Date: February 15, 2013

To: Stream Restoration Expert Panel
Urban Stormwater Work Group

From: Tom Schueler, Chesapeake Stormwater Network
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Re: Summary of Comments Received on Stream Restoration Expert Panel Report and Proposed Options for Resolving Them

Background:

The Expert Panel presented its recommendations on December 18, 2012 at a joint meeting of the Urban Stormwater Work Group, Agricultural Workgroup, Watershed Technical Work Group and the Stream Group of the Habitat Goal Implementation Team. A follow up meeting with the Ag Work Group was held on January 10, 2013.

The decision was made to provide a 45 day general comment period, which expired on January 31, 2013, before commencing the CBP BMP review process to seek official endorsement by CBP. The process will begin by seeking approval from the Urban Stormwater Workgroup at its meeting scheduled for February 19. We will incorporate these technical edits in a second version later this month.

As of 1/31/2013, we have received written and/or verbal comments from the following groups: Maryland Stream Restoration Association, EPA Region 3, WV DEP, PA DEP (Goerman and Harfrant), Land Studies, Cardno-Entrix and the Agricultural Workgroup. The entire file of comments received will be posted to the USWG website.

The comments primarily focused on two broad areas:

- Policy concerns on the report's implications for permitting of future projects.
- Technical issues regarding the application of protocols to different kinds of stream restoration projects.

The panel's response to comments in each of these areas are discussed separately in this memo. Due to the sheer volume of comments, the responses are organized by general themes or clusters.

Part A: Response to Comments Regarding Permitting and Policy

There were eight major clusters of comments in this area, as follows:

1. General response on restoration permitting issues
2. Stormwater retrofitting in upland areas
3. Lack of prescription in permitting requirements
4. Assessing functional uplift

5. Application of protocols in rural watersheds
6. Longer term adaptive management recommendations
7. Longevity of stream restoration practices
8. Verification of stream restoration projects

1. General response on restoration permitting issues.

From its onset, the Panel was very mindful of the many environmental permitting implications that might arise from increased implementation of stream restoration projects in one part of the watershed in order to meet water quality standards in the Bay. The Panel was chosen to reflect an equal balance of stream researchers, practitioners and state project reviewers, all of which closely follow the science and practice in the rapidly evolving field of stream restoration.

The Panel had a guiding principle that it would be agnostic with respect to the different design approaches to stream restoration (e.g., NCD, RSC, LSR and their variants). All agreed that projects designed under any approach could be located or constructed well or badly, and each panel member (and most Bay states) have their own preferences as to the design approaches that work best under their local stream conditions. These undoubtedly will be tailored in each state's approach to the permitting process.

While the Panel was willing to translate the available science to craft improved protocols for estimating nutrient and sediment reduction associated with various kinds of stream restoration, it was not charged with solving the inevitable policy and permitting issues that emerge from greater implementation of restoration projects, both in the uplands and the stream corridor.

Indeed, the proper role for resolving these issues is expressly reserved by the state and federal regulatory authorities who are now regulating both the restoration of upland areas and the stream corridor. The Panel recommends that these agencies adopt both a watershed and an adaptive management approach to resolve these issues, and solicit the advice of a wide range of scientists, practitioners, and others to develop workable technical guidance on a comprehensive permitting approach.

Finding the right balance on how to regulate the implementation of restoration projects in both upland areas and the stream corridor will not be easy, but could be based on the relative degree of stream, floodplain and estuarine impairment. Achieving this balance is one of the most urgent watershed management priorities for both local streams and the Bay watershed, in the view of many Panel members.

To this end, individual expert panel members have agreed to share their perspectives at a meeting with federal regulators scheduled for late March. The Panel appreciates the leadership of ACE/FWS/EPA in setting up the process for this important dialogue.

The 5 Bay states represented on the Panel did come to general consensus on environmental permitting recommendations (VA/PA/MD/WV/DC), as well as the 5 practitioners on the Panel that must work within the existing permitting system. These

general recommendations could be considered a starting point when federal agencies devise more detailed permitting guidance.

2. The Role of Restoration Projects in Upland Areas

Several reviewers raised the important question related to the need to restore both upland areas and the stream corridor. While the Panel did not provide a lot of specific guidance on this question, it tacitly assumed that localities would take a watershed approach to restoration. Urban watersheds can only be comprehensively restored by installing practices in upland areas, the stream corridor, and in appropriate settings, within the stream itself.

The CBP currently has completed or launched a half dozen expert panels on urban BMPs, most of which are applied to upland areas (new runoff reduction practices, stormwater retrofits, urban nutrient management, stream buffers, enhanced erosion and sediment control and illicit discharge prevention). The goal is to give our state and local CBP partners a wide range of watershed tools to meet restoration goals, with the premise that most of them will be applied in upland areas.

The Panel was silent on offering a recommendation as to what proportion of practices should be applied to uplands versus the stream corridor, for the simple reason that we currently lack the science to do so.

3. Lack of Prescriptive Permitting Requirements

Several reviewers noted that the Panel originally had made more extensive and prescriptive recommendations for individual project assessment, monitoring, upland retrofitting and functional uplift. Several CBP partners argued that these topics went beyond the original charge of the Panel, and were the purview of the appropriate state and federal regulatory agencies. The Panel was very sensitive to this issue, and as such, agreed that the prescriptive recommendations would be replaced by more general recommendations, and that a joint EPA/ACE/FWS work group should be formed to discuss and decide these thorny issues.

4.Measurement of Functional Uplift.

The Panel agreed that measurement of functional uplift was a critical element to ensure projects go beyond the narrow objective of nutrient reduction. The Panel recognized that a wide variety of tools are being developed to measure the function of stream restoration projects. The Panel elected not to recommend one evaluation tool over another, as all are being tested and refined, and several pilot projects are now in progress. The Panel also notes that any tool must be carefully calibrated to project-specific design objectives, and be further refined to deal with the inherent differences among the various approaches to stream restoration (e.g., NCD, RSC, LSR).

5. Application of Protocols to Rural Streams

The Panel was charged to determine whether the urban stream restoration protocols are broadly applicable to rural stream restoration projects. In Section 4.4, the Panel indicated that the basic protocols should work for certain classes of rural stream restoration projects. It is important to note that the Panel also noted that additional work might be needed to adjust the protocols to account for the unique hydrology and nutrient loading conditions encountered in rural watersheds.

The Agricultural Workgroup discussed the expert panel report in December and January, and reserves the right to decide whether to approve, reject or modify the use of stream protocols in rural watersheds, and set its own time-table for making these decisions in future years.

The Panel did not define a "demarcation line" between which streams are urban and rural, but note that the recent literature suggests that 5 to 10% subwatershed impervious cover appears to be the threshold for detecting stream impairment (section 2.1). Each state, however, should have the discretion to set its own demarcation line, based on their unique stream conditions and regulatory framework.

6. Adaptive Management in Stream Restoration

The Panel freely acknowledges the limits of the available science (Section 8.1), the risks that some projects will fail (Section 7) and that both watershed managers and permitting agencies are operating in an uncertain environment. The entire Panel agreed that an adaptive management approach was essential in the coming years, and made several key recommendations in this area:

- A conservative approach was taken in developing the nutrient and sediment reduction protocols so that they would not over-state these benefits. Clear qualifying conditions were established to prevent users from "gaming" the system or incorrectly applying the protocols.

- The Panel also established a six month "test-drive" period to apply the protocols to real world stream restoration projects, in order to see if any refinements or adjustments are needed to enhance the protocols.

- The Panel also put a 2017 "sunset" on its recommendations, with the notion that a new expert panel would be convened to re-examine the protocols in response to new research and implementation experience in the coming 5 years.

- The Panel also identified a series of critical research priorities to fill critical management gaps, and strongly urges that state and federal agencies cooperate together to fund them in the next two years, so localities can be assured that better science will actually be ready by 2017.

The CBP recently awarded the Center for Watershed Protection a multiple year cooperative agreement to serve as the Stream and Sediment Coordinator for the Bay Program and establish a clearinghouse on stream restoration and sediment data. In their role, CWP will be called upon to address some of the adaptive management needs in the coming years, in collaboration with local, state and federal partners, as well as the MD Stream Restoration Association.

7. Longevity of Stream Restoration Practices.

Several comments expressed some confusion as to the actual longevity of stream restoration projects and the maximum duration of the pollutant reduction credit(s) in the CBWM. The Panel recommended a continuous process for on-site inspection and verification for individual stream restoration projects. An individual project can continue to receive credit for 20, 30 or even 50 years, as long as the on-site inspection conducted every 5 years still confirm that the project is meeting its original design objective and functions.

8. Verification of Stream Restoration Projects

A CBP workgroup has recently drafted a series of principles and protocols for verification of stream restoration projects that expand in considerable detail upon the expert panel recommendations with respect to project verification and assessment of functional uplift. The workgroup included local, state and federal resource protection professionals, and their principles will be considered by the Habitat GIT later this month. Once these principles are approved, they will certainly be a useful resource to guide and inform the deliberations of state/federal permitting agencies.

Part B Technical Concerns About Application of the Protocols to Different Types of Restoration Projects

While most of the feedback at the initial meeting and subsequent comments was quite laudatory, there were a few areas of concern:

1. Applicability to legacy sediment removal projects
2. Define and revise key terms.
3. Application of protocols to non-urban stream restoration projects.
4. Concern over use of the BANCS method.
5. Prevented sediment reduction for Legacy Sediment Removal is not credited by Protocol 1.
6. Application of Protocol 2 (the hyporheic box method) and unintended consequences.
7. Qualifying conditions for crediting for floodplain reconnection during stormflow.
8. Concern regarding sediment transport and how streams are represented in the Model.
9. Concern regarding the design examples presented in Section 6.1 favoring natural channel design projects and not projects involving flood plain reconnection.

1. Applicability to Legacy Sediment Removal Projects

Summary of Comments: PADEP provided extensive comments on how the Panel report could better address legacy sediment removal (LSR) projects. While Franklin and Marshall was involved early in the panel deliberations, they were not involved in the development of the final protocols

Response: Bill Stack and I have scheduled a call for February 20 with PADEP to find a way to incorporate their comments; several are already being addressed in this response (e.g., See response # 2, 3, 5, 7 and 9).

2. Define and Revise Key Terms

Summary of Comments: Several reviewers suggested new or revised definitions of key terms in the report:

Response: The following changes are proposed:

> *Urban (New):* Generally a subwatershed with more than 5% impervious cover, although individual states may have their own definition
>
> *Non-Urban (New):* A subwatershed with less than 5% impervious cover, and is primarily composed of forest, agricultural or pasture land uses. Individual states may have alternative definitions
>
> *Upland Restoration (New):* The implementation of best management practices outside the stream corridor to reduce runoff volumes and pollutant loads in order to restore the quality of streams and estuaries
>
> *Legacy Sediment (New):* Sediment that (1) was eroded from uplands during several centuries of land clearing, agriculture and other intensive uses; (2) accumulated behind ubiquitous dams in slackwater environments, resulting in thick accumulations of cohesive clay, silt and sand, which distinguishes "legacy sediment" from fluvial deposits associated with meandering streams; (3) collected along stream corridors and within valley bottoms, effectively burying natural floodplains, streams and wetlands; (4)altered and continues to impair the morphologic, hydrologic biologic, riparian and other ecological services and functions of aquatic resources; (5) can also accumulate as coarser grained more poorly sorted colluvial deposits, usually at valley margins; (6) can contain varying amounts of nutrients that can generate nutrient export via bank erosion processes.
>
> Widespread indicators of legacy sediment impairment include a history of damming, high banks and degree of channel incision, rapid bank erosion rates and high sediment loads. Other indicators include low channel pattern development, infrequent inundation of the riparian zone, diminished sediment

storage capacity, habitat degradation, and lack of groundwater connection near the surface of the floodplain and/or riparian areas.

Legacy Sediment Removal (Revised): A class of aquatic resource restoration that seeks to remove legacy sediments and restore the natural potential of aquatic resources including a combination of streams, floodplains, and palustrine wetlands. Although several LSR projects have been completed, the major experimental site was constructed in 2011 at Big Spring Run near Lancaster, PA. For additional information on the research project, consult Hartranft (2011).

3. Dealing with Rural Stream Restoration Projects

Summary of Comments: Several reviewers questioned whether a separate credit for non-urban streams was warranted to account for differences between urban and non-urban stream systems. There was general criticism of the "urban focus" of the report and while the report recommended the applicability of these protocols for streams in rural areas, reviewers felt this recommendation should be more prominent as well as the causes of stream instability in rural settings.

Resolution: Limited literature exists to document the response of non-urban streams to stream restoration projects in comparison to the still limited, but more extensive literature on urban streams. However, many of the papers reviewed were from rural streams. For instance, papers by Merritts et al. (2010) were used to add to the evidence that streams contribute substantially more loadings than that suggested by the "urban stream" study (Spring Branch) that was used to establish the initial stream restoration credit by the Chesapeake Bay Program.

Several of the papers reviewed to demonstrate the efficacy of the BANCS method were based on studies in rural areas. Revisions to the draft will make the connection of the document to rural streams more clear and will include a brief discussion about the causes of stream instability in rural settings.

The revised report will also include edits to Section 4.4 "Applicability to Non-Urban Stream Restoration Projects" that more prominently reflects the application of the protocols to non urban streams. This section states that "the prevented sediment and floodplain reconnection protocols developed for urban streams would work reasonably well in rural situations" and that the pre-project load will need to be adjusted to reflect the actual non-urban load being delivered to the rural project.

The revisions to the report will add clarifying language and also address the concern described in #6 and #7 regarding credit for nutrient removal during base flow for flood plain reconnection projects that can demonstrate hyporheic connection in the flood plain area.

4. Concern over Use of the BANCS Method

Summary of Comments: The BANCS method was criticized because its suitability for use in the eastern U.S. has not been extensively demonstrated. Regional curves have been developed for the coastal plain, but are lacking for the Piedmont, Valley and Ridge, and Appalachian plateau. In addition, this method does not take into account the effect of freeze-thaw processes, incision, or cohesiveness of bank sediments, and reduces the incentive for restoration on straight streams where the method predicts lower erosion rates.

Proposed Resolution: The limitations of the BANCS method identified by reviewers would result in errors that in many cases would be offsetting. For instance, the BANCS method can overestimate erosion from stream banks comprised of cohesive clays. However, the BANCS method can also under predict erosion resulting from channel incision and head cuts. This was discussed in a study of the Codorus Creek Watershed by the Codorus Creek Watershed Association (CCWA 2008, 2009, 2010), which used a modified version of the BANCS approach to predict stream bank erosion.

We also feel that uncertainty associated with the use of this method is accounted for by only allowing a 50% stream restoration efficiency for Protocol 1. Furthermore, the report does an excellent job of describing the limitations of the BANCS method and making recommendations on its improvement as described below.

- The development of a standardized photo glossary to improve standardization in selecting BEHI and NBS scores.

- Continued support for the development of regional stream bank erosion curves for the BANCS method using local stream bank erosion estimates throughout the watershed and a statistical analysis of their predicted results.

- Using other methods to validate the BANCS method such as aerial photographs that can be used to estimate historical erosion rates.

- The BANCS method should only be performed by a qualified professional, as determined by each permitting authority.

- Extrapolation of BEHI and NBS to unmeasured banks should not be allowed unless photo documentation is used to provide the basis of extrapolation.

Appendix C highlights studies where the BANCS method has been used for the estimation of stream bank erosion, as well as research on how to improve the accuracy of the BANCS method. The report also includes language in *Section 8: Future Research and Management Needs,* that states, *"Several parameters involved in Protocol 1 are based on intensive sampling in the Baltimore and Washington, DC metropolitan areas (e.g., nutrient content of bank and bed sediments, regional stream bank erosion curves). Given the sensitivity of the BANCS methods to these parameters, the Panel*

would be much more confident if more data were available from other regions of the watershed."

The Chesapeake Bay Stream Restoration and Sediment Coordinator (Center for Watershed Protection) will continue to work on improving the accuracy of the BANCS method and plans on working with the Maryland Stream Restoration Association, who has offered assistance with developing tools for standardizing the BANCS method in the eastern U.S.

5. Prevented Sediment Reduction for Legacy Sediment Removal

Summary of Comments: Several issues were raised about how legacy sediment removal projects are credited within the proposed protocols. If the design process effectively removes sediment from the floodplain or stabilizes the banks, a question was raised as to why 100% of the prevented bank erosion was not credited instead of the 50% efficiency applied in Protocol 1.

Furthermore, some reviewers questioned why projects that reconnect to the floodplain at frequent intervals are given the same credit as projects designed using the natural channel design method, which have much higher stream banks and hence greater susceptibility to failure.

Proposed Resolution: The Expert Panel felt strongly that a 50% efficiency is warranted to address the uncertainty regarding the methodology and success of implementation. The few studies found in the Chesapeake Bay watershed with pre and post construction monitoring (Stewart 2013 and CCWA 2008) reported much greater than 50% sediment reduction using the NCD approach.

6. Application of Protocol 2 (the Hyporheic Box Method) and Unintended Consequences

Summary of Comments: Reviewers questioned whether the use of a single denitrification rate should be considered representative of all streams in the Bay watershed. Reviewers also felt that Protocol 2 does not account for hyporheic exchange for projects that reconnect to restored palustrine and floodplain wetlands and the use of a standard 5 ft depth of the hyporheic box is not scientifically justified and may not be realistic for most streams due to the presence of bedrock or other confining layers.

Furthermore some reviewers felt the methodology would result in unintended consequences, including: high width to depth channels that are not conducive to habitat and temporarily storm sediment, artificial raising of the streambed invert above the groundwater and gravel/bedrock, and the installation of artificial downstream dams to increase depth/storage volumes of flow in the floodplain.

Proposed Resolution: The Expert Panel acknowledged the limitations of developing a method based on a single study, but felt that the Protocols were developed based on the best science available recognizing the Chesapeake Bay Program's adaptive management

process. However, the reviewers made several excellent points that will be addressed in revisions to the report. A discussion of these revisions is included below.

Protocol 2 assumes a uniform length and depth of the "hyporheic box" along the length of the stream reach but also discusses that the dimensions of the box would apply to only sections of the reach where hyporheic exchange can be documented. For instance, in *Section 6: Credit Calculation Examples* only part of the stream reach was used to determine the dimensions of the "hyporheic box" since flood plain reconnection did not occur throughout the stream reach.

The revised report will include recommendations that areas with bedrock outcroppings or confining clay layers should also be excluded and the length/width of the hyporheic box adjusted accordingly. The revised report will also include recommendations on how localities can account for factors that would limit the area of hyporheic exchange.

Protocol 3 will be revised to account for hyporheic exchange that occurs during baseflow in projects that reconnect to restored palustrine and floodplain wetlands. Note that because of this change, Protocol 2 will no longer apply for projects that qualify under the revised Protocol 3.

Regarding the possibility of unintended consequences that would lead to restoration designs with extremely wide reaches to maximize hyporheic exchange, stream restoration designers typically model sediment transport as part of the design process. This modeling should indicate whether excess sediment deposition is occurring as a result of the design. Likewise, the stream verification process should document areas of post construction failure resulting from excess sediment deposition in the restoration reach.

7. Edits to Qualifying Conditions and Crediting for Floodplain Reconnection during Stormflow

Summary of Comments: The question was raised as to whether floodplain connection should be equated to a wetland treatment efficiency in particular the applicability of applying the wetland efficiencies cited by Jordan (2007) to flood plain wetlands. There was also a question as to how long a restored floodplain wetland would be viable and how the nutrient uptake efficiency will change over time. In addition, the qualifying condition of a 1% wetland to watershed ratio was suggested to be too limiting and difficult to obtain. Floodplain and stream connection during baseflow, in addition to stormflow, was suggested as important crediting factor.

Proposed Resolution: The application of wetland efficiencies from Jordan (2007) represents only one component of Protocol 3. The other key elements include determining the volume of flow entering the floodplain and the available wetland storage. The Expert Panel felt that the use of Jordan (2007) represents the best science available and that the other key elements of the Protocol are equally important in determining sediment and nutrient efficiencies. Also, as discussed in #6, the revised report will allow for the incorporation of base flow loadings for qualifying floodplain

reconnection projects which will better represent nutrient processing in Palustrine and floodplain wetlands.

Accounting for changes to wetland efficiency over time is an issue that will have to be addressed as part of the ongoing process of verification. The verification process suggested by the Expert Panel should address major deficiencies associated with the design. The performance of palustrine and wetland efficiencies over time is a valid research question that will have to be addressed through continued research.

The Expert Panel felt that using a 1% wetland to watershed ratio was warranted to assure adequate hydraulic residence time within the floodplain wetlands. The Expert Panel will review these comments and decide whether this recommendation should be changed.

8. Sediment Transport and How Streams are Represented in the Model

Summary of Comments: A few of the comments were critical of the oversimplification of sediment erosion and transport processes, especially with respect to stream channel erosion, flood plain storage and sediment transport. One comment questioned the use of the Sediment Delivery Factor and how streams were represented in the Chesapeake Bay Watershed Model.

Proposed Resolution: The Chesapeake Bay Program recognizes that crediting for stream restoration projects is challenging because 0-3rd order streams are not specifically modeled by the Chesapeake Bay Watershed Model. The Stream Restoration and Sediment Coordinator (Center for Watershed Protection) will be working with the Modeling Team to determine how to better represent these stream classes, as well as modeling sediment transport in the next phase of model development.

9. Design Examples Favor Natural Channel Design Projects and Not Projects Involving Flood Plain Reconnection

Summary of Comments: The 3 design examples in Section 6.1 were based on typical projects one might encounter in urban areas where there is limited flood plain area for reconnection. As a result, most of the sediment and nutrient reduction shown in Table 7 is attributed to Protocol 1 which is based on a method (BANCS) developed for Natural Channel Design (NCD). There is concern that these examples might suggest the NCD approach over other methods (e.g. flood plain reconnection).

Proposed Resolution: The Expert Panel endorsed Protocol 1 because even though the BANCS method was developed for NCD, it could be applied equally to flood plain reconnection methods. The Protocols might influence a manager's decision to use one method over another; however there are numerous other factors (property access, available floodplain, costs, habitat concerns) that influence a manager's decision. Furthermore, Figures 4, 5 and 6 of Protocol 3 adequately demonstrate the benefits of flood plain reconnection from the stand point of sediment and nutrient reduction where sufficient flood plain area exists.

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