attainment (e.g., shallows).
- Increase the capacity to be flexible and adaptively monitor, e.g., assessing rates, adjusting temporal and spatial scales when necessary.

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- Process to link WQS to LR of importance
- Investment in monitoring network designed to learn about WQ responses to load reductions and LR response to WQ change
- Re-evaluate current criteria
- Criteria that can be measured
- Write criteria as probability of attainment

MORE EFFECTIVE IMPLEMENTATION. *THE EXISTING NPS PROGRAMS WILL BE INSUFFICIENT TO MEET TMDL GOALS. BOTH PHYSICAL (BMP EFFECTIVENESS) AND SOCIAL (BEHAVIORAL CHANGE) ASPECTS OF IMPLEMENTATION NEED REVISION TO MAKE SUBSTANTIAL PROGRESS IN REDUCING NONPOINT SOURCE NUTRIENT/SEDIMENT LOADS:*

- Improve capacity and incentives to target NPS investments and requirements. Potential improvements include technical targeting of investments, different program designs to incentivize desirable management actions, and more targeted regulatory requirements.
- Increase management focused on addressing mass imbalances.
- Allow alternative ways to account and comply with the TMDL.
- Establish opportunities that test the efficacy of different strategies and management approaches (social and physical). Such experimentation requires tailored monitoring strategies for evaluation.

EXPAND ADAPTIVE GOVERNANCE/MANAGEMENT. *THE ATTAINMENT OF WQS WILL ONLY GET COSTLIER AND THE EFFECTIVENESS OF NUTRIENT/SEDIMENT INVESTMENTS MORE UNCERTAIN; THEREFORE, THE PROGRAM MUST EVOLVE BEYOND ITS CURRENT ADAPTIVE MANAGEMENT APPROACH. FOUR ACTIONS WOULD MOVE THE PARTNERSHIP TOWARDS THIS GOAL:*

- Acknowledge the formalization of AM in the SRS process but recognize that there are limitations in its implementation; the process needs revision in the context of future challenges.
- Structure the work of the partnership in a way that honors diversity, transparency, inclusivity, and the sound integration of technical knowledge, and appropriately matches the decision making party to the decision at hand.
- Move towards active adaptive management, which implies a focus on experimental design to improve/evaluate technical/behavioral responses, explicitly addresses uncertainty, effectively utilizes monitoring resources, and reevaluates goals.
- Envision a future Bay, including future WQS and an organizational approach to decision-making that approaches its decisions as social ones, informed by technical/science-based information (rather than the opposite).
- Clearly define what we mean by adaptive management at different portions of the cycle and at varying levels of scale.