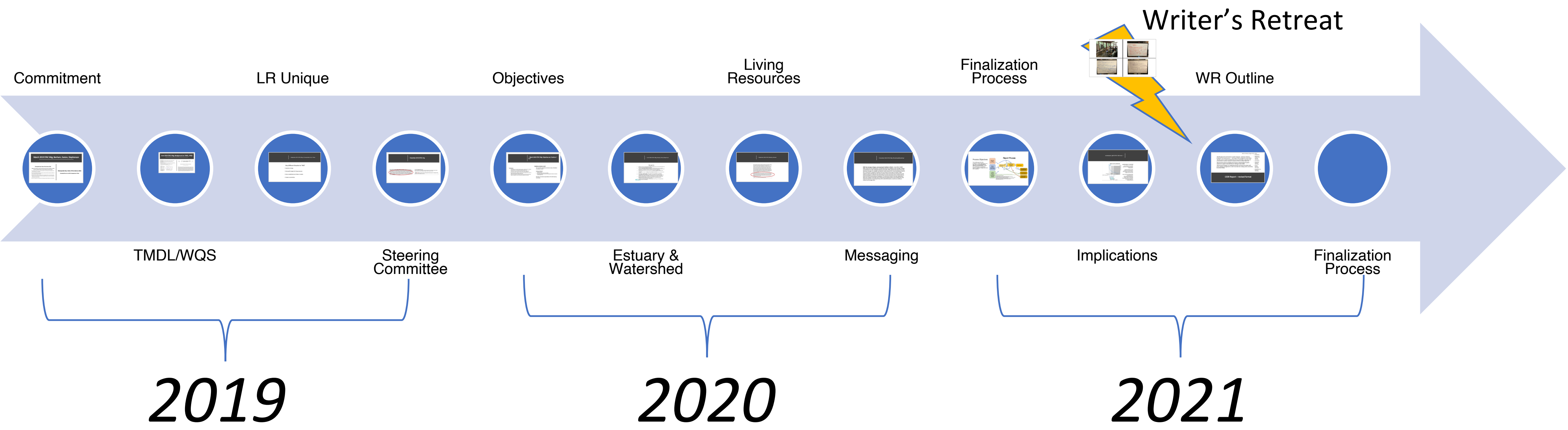
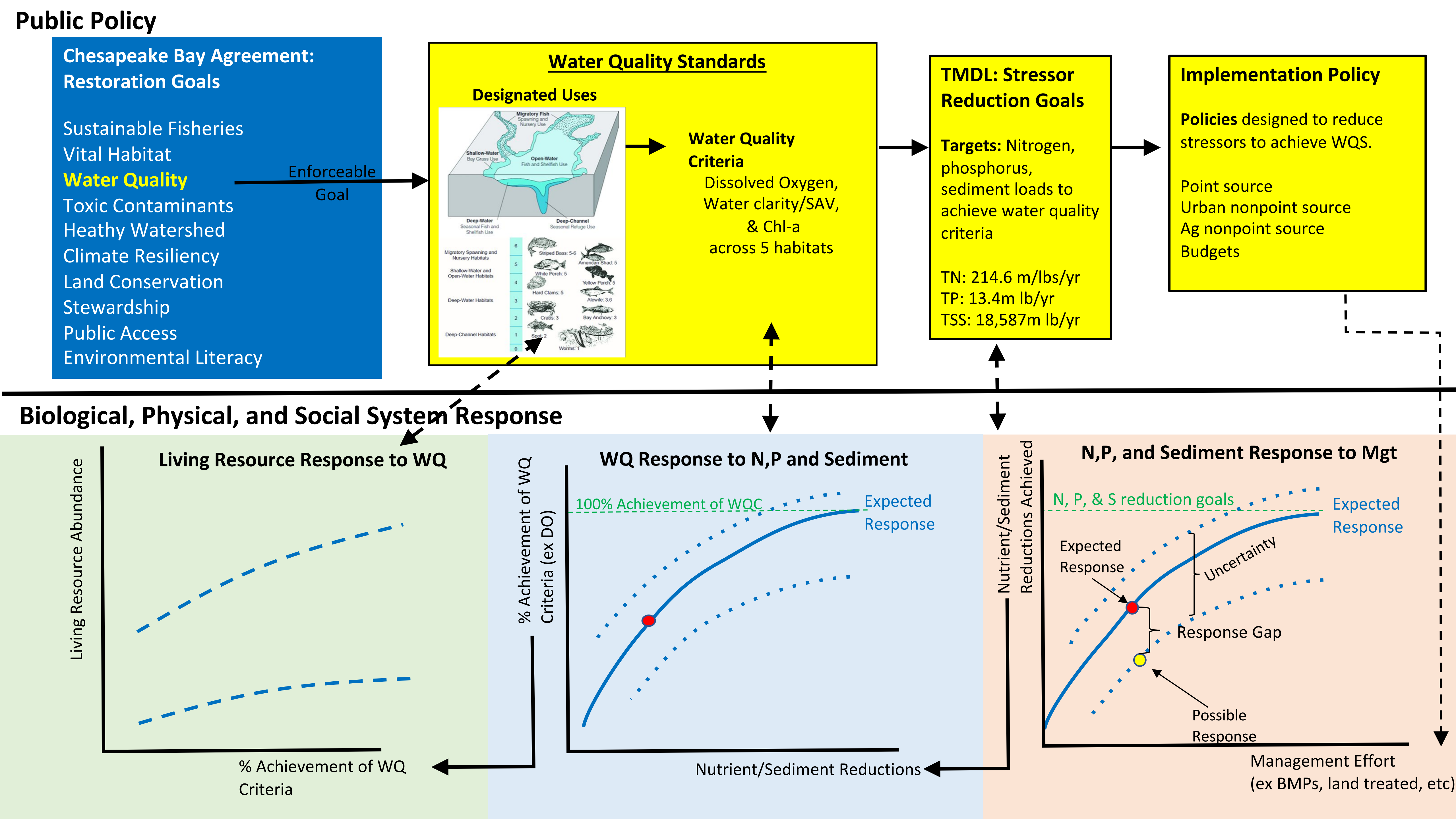
The Comprehensive Evaluation of System Response (CESR) Report

The Twelve Days of CESR

CESR Timeline
March 2019 – December 2021



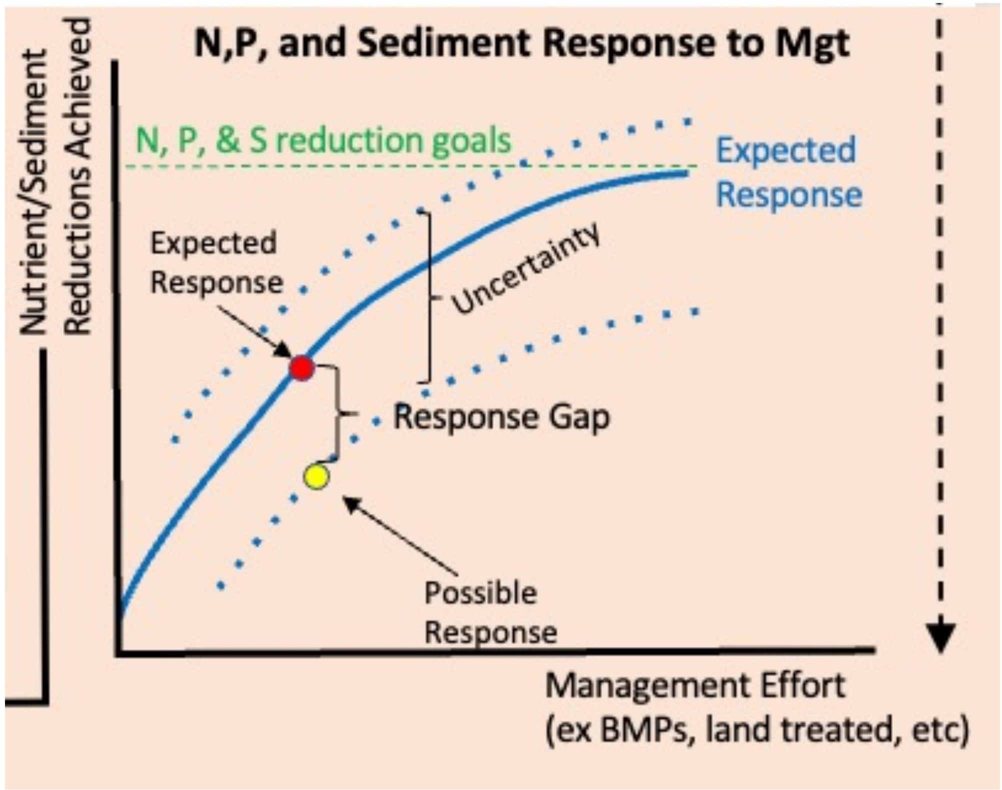

Public Policy
Chesapeake Bay Agreement: Restoration Goals
Sustainable Fisheries
Vital Habitat
Water Quality
Toxic Contaminants
Heathy Watershed
Climate Resiliency
Land Conservation
Stewardship
Public Access
Environmental Literacy
Enforceable Goal
Water Quality Standards
Designated Uses
Water Quality Criteria
Dissolved Oxygen, Water clarity/SAV, & Chl-a across 5 habitats
TMDL: Stressor Reduction Goals
Targets: Nitrogen, phosphorus, sediment loads to achieve water quality criteria
TN: 214.6 m/lbs/yr
TP: 13.4m lb/yr
TSS: 18,587m lb/yr
Implementation Policy
Policies designed to reduce stressors to achieve WQS.
Point source
Urban nonpoint source
Ag nonpoint source
Budgets
Biological, Physical, and Social System Response
Living Resource Response to WQ
Living Resource Abundance
% Achievement of WQ Criteria
WQ Response to N,P and Sediment
% Achievement of WQ Criteria (ex DO)
100% Achievement of WQC
Expected Response
Nutrient/Sediment Reductions
N,P, and Sediment Response to Mgt
Nutrient/Sediment Reductions Achieved
N, P, & S reduction goals
Expected Response
Expected Response
Uncertainty
Response Gap
Possible Response
Management Effort (ex BMPs, land treated, etc)

Watershed Framing Questions

- Is the physical and social system responding to management efforts to meet TMDL N, P, and S goals in ways consistent with expectations?

- What are the major uncertainties in efforts to reduce N, P, and S stressors delivered to the Chesapeake Bay?

- What management actions/policy options could improve nutrient/sediment response or reduce response uncertainties? (see implications)

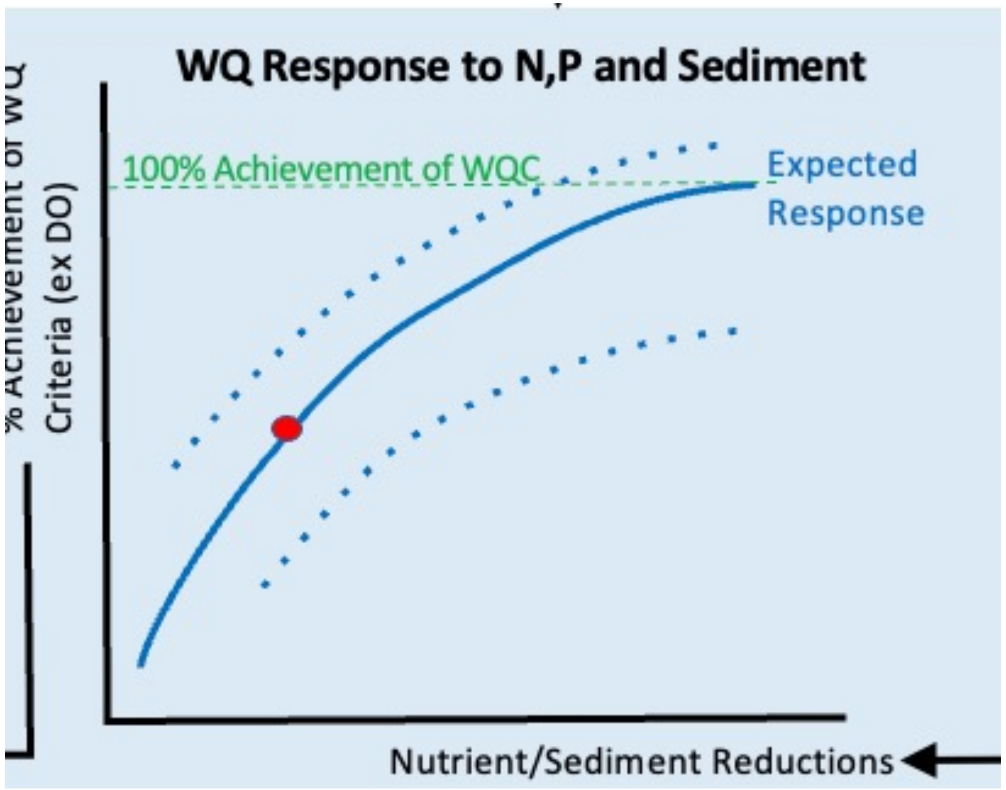


Watershed Summary

- The most significant source of contemporaneous nutrient and sediment loads originates from agricultural and urban NPS. Watershed-scale water quality monitoring suggests that NPS management actions have had mixed success in reducing nutrient and sediment loads delivered to the Bay. The divergence between expected and realized load reductions is particularly problematic for phosphorus.
- The limited response could be attributed to a number of factors including: 1) lag times between BMP implementation and water quality response are significant, yet the TMDL will ultimately be achieved, but after 2025; 2) BMP and NPS program implementation are not as effective as expected, due to both technical and behavioral responses.
- While there is evidence to suggest that part of the gap is attributable to lag times, there is substantial evidence that NPS program effectiveness is also responsible.
- An implementation gap also exists between what is expected and what can be achieved through existing NPS incentive programs (e.g., can conventional voluntary BMP programs generate sufficient levels of behavioral change and implementation to achieve TMDL reduction goals). Little historical evidence exists in the Bay watershed or elsewhere to show that conventional, voluntary, incentive-based programs can generate and sustain the magnitude of NPS load reductions needed to meet water quality standards.
- To meet TMDL and water quality goals NPS management programs will require fundamental policy changes. Allocating more resources within the same programs will be insufficient to meet TMDL goals. Given the current level of investment, the costs (and associated uncertainty) of additional nutrient and sediment reductions will increase, suggesting a need to further strengthen adaptive management in the system.

Estuary Framing Questions

- Is estuary water quality responding in ways consistent with expected response to stressor reductions (N,P, & S) achieved to date?
- What are the major uncertainties in efforts to assess Bay water quality criteria (DO, water clarity/SAV, chl-a)?
- What are the major uncertainties in efforts to achieve Bay water quality criteria (DO, water clarity/SAV, chl-a)?
- What management actions/policy options could improve estuary water quality (criteria) response?



Estuary Summary

- N and P concentrations have declined in the vast majority of segments where loads were reduced, while water quality trends in Coastal Plain watersheds show evidence of decline. Recent patterns in TN load and concentration reductions have been linked to a resurgence of submerged aquatic vegetation (SAV) in many regions of the Bay. Dissolved oxygen has shown a complicated response to nutrient load changes. Although the overall summer hypoxic volume did not change over the past 35 years, some metrics of oxygen conditions improved (including Deepwater DO). It appears that warming as well as physical controls such as stratification has limited the otherwise positive oxygen response to the TMDL.
- While DO is good integrative indicator of mainstem conditions, it does not reflect conditions in the shallow water habitats (T-zones), where large portions of the Bay's living resources occur. DO in these habitats responds to an increased number of variables beyond nutrient and sediment reductions, and an understanding of these dynamics is critical for both identifying effective management actions in the shallow waters themselves, but also to understand the relationship between shallow water habitats and WQS in other habitats (e.g., Deepwater DO). Despite the importance of the T-zone, the bioreactivity of triblets, and the importance of coastal areas to stakeholders, these landscape elements are not explicitly represented in the Bay model, nor are they monitored to support understanding.
- Ecological 'tipping points' are a reality at the scale of subsystems in the Bay, and have been demonstrated to exist in water clarity, dissolved oxygen, and SAV relationships. Developing a better predictive understanding of tipping points and their causes, especially those that focus on developing early restoration signals to provide more immediate feedback on implementation effectiveness of various TMDL actions, should be a priority for both monitoring and modeling. Ecological tipping points in one part of the estuary need to be tested in other parts of the estuary, particularly with regard to salinity regimes.
- A future vision for the Chesapeake Bay that does not simply attempt to revert to some historical reference point for water quality and living resources within the Bay must be created.
- The restoration focus must point the way to a future that provides a Bay that meets societally agreed upon needs and expectations, while also incorporating expected changes in Bay attributes due to population growth, land use changes, and widespread impacts of climate change. This vision will be continually informed by developing early restoration signals to provide more immediate feedback on implementation effectiveness of various TMDL actions.

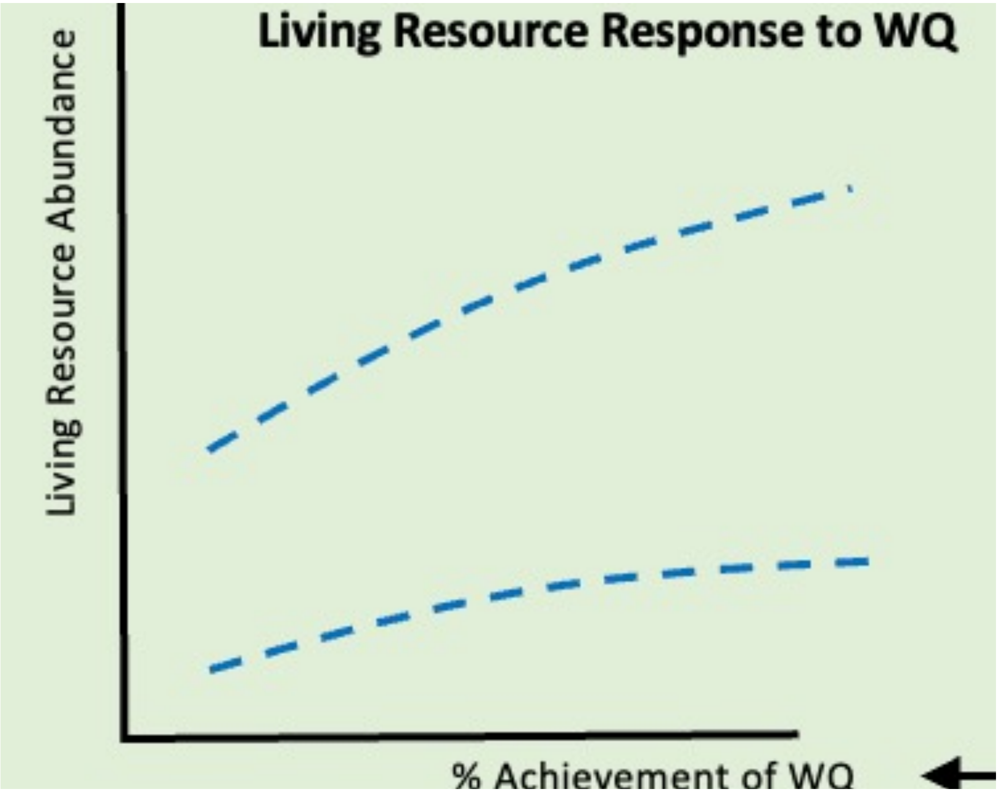
Living Resource Framing Questions

- To date, how is the CBP assessing the response of LR to management actions designed to improve WQ and habitat? And how does this compare to other large-scale restoration programs?

- What are the challenges relating the response of living resources to current numeric water quality criteria and habitat actions, recognizing that living resource conditions are affected by changes in multiple factors?

- What can be done to improve confidence in understanding LR response to WQ conditions?

- What LR reflect or are responsive to WQ conditions? How can the analyses inform what types and magnitude of changes in water quality and habitat are needed to evoke an agreed-upon set of the desired living resources responses?

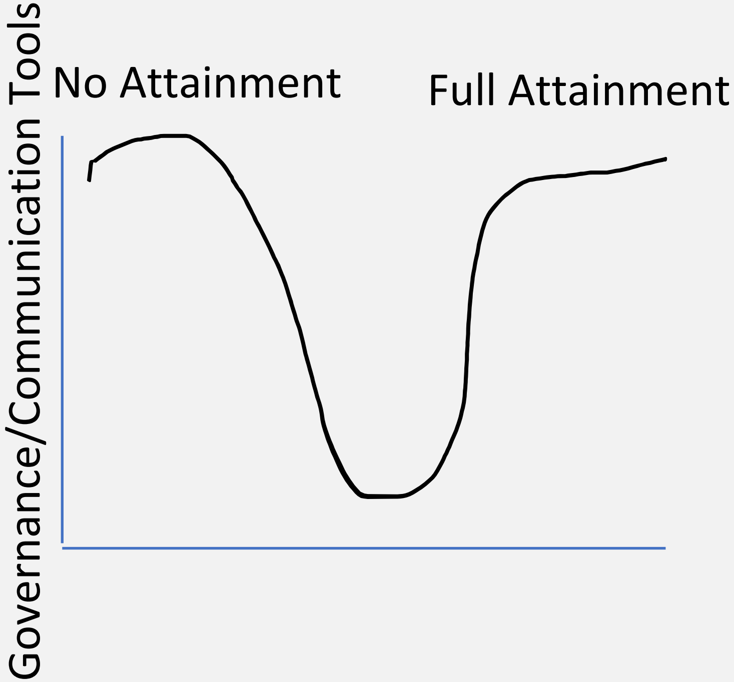


Living Resource Summary

- There is long history of assessing habitat quality and quantity on organisms of the Chesapeake Bay, and the degree to which specific aspects of water quality and habitat (e.g., DO, wetlands) are identified as the causes of detected changes in the living resources vary widely among these analyses. To date, there has not been a comprehensive examination of living resources responses in-situ that also attempts to relate the responses to CBP actions. Instead, the responses of living resources have been considered in two ways: 1) the use of species tolerances and habitat affinities in the up-front designing of the water quality criteria and designated uses for regions throughout the Bay; and 2) examination of the long-term trends of species that are tightly linked to the water quality goals (e.g., seagrass).
- By improving water quality, you have maintained the ability of water quality to support LR in the Bay in spite of increasing anthropogenic stressors. However, while the WQS are a necessary factor in the support of LR, they are not sufficient alone. Much larger levers, or factors, in the presence and abundance of LR (e.g., substrate, temperature, salinity, fishing pressure) are not under the direct control of the Partnership. Therefore, there should not be an expectation that LR will respond in a relative way to improvements in water quality.
- The relationship between attainment of all WQS and the capacity of WQS to support LR may not be linear, and may exhibit plateaus at both ends of the attainment axis (i.e., non-attainment and full attainment of all standards).
- While a comprehensive response of LR abundance is not feasible, a robust LR assessment could provide an answer in terms of capacity to support LR. There are four major pathways for assessing living resource responses to potential management actions (including and beyond WQS):
- Status-quo: Continue with reliance on the design of the water quality standards, the examination of habitat improvements (e.g., acres of wetlands), and selected temporal trends in a relatively limited number of indicator species;
- Moderate expansion: Expand on the status-quo habitat construction and indicator species approach in terms of adding Bay-wide assessment of habitat changes and additional species, and perform, when feasible, analyses linking detected responses to specific aspects of water quality and habitat (although not necessarily to CBP actions);
- Major expansion: Expand on the habitat construction and indicator species approach but start at the beginning and design a systematic approach with the purpose of making statements at the population and food web levels and attempt to attribute responses to specific water quality and habitat variables and further to CBP-related actions;
- New approach: Continue with the status-quo, but also design and implement a comprehensive living resources assessment that examines population and food web level responses and is wide-ranging enough to enable statements about specific species responses to CBP actions and also about the health and status of the whole Bay ecosystem.
- Evaluating the different options for assessing living resource responses involves systematically proceeding through the framework presented in the Resource Document and draws on 12 major concepts. While a comprehensive response of LR abundance is not feasible, a robust LR assessment could provide an answer in terms of capacity to support LR.

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.

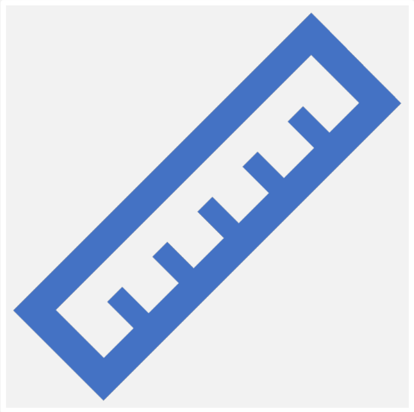


Rethink Criteria. *Given what we've learned and the changing stressors on the Bay, it will be necessary to reconsider desired endpoints and/or reevaluate how they are defined.* ***Defining*** *and assessing criteria must be tightly linked; recommendations under each are as follows:*

- 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.

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:*

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.

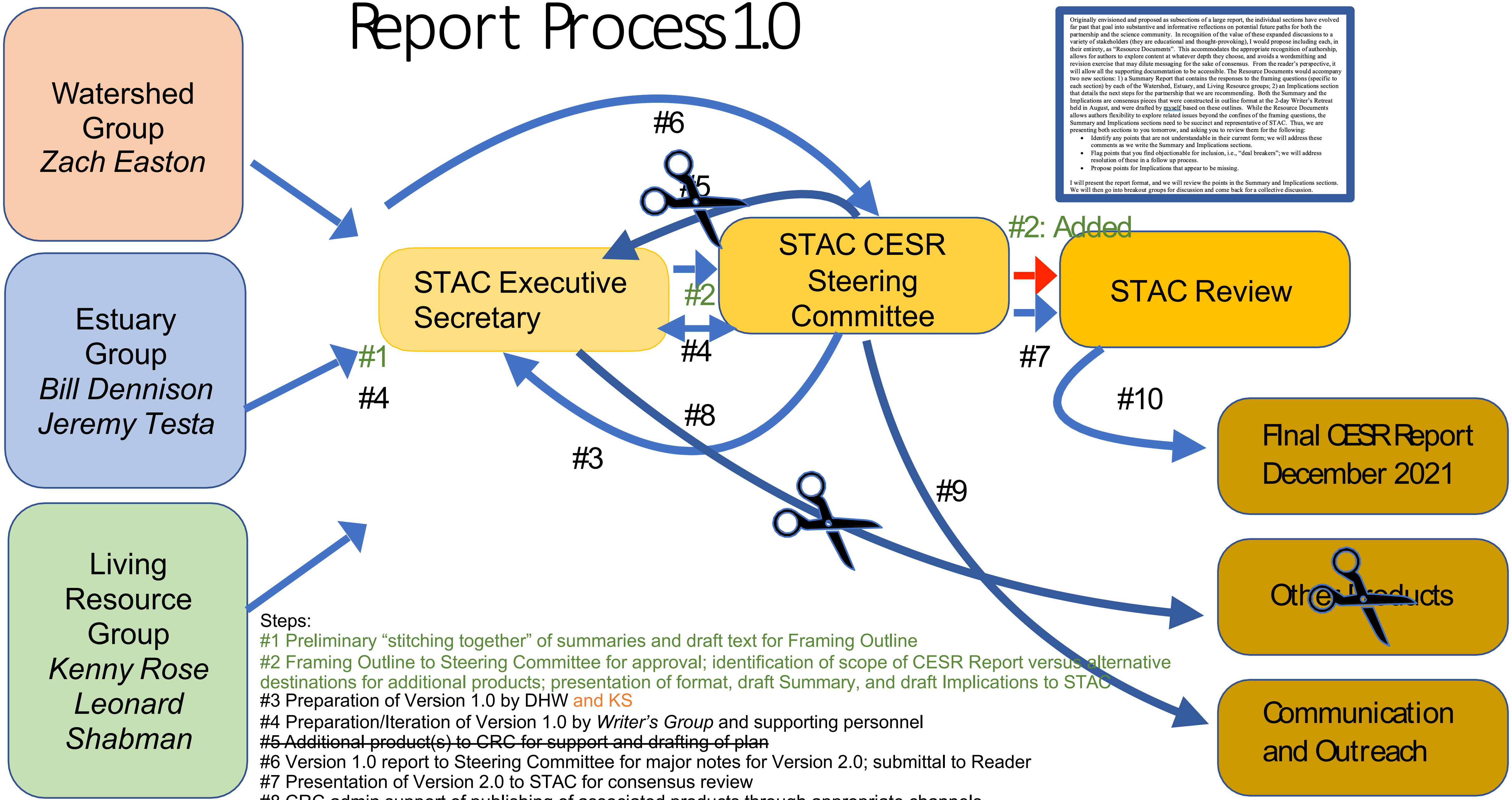
More Effective Implementation. *The existing NPS programs will be insufficient to meet TMDL goals. Both physical (BMP effectiveness) and social (behavioral change) aspects of implementation need revision to make substantial progress in reducing nonpoint source nutrient/sediment loads:*

- 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.

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.

Report Process 1.0



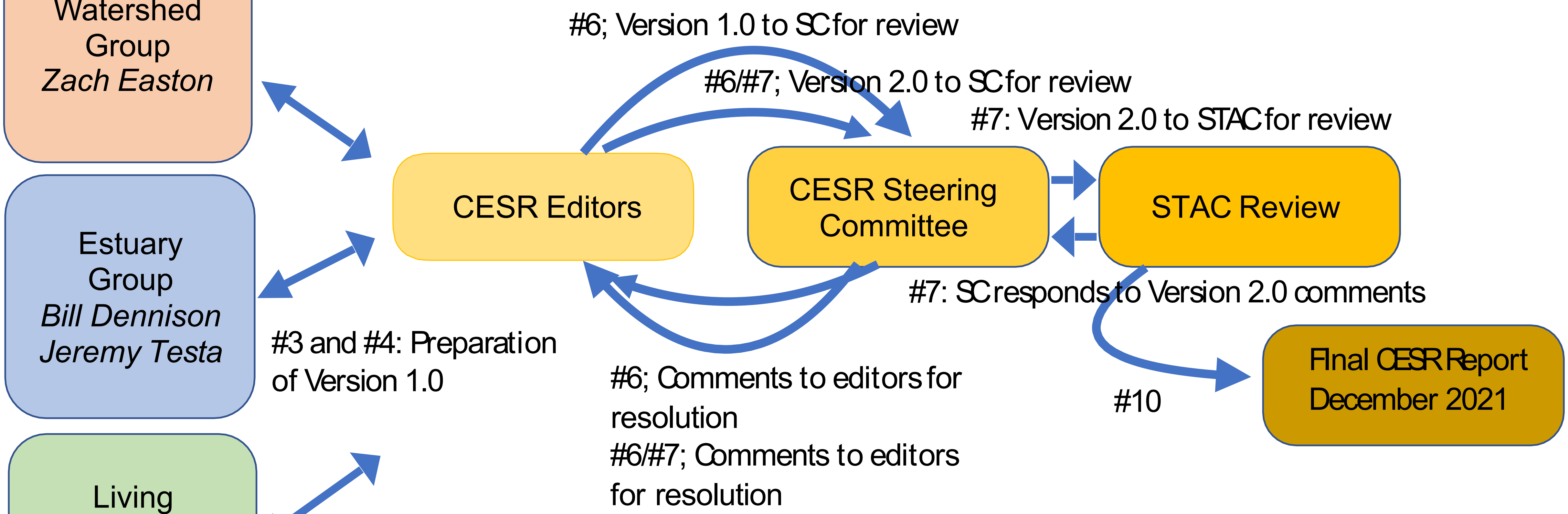
Originally envisioned and proposed as subsections of a large report, the individual sections have evolved far past that goal into substantive and informative reflections on potential future paths for both the partnership and the science community. In recognition of the value of these expanded discussions to a variety of stakeholders (they are educational and thought-provoking), I would propose including each, in their entirety, as "Resource Documents". This accommodates the appropriate recognition of authorship, allows for authors to explore content at whatever depth they choose, and avoids a wordsmithing and revision exercise that may dilute messaging for the sake of consensus. From the reader's perspective, it will allow all the supporting documentation to be accessible. The Resource Documents would accompany two new sections: 1) a Summary Report that contains the responses to the framing questions (specific to each section) by each of the Watershed, Estuary, and Living Resource groups; 2) an Implications section that details the next steps for the partnership that we are recommending. Both the Summary and the Implications are consensus pieces that were constructed in outline format at the 2-day Writer's Retreat held in August, and were drafted by myself based on these outlines. While the Resource Documents allows authors flexibility to explore related issues beyond the confines of the framing questions, the Summary and Implications sections need to be succinct and representative of STAC. Thus, we are presenting both sections to you tomorrow, and asking you to review them for the following:

- Identify any points that are not understandable in their current form; we will address these comments as we write the Summary and Implications sections.
- Flag points that you find objectionable for inclusion, i.e., "deal breakers"; we will address resolution of these in a follow up process.
- Propose points for Implications that appear to be missing.

I will present the report format, and we will review the points in the Summary and Implications sections. We will then go into breakout groups for discussion and come back for a collective discussion.

Steps:
#1 Preliminary "stitching together" of summaries and draft text for Framing Outline
#2 Framing Outline to Steering Committee for approval; identification of scope of CESR Report versus alternative destinations for additional products; presentation of format, draft Summary, and draft Implications to STAC
#3 Preparation of Version 1.0 by DHW and KS
#4 Preparation/Iteration of Version 1.0 by *Writer's Group* and supporting personnel
~~#5 Additional product(s) to CRC for support and drafting of plan~~
#6 Version 1.0 report to Steering Committee for major notes for Version 2.0; submittal to Reader
#7 Presentation of Version 2.0 to STAC for consensus review
~~#8 CRC admin support of publishing of associated products through appropriate channels~~
#9 Planning/Partnership with CBP for Outreach Plan (CESR and others)
#10 Publishing of signed Version 2.0

Report Process 2.0



Steps:
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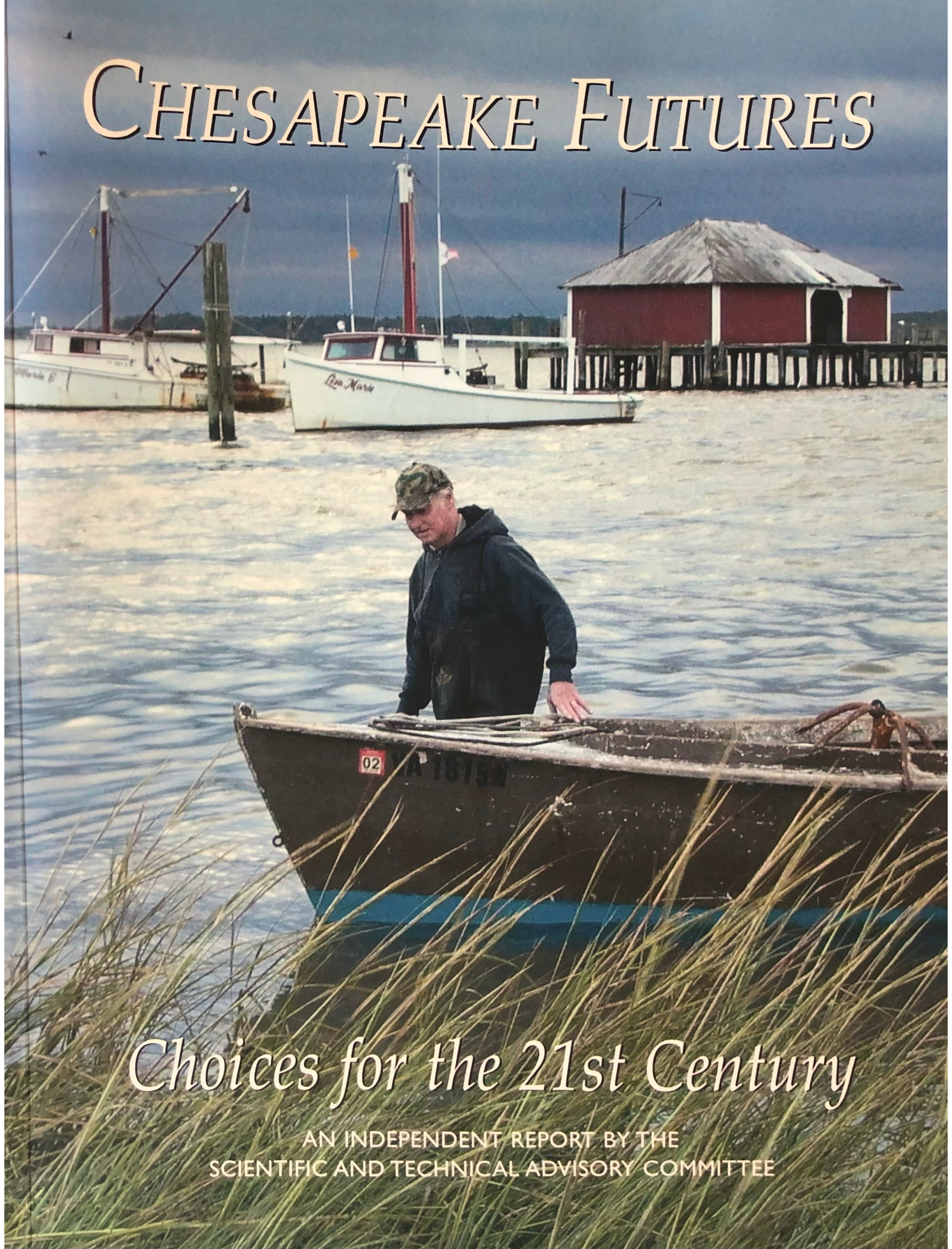
~~#5 Additional product(s) to CRC for support and drafting of plan~~
#6 Version 1.0 report to Steering Committee for major notes for Version 2.0; submittal to Reader
#6/#7. Version 2.0 to Steering Committee with resolution of comments
#7 Presentation of Version 2.0 to STAC for consensus review; Steering Committee resolves STAC comments
~~#8 CRC admin support of publishing of associated products through appropriate channels~~
#9 Planning/Partnership with CBP for Outreach Plan (CESR and others)
#10 Publishing of signed Version 2.0

CESR Finalization Process

- **STAC Member "Red Flag" Review** (2 weeks): STAC members will review outline points and 1) identify any points that are not understandable in their current form; 2) flag points that you find objectionable for inclusion, and 3) propose points for Implications that appear to be missing. Denice will receive and vet with SC. 12/17/2021
- **CESR Report Version 1.0 to Steering Committee** (~6 weeks): Denice and Kurt (editors) send draft to Steering Committee based on Writer's Group outline. Editors will work informally with members of the writer's group to clarify and refine text. 1/7/2021
- **Steering committee sends comments on V.1 back to editors** (2-3 weeks): Comments directed at content, indicating points that need clarification, errors, and fundamental disagreements. We will use a technical editor. 1/28/2021
- **Version 2.0 to Steering Committee** (3 weeks)**:** Denice and Kurt revise document based on steering committee comments and deliver version 2.0 to Steering Committee. 2/18/2021
- **Steering Committee reviews Version 2.0** (2 weeks)**:** Any remaining issues are addressed and Steering Committee approves final version. 3/4/2021
- **Steering Committee sends out Version 2.0 to STAC** (2 weeks): STAC responds to Steering Committee as per: 1) agree (absence of comment indicates consent); 2) errors and omissions of content, or 3) serious concerns with report content documented. 3/18/2021
- **Steering Committee** directs editors to revise document based on STAC member comments, if appropriate. (1 week).
- **Steering Committee releases final version to STAC**. STAC members will be asked to formally approve of the document. 3/25/2021



CHESAPEAKE FUTURES
Choices for the 21st Century

edited by
Donald F. Boesch
and
Jack Greer

An Independent Report by the
Scientific and Technical Advisory Committee

Authors and Acknowledgements

The production of Chesapeake Futures was very much a team effort. Donald Boesch and Jack Greer were the principal writers/editors for the report as a whole, but several workgroups, listed here, drafted and contributed the report's many sections. Time given by the workgroup members and other participants was entirely voluntary. STAC offers its appreciation to all who donated their time and effort to produce this ambitious report.

Key to the production of Chesapeake Futures was the extensive help of several assistants and contractors: Caryn Boscoe helped serve as coordinator of the Futures project; Catherine Schmitt filled many information gaps in the report; and Nina Fisher has been central in bringing the project to completion and preparing it for publication. Listed here are the individuals who made up the core group for the Chesapeake Futures project, including the Steering Committee and each Task Force group.

Steering Committee

Donald F. Boesch (Chair)
University of Maryland Center for Environmental Science (UMCES)

Caryn Abrey (Coordinator)
Chesapeake Research Consortium

Jack Greer
Maryland Sea Grant College Program

Grant Gross
Chesapeake Research Consortium

Richard Jachowski
Patuxent Wildlife Research Center/ U.S. Geological Survey

Doug Lipton
University of Maryland

James Lynch
Pennsylvania State University

David O'Neill
Center for Chesapeake Communities; Chesapeake Bay Trust

Jonathan Phinney
Center for Marine Conservation; National Oceanic & Atmospheric Administration

Jaclin Schweigart
Chesapeake Research Consortium

Alan Taylor
Chesapeake Research Consortium

Population and Socio-Economic Change Task Force:

Joe Tassone (Co-chair)
Maryland Department of Planning

Waldon Kerns (Co-chair)
Virginia Tech University

Emery Cleaves
Director, Maryland Geological Survey

Edwina Coder
Lancaster, Pennsylvania

Scott W. Kudlas
Chesapeake Bay Local Assistance Department

Doug Parker
University of Maryland

Herb Brodie
Chestertown, Maryland

Land Use and Landscape Changes Task Force:

Caren Glotfelty (Chair)
Pennsylvania State University

Ann Fisher
Pennsylvania State University

Richard Weismiller
University of Maryland

Tom Cahill
Cahill Associates

Grace Brush
Johns Hopkins University

Bill Eberhardt
Citizens Advisory Committee

Tom Larson
Lamont, Pennsylvania

Louis F. Pitelka
University of Maryland Center for Environmental Science

Steve Seagle
University of Maryland Center for Environmental Science

Innovative Technologies Task Force:

Clifford Randall (Chair)
Virginia Tech University

Theo Dillaha
Virginia Tech University

Thomas J. Grizzard
Occoquan Watershed Monitoring Laboratory

Lawrence W. Harding, Jr.
University of Maryland Center for Environmental Science; Maryland Sea Grant

Pai-Yei Whung
National Oceanic & Atmospheric Administration / Atmospheric Research Laboratory

Future Estuarine Conditions Task Force:

Robert Ulanowicz (Chair)
University of Maryland Center for Environmental Science

Walter R. Boynton
University of Maryland Center for Environmental Science

Kent Mountford
Cove Corporation

M. Gordon (Reds) Wolman
Johns Hopkins University

Michael F. Hirschfield
Chesapeake Bay Foundation; Oceana

W. Michael Kemp
University of Maryland Center for Environmental Science

Special Thanks

Many contributed to the completion of this report. Although Don Boesch and Jack Greer wrote much of the report and wove the many contributions of technical experts into whole cloth, Joe Tassone, Steve Seagle, and Caren Glotfelty were the primary authors of Development and Sprawl, Forests in Transition, and Adapting Agriculture, respectively. Deborah Weller and fellow staff of the Maryland Department of Planning performed key development analyses. Scientists from the Pennsylvania State University associated with the Mid-Atlantic Regional Assessment of Climate Change made important contributions to Adapting Agriculture and the discussions of the impact of climate change on the Bay. Russ Brinsfield and Dick Weismiller contributed perceptive comments on the future of agriculture in the region. Gary Shenk of the Chesapeake Bay Program Office provided invaluable insight and information concerning the Chesapeake Bay Watershed Model. Jeff Halka offered his understanding of the Bay's sediment budget. The Natural Resource Conservation Service, and especially Jen Pakula from the Annapolis office, helped to provide photographs and maps. The valuable research of Jim Hagy, now of the Environmental Protection Agency, provided revealing insights on what a "saved" Bay might look like. Finally, members of the Scientific and Technical Advisory Committee and representatives of the federal and state agencies that help inform and shape the Chesapeake Bay Program contributed insightful review and helpful comments on drafts.

Achieving Water Quality Goals in the Chesapeake Bay:

An Evaluation of System Response

A Consensus Report from the Scientific and Technical Advisory Committee (STAC)

Chesapeake Bay Program

Annapolis, Maryland

Month 2022

Scientific and Technical Advisory Committee (STAC)

About the Scientific and Technical Advisory Committee
The Scientific and Technical Advisory Committee (STAC) provides scientific and technical guidance to the Chesapeake Bay Program (CBP) on measures to restore and protect the Chesapeake Bay. Since its creation in December 1984, STAC has worked to enhance scientific communication and outreach throughout the Chesapeake Bay Watershed and beyond. STAC provides scientific and technical advice in various ways, including (1) technical reports and papers, (2) discussion groups, (3) assistance in organizing merit reviews of CBP programs and projects, (4) technical workshops, and (5) interaction between STAC members and the CBP. Through professional and academic contacts and organizational networks of its members, STAC ensures close cooperation among and between the various research institutions and management agencies represented in the Watershed. For additional information about STAC, please visit the STAC website at http://www.chesapeake.org/stac.

Publication Date: Month Day, 2022

Publication Number: 22-XXX

Suggested Citation:

Scientific and Technical Advisory Committee (STAC). 2022. *Achieving Water Quality Goals in the Chesapeake Bay: An Evaluation of System Response*. STAC Publication Number 22-XXX. Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC), Edgewater, MD. XX pp.

Report Steering Committee

Brian Benham, Virginia Tech
Anthony Buda, USDA Agricultural Research Service.
Bill Dennison, University of Maryland Center for Environmental Science
Zachary Easton, Virginia Tech
Ellen Gilinsky, Ellen Gilinsky LLC
Andy Miller, University of Maryland, Baltimore County
Mark Monaco, NOAA, National Centers for Coastal Ocean Science
Kenny Rose, University of Maryland Center for Environmental Science
Leonard Shabman, Resources for the Future
Kurt Stephenson, Virginia Tech
Jeremy Testa, University of Maryland Center for Environmental Science

STAC Members

List

Other Contributors

Carl Hershner, Virginia Marine Institute (retired)
Peter Tango, USGS

Report Editors

Kurt Stephenson, Virginia Tech
Denice Wardrop, Chesapeake Research Consortium

STAC Staff

Annabelle Harvey, Chesapeake Research Consortium
Meg Cole, Chesapeake Research Consortium

Achieving Water Quality Goals in the Chesapeake Bay: An Evaluation of System Response

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4. Achieving Water Quality Standards in the Chesapeake Bay
5. Living Resource Response to Changes in Water Quality
6. Implications for Future Water Quality Policy and Management for the Bay

Supplemental Reports (listed, but not included, in the report and published by CRC separately):

Easton, Z., K. Stephenson, B. Benham, J.K. Bohlke, C. Brosch, A. Buda, A. Collick, L. Fowler, E. Gilinsky, C. Hershner, A. Miller, G. Noe, L. Palm-Forster, T. Thompson. 2022. *Evaluation of Watershed System Response to Nutrient and Sediment Policy and Management*, STAC Publication Number 22-XXX. Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC), Edgewater, MD. XX pp.

Dennison, W., L. Sanford, J. Testa, B. Benham, C. Hershner, W. Ball, D. Gibson, M. Runge, and K. Boomer. 2022. *Knowledge Gaps, Uncertainties, and Opportunities Regarding the Response of the Chesapeake Bay Estuary to proposed TMDLs,* STAC Publication Number 22-XXX. Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC), Edgewater, MD. XX pp.

Rose, K., M. Monaco, K. Havens, H. Karimi, J. Hubbart, E. Smith, J. Stauffer, T. Ihde, L. Shabman. 2022. *Proposed Framework for Analyzing Water Quality and Habitat Effects on the Living Resources of Chesapeake Bay.* STAC Publication Number 22-XXX. Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC), Edgewater, MD. XX pp.

Screenshot

On the Twelfth Day

- Please respond to Denice with concerns and comments (Red Flag Review) on content by 17 December
- Please contact Denice and/or Steering Committee with process and format comments
- Recommendations/thoughts re: utilizing trusted “policy readers”