Oyster BMP Expert Panel Update on the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework

Prepared for the Chesapeake Bay Program (CBP) Partnership by the Oyster BMP Expert Panel
on February 1, 2016

Reviewed by the Chesapeake Bay Program Partnership on _______________

1.0. Purpose of Briefing

The Panel is asking the Partnership and the Water Quality Goal Implementation Team (WQGIT), in coordination with the Fisheries and Habitat GITs, to review and provide input on the following items:

1. The 3 main steps in the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework; are there any suggestions or concerns with these steps pertaining to what is needed for the consideration of oyster practices as BMPs?

2. The strategy of grouping individual oyster practices that have similar environmental and/or implementation considerations into broad oyster practice categories for nutrient and suspended sediment reduction effectiveness evaluation; are there any suggestions or concerns with this approach?

3. The strategy of developing and applying individual nutrient and suspended sediment reduction effectiveness crediting protocols based on oyster-associated nutrient and suspended sediment reduction processes; are there any suggestions or concerns with this approach?

4. Decision points in Step 1 and Step 2 of the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework; are there any suggestions or concerns with these decision points?

5. Guidelines identified in Step 3 of the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework; are there any suggestions or concerns pertaining to whether these guidelines will adequately capture what is needed to inform decisions concerning the application of the recommended estimates from Step 2?

6. The 4 main oyster practice categories identified by the Panel; are there any suggestions or concerns with these categories?

7. The currently 8 identified oyster-associated nutrient/suspended sediment reduction effectiveness crediting protocols; are there any suggestions or concerns with these being developed as crediting protocols for reduction effectiveness estimates? Note: The panel may modify or identify additional crediting protocols as a result of their data review and if so, will ask for Partnership input at a later date.

2.0. Changes from the Oyster BMP Expert Panel Charge

Key changes from the Oyster BMP Expert Panel Charge[1] are listed below:

- In the charge, the decision framework was referred to as the "pollutant removal crediting decision framework;" however, the Panel decided it would be better to refer to it as the "Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework," (also referred to as the Decision Framework in this paper) in order to make it clear that the framework is for determining the nitrogen, phosphorus, and suspended sediment reduction effectiveness of oyster practices and not decisions concerning other pollutants or how to implement nutrient trading credits (there has been some confusion about this with stakeholder groups).

- Initially, the charge included in the timeline an incremental approval step for the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework. Upon further review, the Panel determined that incremental approval of the Decision Framework has the potential to delay panel progress, and it would be more efficient to have the Partnership approve the Decision Framework as part of the recommendation report. The reasoning for this is because the Panel may find the need to adjust the decision steps in the framework as they work through them and seeking approval for each change could slow Panel progress significantly. However, the Panel did feel it is important to have the Partnership review and provide input on the Decision Framework as it is being developed. Therefore, the Panel will incorporate requests for CBP Partnership input during the Panel's updates to the Water Quality GIT.

3.0. Introduction

The Panel convened on September 30, 2015 and has met a total of six times (9/30/2015, 10/26/2015, 11/2/2015, 11/19/2015, 12/14/2015, and 1/7/2016). The Panel also hosted an open public stakeholder meeting on November 2, 2015 to allow stakeholders an opportunity to present information for the Panel to consider.

To date, Panel meetings have focused on discussing components from charge item 1 and 2 that relate to identifying and defining oyster practices for BMP consideration and developing the Decision Framework to determine nutrient (nitrogen and phosphorus) and suspended sediment reduction effectiveness estimates using individual crediting protocols based on oyster-associated nitrogen, phosphorus, and suspended sediment reduction processes. A summary of the Panel's goals and charge can be found in Appendix A.

This briefing paper describes the following Panel deliberations:

- Steps to be included in the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework.

- Establishment of oyster practice categories for BMP consideration (part of Step 1 of the Decision Framework).

- Identification of oyster-associated nitrogen, phosphorus, and suspended sediment reduction processes that could be developed into individual reduction effectiveness crediting protocols (part of Step 1 of the Decision Framework).

[1] The Oyster BMP Expert Panel Charge can be found at
http://www.chesapeakebay.net/channel_files/23104/oyster_bmp_expert_panel_charge_final_9-14-15.pdf

The Panel is asking the Partnership and the Water Quality GIT, in coordination with the Fisheries and Habitat GITs, to review and provide input on the Panel's outcomes concerning the above deliberations, focusing on the seven review questions listed in Section 1.0, "Purpose of Briefing." Input from the Partnership and GITs, along with any comments from the public, will be reviewed by the Panel to assist with the Panel's recommendations.

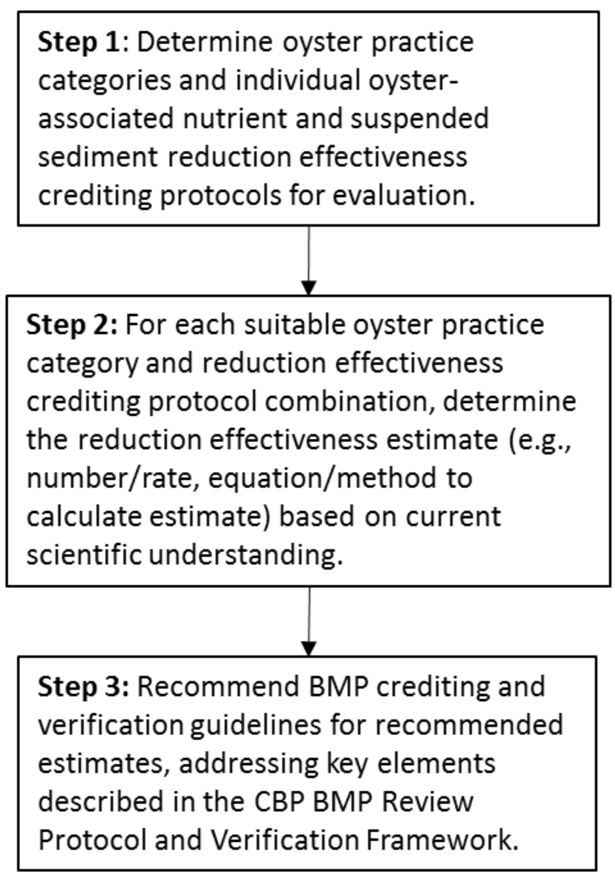
4.0. Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework

The goal of the Decision Framework is to provide a methodology that would allow the incremental determination and application of nutrient and suspended sediment effectiveness estimates based on available science for various oyster practices. The Panel agreed that the Decision Framework should consist of individual crediting protocols based on oyster-associated nutrient and sediment reduction processes. This would allow the determination and incremental approval of nutrient and sediment reduction effectiveness estimates from protocols where there is adequate science. The panel is also building into the Decision Framework opportunities to identify knowledge gaps to assist in determining the components needed to establish an estimate for protocols where data is lacking, including a decision pathway where unknown estimates could be revisited when new science becomes available. The following sub-sections describe the Panel's deliberations on the Decision Framework to date.

4.1. Main Steps of the Decision Framework (Review Question 1)

The panel identified 3 main steps for the Decision Framework (see Figure 1). The rationale for each step is described in their respective sections.

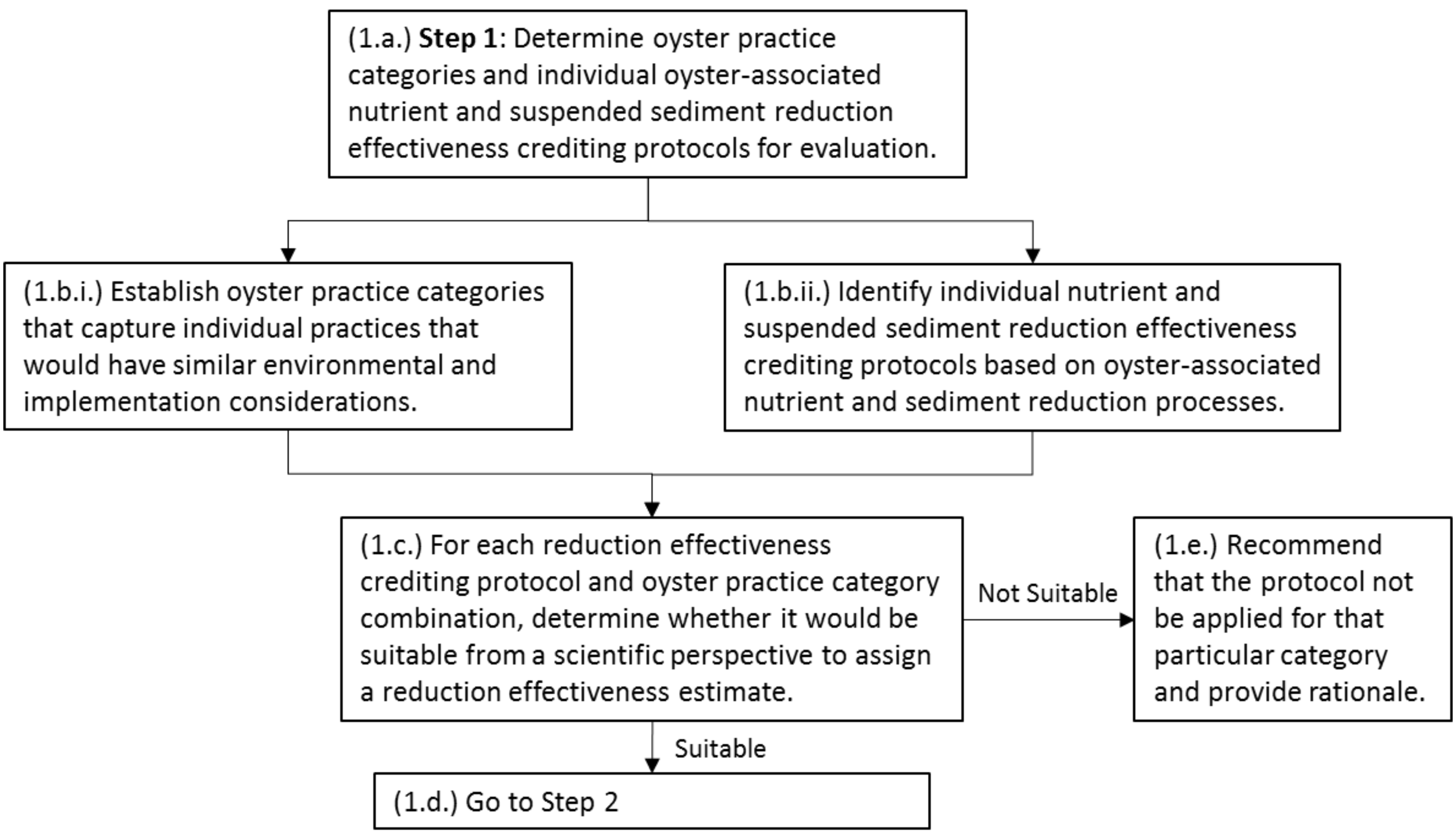
Figure 1. Main steps for the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework.



4.2. Step 1 of the Decision Framework (Review Questions 2, 3, and 4)

Step 1 decision points of the Decision Framework are described in Figure 2. During Panel discussions, the panelists discovered that there are many ways in which various oyster practices related to aquaculture (defined as practices where oysters are removed from the water) and restoration (defined as practices where oysters are not removed from the water) are implemented in Chesapeake Bay and would likely require different environmental factors to be considered. As a result of this finding, the Panel agreed that using a strategy that groups individual oyster practices that have similar environmental and implementation considerations into broad oyster practice categories for nutrient and suspended sediment reduction effectiveness evaluation would be more efficient than tackling practices individually. Essentially, categorization of practices would allow a more focused evaluation of the data to determine the reduction effectiveness estimates and also simplify the establishment of crediting and verification guidelines because the practices in each category would involve similar decision choices. This decision point is incorporated in Step 1 of the Decision Framework (see box 1.b.i. in Figure 2). The Panel also proposes that these categories be thought of as separate BMPs so that they can be evaluated individually. Therefore, if an estimate can be established for one category, but not the others, then that category should be able to be moved forward through the BMP approval process. The Panel's deliberation on what these categories should be can be found in the Section 5.1.

Figure 2. Step 1 decision points of the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework identified by the Panel.



The Panel agreed that oysters can play a role in improving water quality because of their filter-feeding capabilities. The Panel determined that each oyster-associated process that reduces nitrogen, phosphorus, and suspended sediment should be developed as an individual reduction effectiveness protocol (see Figure 2, 1.b.ii.). These protocols would be additive in such that oyster practice categories may qualify for credit under one or more of the protocols. This strategy would be similar to the approved approach used by the Urban Stream Restoration BMP Expert Panel.[2] Estimates for each protocol will be determined in Step 2 of the Decision Framework (see Section 4.3). The Panel will also prioritize which protocols they will focus on based on data availability and discuss with EPA Panel representatives any policy questions that are raised. Crediting guidelines would be developed for each protocol estimate (see Section 4.4, "Step 3 of the Decision Framework").

During Panel discussions, it was determined that it would not always make scientific sense to group a particular reduction effectiveness protocol with a particular oyster practice category. For instance, protocols associated with enhanced burial of nitrogen and phosphorus would likely not be suitable to group with aquaculture-related oyster practice categories because disturbance from harvesting would likely prevent burial processes from happening (i.e., the conditions would never be suitable to support enhanced burial). As a result, the Panel incorporated this decision point into Step 1 of the Decision Framework (see Figure 2, Box 1.c.). The Panel felt this decision point was important to evaluate early on in the Decision Framework because it wouldn't make sense to spend time evaluating combinations that weren't scientifically suitable. Note that "scientifically suitable" in this context refers to whether or not the oyster-associated reduction process the protocol is based on could even occur when compared to practices in a particular oyster practice category. The decision point in determining whether there is sufficient data to determine an estimate for a scientifically suitable combination is built into Step 2 of the Decision Framework (see Section 4.3; Figure 4, Box 2.b.). Suitable combinations would go to Step 2 of the Decision Framework to determine the reduction effectiveness estimate (Figure 2, Box 1.d.). The Panel would not evaluate any combinations that are determined to not be scientifically suitable (Figure 2, Box 1.e.). A visual example of what this decision would look like can be found in Figure 3.

Figure 3. Visual example of the decision point from Step 1, Box 1.c. of the Decision Framework (see Figure 2). This example is hypothetical, including the assigned "#" and "x" values.

Oyster Practice Category/ Crediting Protocol Combinations	Oyster Practice Category A	Oyster Practice Category B	Oyster Practice Category C	Oyster Practice Category D
Protocol 1	#	#	#	#
Protocol 2	#	#	#	#
Protocol 3	x	x	x	#
Protocol 4	#	#	#	#
Protocol 5	#	#	#	#
Protocol 6	#	#	#	#
Protocol 7	x	x	x	#
Protocol 8	x	x	x	#

# = Scientifically suitable to evaluate a reduction effectiveness estimate
x = Not scientifically suitable to evaluate a reduction effectiveness estimate

[2] Schueler, T. and Stack, B. 2014. Recommendations of the expert panel to define removal rates for individual stream restoration projects. Available at http://www.chesapeakebay.net/documents/Final_CBP_Approved_Stream_Restoration_Panel_report_LONG_with_appendices_A-G_02062014.pdf

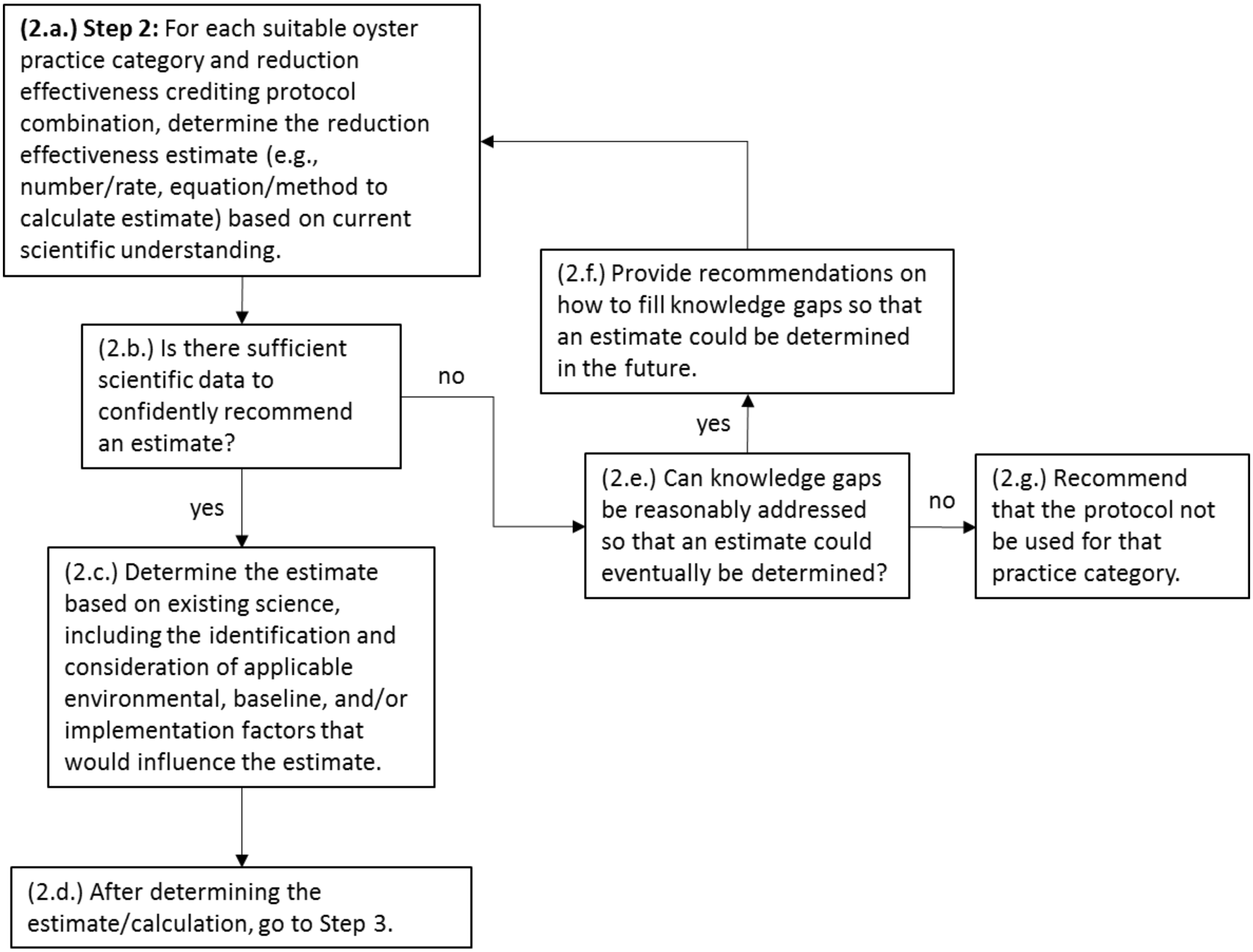
4.3. Step 2 of the Decision Framework (Review Question 4)

Step 2 decision points of the Decision Framework are described in Figure 4. These decision points focus on determining an estimate for each suitable oyster practice category and reduction effectiveness crediting protocol combination. The Panel included both “number/rate” and “equation/method to calculate” as examples of how the estimate may appear in the Panel recommendations because the Panel recognized that for some of the reduction effectiveness protocols it would be feasible to recommend an exact number or rate that could be applied regardless of location (i.e., low variability in the data), while other protocols would be more influenced by site-specific conditions requiring a method for jurisdictions to use to calculate the estimate (i.e., high variability in the data) (Figure 4, Box 2.a.). The Panel will also discuss whether there are any universal reduction effectiveness estimates for a protocol that could be applied across multiple oyster practice categories during their data review of the combinations.

The Panel decided that it would be important to incorporate a decision point that asks whether there is sufficient scientific data to confidently recommend an estimate (Figure 4, Box 2.b.). The Panel will answer this question using their best professional judgement. If yes, then the scientific information and data will be used to determine the estimate (Figure 4, Box 2.c.). The Panel will also identify and consider any applicable factors that could influence the estimate, particularly factors that are environmental (e.g., seasonal changes in water temperature that would affect oyster growth rates), baseline (e.g., denitrification that would occur without added oysters), or implementation (e.g., type of gear used)-related. In some cases, protocols may need to include a range or multiple estimates to account for these influencing factors. Crediting and verification guidelines for each estimate will be determined in Step 3 of the Decision Framework (see Section 4.4; Figure 5).

If the Panel determines there isn’t sufficient data to confidently determine an estimate, then they will determine if knowledge gaps can be reasonably addressed (Figure 4, Box 2.e.), and if so, provide recommendations on how to fill these gaps so an estimate can be determined in the future (Figure 4, Box 2.f.). The Panel will work with EPA advisors to define what would constitute a “no” answer to this decision point (Figure 4, Box 2.g.) given that BMPs are ever evolving. In Figure 4, Box 2.f. loops back to the beginning of Step 2 to demonstrate that when new science becomes available, the process should be repeated. The thought for this is that if jurisdictions are interested in a combination where an estimate couldn’t be determined and collects the necessary data to fill the knowledge gaps, then they would be able to submit this to the CBP Partnership for review and approval without having to convene a new expert panel.

Figure 4. Step 2 decision points of the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework identified by the Panel.



4.4. Step 3 of the Decision Framework (Review Question 5)

Step 3 elements of the Decision Framework are listed in Figure 5. This step focuses on providing recommendations on key items (Figure 5, Boxes 3.b. through 3.h.) that should be considered and incorporated into crediting and verification guidelines for the estimates determined in Step 2. These items were identified to fulfill the requirements in the CBP's Expert BMP Panel Review Protocol[3] for nutrient (nitrogen and phosphorus) and sediment controls and are described further in that document. The Panel will work with EPA advisors on the Panel to formulate these guidelines. Note that these guidelines will be designed to help the CBP and jurisdictions to make an informed decision and that final decisions concerning which credits are pursued and how they will be verified is the responsibility of the CBP and jurisdictions.

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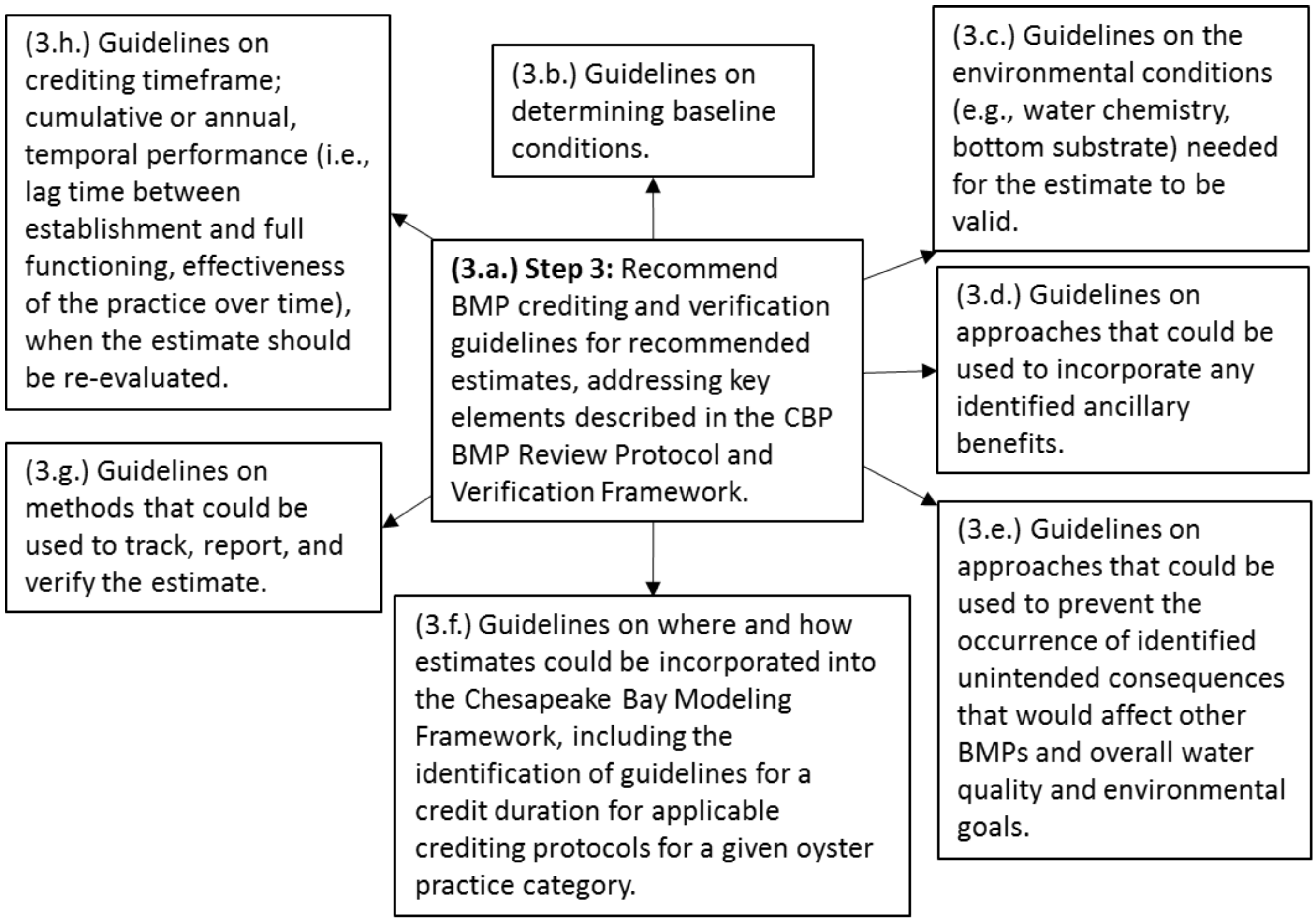
[3] The Chesapeake Bay Program Partnership's Expert Panel Review Protocol can be found at http://www.chesapeakebay.net/publications/title/bmp_review_protocol.

Figure 5. Step 3 elements of the Oyster BMP Nutrient and Suspended Sediment Reduction Effectiveness Decision Framework identified by the Panel.



5.0. Decision Framework Step 1 Progress

While developing the Decision Framework, the Panel deliberated on decision points found in boxes 1.b.i. and 1.b.ii. in Step 1 (Figure 2). These decision points are related to establishing unique oyster practice categories for BMP consideration (Section 5.1) and identifying oyster-associated nutrient and suspended sediment-related reduction processes to be developed into individual reduction effectiveness crediting protocols (Section 5.2).

5.1. Oyster Practice Categories Defined and Rationale (Review Question 6)

The charge identified seven main categories that oyster practices could fall under (see Appendix B). The Panel further refined these categories to four main categories after discussing them from a nutrient and suspended sediment reduction crediting perspective (Table 1). This deliberation corresponds to Step 1, Box 1.b.i of the Decision Framework (Figure 2).

Table 1. Oyster practice categories and their definitions.

Category	Oyster Practice	Description
A	Water Column Oyster Aquaculture	Oysters reared above the sediment surface for eventual removal from the water.
B	Bottom Oyster Planting Aquaculture	Spat-on-shell planted directly on the bottom or small oysters moved from one bottom location to another for eventual removal from the water.
C	Bottom Oyster Substrate Planting Aquaculture	Planting oyster shells or alternative substrate, such as granite, directly on the bottom to attract recruitment of natural (wild) oysters for eventual removal from the water.
D	Oyster Reef Restoration	Planting of oyster shell or alternative substrate and/or spat-on-shell or individual oysters reared elsewhere on bottom or raised substrate to enhance oyster population and/or oyster biomass in areas where removal is not permitted (e.g., sanctuaries).

Oyster practices in the Chesapeake Bay can be characterized as extensive, which is cultivation of natural, wild stocks, or intensive, the cultivation of hatchery-produced oysters. Intensive or extensive practices can take place near, off, or on the bottom for aquaculture or reef restoration purposes. Spat-on-shell refers to oyster larvae that have settled onto shell and subsequently have been planted.

Initial Panel discussions resulted in combining “intensive off-bottom suspended aquaculture” and “intensive near-bottom cage or rack-in-bag aquaculture” into the category, “intensive water column oyster aquaculture.” Panel members agreed that it would make more sense from a biogeochemical perspective to describe both “off bottom” and “near bottom” as “water column,” since the individual practices that would fall into these categories would be occurring in the water column regardless of vertical placement and would therefore have similar biogeochemical considerations. Terminology was also adjusted in the definition. The term “cultchless” was removed because panel members realized that spat-on-shell oysters are also used. The term “container” replaced “bags and cages” because other types of receptacles are used in aquaculture operations. The Panel also agreed that all the category descriptions should be broad enough to capture potential new methods. During this discussion, changes were also made in the practice “intensive/ extensive spat-on-shell bottom restoration.” The Panel recognized that spat-on-shell is not only planted alone, but can be planted along with alternative substrate such as granite, and thus added the wording, “or alternative substrate” in the description.

A subsequent discussion resulted in further refinement. “Intensive spat-on-shell bottom aquaculture” and “intensive spat-on-shell bottom public fishery” were combined into “bottom oyster planting aquaculture” and “extensive shell planting aquaculture” and “extensive shell planting public fishery” were combined into, “bottom oyster substrate planting aquaculture.” Panel members agreed that these practices should be grouped in this manner because, for the purposes of determining nutrient reduction effectiveness, it would not matter if the practice occurred in an area designated as a public fishery versus a private lease. While “bottom oyster substrate planting” is a form of bottom aquaculture, the Panel did not combine it with “bottom oyster planting aquaculture” because with “bottom oyster planting aquaculture,” you have a starting number, since you know how many oysters are initially planted, versus “bottom oyster substrate planting,” where you don’t have a starting number, since you are solely relying on natural recruitment. Because of this distinction, the Panel decided that it would be best to keep these categories separate due to the fact they would likely have very different crediting and verification guidelines.

Additionally, for the category, “bottom oyster planting aquaculture,” panel members acknowledged that there are occasions where oysters are moved from one location to another. The Panel included this in the category description since it would be a critical implementation factor that would have to be considered in the decision framework. Also, during this discussion, the Panel agreed that the distinction "intensive" and "extensive" was no longer needed because hatchery and wild oysters could be used in any of the aquaculture or restoration practices. The Panel agreed that the water quality benefits would likely be the same between a hatchery-produced oyster and a wild oyster, and if the data review demonstrates otherwise, then this consideration could be built into the decision framework at a later date.

During the consensus discussion, the Panel streamlined the terminology of the oyster practice categories and their corresponding descriptions, resulting in the final oyster practice category recommendations found in Table 1. For the "water column oyster aquaculture" category description, the term "container," which had originally replaced "bags and cages," and the phrase "near the bottom or near the surface" were replaced with, "oysters reared above the sediment surface," because panel members noted that non-container methods may be used and also that mid-water production could also occur. For the categories, "water column oyster aquaculture," "bottom oyster planting aquaculture," and "bottom oyster substrate planting," the term "harvest" was replaced with "removal from the water" because it was decided that "harvest" implies human consumption; however, panelists have seen studies in Europe where bivalves are grown for their water quality benefits and then used as animal feed.[4] The oyster practice category, "bottom oyster reef restoration," was changed to "oyster reef restoration" and the language, "or raised substrate" was added because some restoration techniques use materials that elevate oysters off the bottom. Additionally, the language, "to promote natural production" was replaced with "to enhance oyster population and/or oyster biomass" because it was recognized by the Panel that the biomass from the planted spat-on-shell and/or cultured oysters would be just as important, or even more so in certain locations where natural recruitment is low, when determining the reduction effectiveness estimates.

5.1.1. Individual Oyster Practice Descriptions

The individual oyster practices that occur in Chesapeake Bay that fall under each of the oyster practice categories from Table 1 are described below:

Category A: Water Column Oyster Aquaculture

Representative water column oyster aquaculture methods include rearing hatchery produced cultchless oysters or spat-on-shell oysters in rafts, cages, bags, trays, nets or suspended on lines above the sediment surface. Oysters are typically reared for over a year until they reach market size (76 mm) and then harvested for consumption. Examples of water column oyster aquaculture include:

- Raft culture—Rafts use floatation devices (e.g., buoys, PVC, foam) to suspend plastic mesh bags on the water surface or cages just below the surface of the water. Oysters are typically submerged at the surface using rafts. Rafts are frequently monitored and cleaned, and the oysters are sorted for size and transferred between containers as they get larger. Oysters are typically removed from the containers once they reach market size.

- Cage culture—Oyster cages are constructed with metal or plastic mesh surrounding a rigid metal frame that sits on the seafloor. Oysters remain suspended off the bottom because the frame of the cages are designed to touch the bottom and keep oysters several inches from the sediment surface. Like rafts, cages are frequently monitored and cleaned, and the oysters are sorted for size and transferred between cages as they grow. The oysters typically remain in the cages until they reach market size.

[4] Schernewski, G., Stybel, N., and Neumann, T. 2012. Zebra Mussel Farming in the Szczecin (Oder) Lagoon: Water-Quality Objectives and Cost-Effectivenes. Ecology and Society 17(2): 4.

Category B: Bottom Oyster Planting Aquaculture

Representative bottom oyster aquaculture methods include planting hatchery produced spat-on-shell directly on the bottom or small oysters that are moved from one bottom location to another for eventual removal from the water. Oysters are typically left on the bottom to grow for over a year until they reach market size and harvested for consumption. Examples of bottom oyster aquaculture include:

- Bottom cultured oysters—Hatchery produced spat-on-shell is planted onto the bottom and left to grow until oysters reach market size and can be harvested for consumption. Bottom cultured oysters typically require over two years to reach market size, but oysters may be left in the water beyond minimum market size.

- Moving oysters between bottom locations—Small hatchery-produced oysters from spat-on-shell or hatchery-produced or wild clutched or cultchless oysters are moved from one bottom location to another to be grown out to market size. This could include moving oysters from polluted waters to a bottom lease in approved waters or moving wild oyster seed from public grounds to a private bottom lease. Age when oysters are moved ranges from ½ year old to 10 years old, and can be dependent on the size of the oysters.

Category C: Bottom Oyster Substrate Planting Aquaculture

Representative oyster substrate planting methods include planting recycled oyster shell or alternative substrate, such as granite, directly on the bottom to attract recruitment of natural (wild) oysters for eventual removal from the water. Examples of oyster substrate planting include:

- Oyster shell substrate planting—Recycled oyster shell or recovered buried or fossil oyster shell are planted on the bottom to attract natural (wild) oyster recruitment. Oysters produced using this practice are treated and harvested similarly to on bottom cultured oysters.

- Alternative substrate planting—Alternative substrate, such as mixed shell (other than oyster shell) or granite, planted on the bottom to attract natural (wild) oyster recruitment. Oysters produced using this practice are treated like on bottom oyster culture.

Category D: Oyster Reef Restoration

Representative oyster restoration methods include planting recycled oyster shell or alternative substrate, such as granite, and/or spat-on-shell or individual oysters reared elsewhere directly on the bottom to enhance oyster population and/or oyster biomass in areas where removal is not permitted (e.g., sanctuaries). Enhanced oyster population and/or biomass could be from what was planted or from any potential natural recruitment. Examples of oyster restoration include:

- Direct spat-on-shell oyster reef restoration—Hatchery-produced spat-on-shell is directly planted overtop natural oyster reefs/historical areas or reefs that have been built using recycled oyster shell, or alternative substrate, such as granite or mixed shell.

- Oyster reef restoration using cultured oysters—Hatchery produced spat-on-shell or cultchless oysters are reared in containers to a certain age/size and eventually planted on natural oyster reefs/historical areas, or reefs that have been built using recycled oyster shell, alternative substrate, such as granite, or spat-on-shell.

5.2. Reduction Effectiveness Crediting Protocols (Review Question 7)

Through filter-feeding, oysters remove nutrients from the water by consuming and assimilating the nitrogen and phosphorus from what they eat (algae, for the most part) into their tissue and shells. Oysters also enhance nitrogen removal by depositing digested or undigested organic particles on the bottom making it more accessible to bacteria that convert bioavailable nitrogen to nitrogen gas via denitrification or increasing the opportunity for the nitrogen and phosphorus in the organic matter to be buried in the bottom sediment. Nitrogen gas is not a bioavailable form of nitrogen and therefore, does not promote the growth of excess organic matter. The nitrogen gas is eventually released into the atmosphere removing it from the water. Burial traps the nutrients in the sediment where they are no longer re-suspended in the water column. Oysters also remove suspended sediment particles from the water column during filter-feeding by depositing them on the bottom, which helps clear the water.

The Panel discussed the various oyster-associated nitrogen, phosphorus and suspended sediment reduction processes and currently identified the following eight individual reduction effectiveness crediting protocols:

1. Nitrogen Assimilation in Oyster Tissue
2. Nitrogen Assimilation in Oyster Shell
3. Enhanced Denitrification Associated with Oysters
4. Phosphorus Assimilation in Oyster Tissue
5. Phosphorus Assimilation in Oyster Shell
6. Suspended Sediment Reduction Associated with Oysters
7. Enhanced Nitrogen Burial Associated with Oysters
8. Enhanced Phosphorus Burial Associated with Oysters

The Panel may modify these crediting protocols and/or identify additional crediting protocols as a result of their data review. If changes are made or additional protocols are identified, then the Panel will incorporate a request for CBP Partnership input during one of their updates to the WQGIT.

The Panel concurred that Protocols 1, 2, 4, and 5 involving nitrogen and phosphorus assimilation in oyster tissue and shell would likely have sufficient data to determine reduction effectiveness estimates based on the findings from the 2013 STAC Review Report, "Evaluation of the use of shellfish as a method of nutrient reduction in the Chesapeake Bay."[5] The Panel will consider the data from this report and also review new scientific data and information to determine the reduction effectiveness estimates.

The Panel agreed that Protocols 3, 7, and 8 would require more in depth discussion given the variability in denitrification data and the complexity of quantifying the enhanced burial of nutrients associated with an increase in oysters. The term "enhanced" and "associated with oysters" were added to Protocols 3, 7, and 8 because the Panel wanted to be clear that the oysters are not directly carrying out denitrification or burial, but instead enhances these processes by increasing the movement of organic particulate matter from the water column to the bottom through filtering and increasing the habitat area (via reef structures) for other contributing organisms to populate. Even though there is likely less information on enhanced burial of nutrients associated with oysters, the Panel still felt strongly that these protocols should be evaluated given their potential in reducing nutrients from the water column. The Panel recognized that burial would have to be highly efficient in order to be effective and will consider this when determining whether Protocols 7 and 9 should be applied to certain oyster practice categories.

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[5] STAC (Chesapeake Bay Program Scientific and Technical Advisory Committee). 2013. Evaluation of the Use of Shellfish as a Method of Nutrient Reduction in the Chesapeake Bay. STAC Publ. #13-005, Edgewater, MD. 65 pp

The Panel had an in depth conversation concerning how suspended sediment could be incorporated into a crediting protocol as suspended sediment would only be removed from the water column and deposited on the bottom by the oysters and not removed from the Bay. Even so, the Panel felt it would be important to capture this water quality benefit since oysters can substantially clear the water. Given that the Chesapeake Bay TMDL assesses total suspended solids, which includes both organic and inorganic particulate matter, and the water quality standard for which the TMDL is written for is directly related to water clarity, the Panel decided that it would be appropriate to evaluate suspended sediment reduction by oysters from a water clarity perspective and will incorporate suspended sediment reduction recommendations under Protocol 6, "Suspended Sediment Reduction Associated with Oysters."

6.0. Panel Next Steps

The Panel will present this briefing paper to the WQGIT and CBP Partnership during the February 8, 2016 WQGIT meeting. The Panel will review all CBP Partnership, GIT, and any public comments on this briefing paper to help prepare for their data review workshop later in February and to inform their overall recommendations.

Appendix A: Summary of the Oyster BMP Expert Panel Charge

The Oyster BMP Expert Panel is charged to fulfill the overall goals following the Chesapeake Bay Program Partnership's Expert BMP Panel Review Protocol for nutrient (nitrogen and phosphorus) and sediment controls:

1. Reach a consensus on acceptable pollutant reduction effectiveness estimates for oyster practices in Chesapeake Bay based on existing science.

2. Determine a methodology to update these estimates when new science becomes available.

3. Establish pollutant removal crediting and verification guidelines as it relates to their application in the CBP partnership's model framework used to inform the Chesapeake Bay TMDL.

To support the achievement of the above goals, the Oyster BMP Expert Panel is focusing on the following three charge items:

> **Charge Item 1:** Identify and define oyster practices, including aquaculture operations and restoration activities for nutrient reduction BMP consideration. Evaluate whether existing science supports the evaluation of sediment reduction effectiveness.
>
> **Charge Item 2:** Develop a pollutant reduction crediting decision framework that will allow the incremental approval of pollutant reduction effectiveness estimates for individual oyster practices and associated pollutant removal/nutrient cycling processes (e.g., nitrogen and phosphorus bioassimilation in tissue, nitrogen and phosphorus bioassimilation in shell, nitrogen removal via denitrification).
>
> **Charge Item 3:** Use the established framework from charge item 2 to propose pollutant removal effectiveness estimates that are determined to have sufficient science for one or more applicable pollutant reduction/nutrient cycling processes to help inform the Chesapeake Bay TMDL 2017 Midpoint Assessment.

Appendix B. Initial oyster practice categories and corresponding definitions from the charge.

Oyster Practice	**Description**
Intensive Off Bottom Suspended Aquaculture	Hatchery-produced, cultchless oysters reared in floating cages near the surface for harvesting purposes.
Intensive Near Bottom Cage or Rack-and-Bag Aquaculture	Hatchery-produced, cultchless oysters reared in cages or bags near the bottom for harvesting purposes.
Intensive Spat-on-Shell Bottom Aquaculture	Hatchery-produced spat-on-shell planted on bottom leases for harvesting purposes.
Intensive Spat-on-Shell Bottom Public Fishery	Hatchery-produced, spat-on-shell planted on public shellfish fishing areas (PFSAs) for eventual harvest.
Intensive/Extensive Spat-on-Shell Bottom Restoration	Hatchery-produced, spat-on-shell planted to promote natural reproduction in areas where harvesting is not permitted (e.g., sanctuaries).
Extensive Shell Planting Aquaculture	Planting oyster shells on the lease bottom to attract recruitment of natural (wild) oysters for harvesting purposes.
Extensive Shell Planting Public Fishery	Planting oyster shells on public shellfish fishing areas to attract recruitment of natural (wild) oysters for harvesting purposes.