BMP Expert Panel for Nontidal Wetland Rehabilitation, Creation and Enhancement

Thursday, September 19, 2019

Jeremy Hanson, Panel Coordinator, Virginia Tech | CBPO
Dr. Neely Law, Panel Chair, CWP

Chesapeake Bay Program
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Overview

- Recap of panel charge, membership and timeline
- Summary of panel recommendations
- Response to comments from partnership review

Panel Charge and Membership

Panel Charge

- Formed to evaluate nitrogen, phosphorus and sediment reduction benefits of three nontidal wetland BMPs:
  - Rehabilitation
  - Enhancement
  - Creation
- Wetland Workgroup approved Charge for the panel, May 2017
- Charge and Scope of Work confirmed in September 2017 when panel membership was approved by the Wetland Workgroup

Panel membership and support roster

Name	Affiliation	Role
Neely L. Law, PhD	**The Center for Watershed Protection (CWP)**	**Panel Chair**
Kathleen Boomer, PhD	**Foundation for Food and Agriculture Research**	**Panel Member**
Jeanne Christie	**Christie Consulting Services LLC**	**Panel Member**
Greg Noe, PhD	**U.S. Geological Survey**	**Panel Member**
Erin McLaughlin	**Maryland DNR**	**Panel Member**
Solange Filoso, PhD	**Chesapeake Biological Lab**	**Panel Member**
Denice Wardrop, PhD, PE	**Penn State**	**Panel Member**
Scott Jackson	**University of Massachusetts**	**Panel Member**
Steve Strano	**NRCS-Maryland**	**Panel Member**
Rob Roseen, PhD, PE, D.WRE	**Waterstone Engineering**	**Panel Member**
Ralph Spagnolo	**EPA Region 3**	**Panel Member**
Jeremy Hanson	*Virginia Tech*	*Panel Coordinator*
Brian Benham	*Virginia Tech*	*VT Principal Investigator*
Lisa Fraley-McNeal	*CWP*	*Support*
Bill Stack	*CWP*	*Support*
Deb Caraco	*CWP*	*Support*
Jeff Sweeney	*EPA CBPO*	*CBPO Modeling Team and Watershed Technical Workgroup rep*
Carrie Traver	*EPA Region 3*	*EPA Region 3 rep*

Panel Timeline

- Membership approved by Wetland Workgroup in September 2017
- Convened for first call in November 2017
- Open stakeholder session: February 28, 2018 (https://bit.ly/2YlWHcI)
- 14 Panel meetings from November 2017 to June 2019
- Report posted and distributed: July 10-15, 2019
- Recommendations "roll-out" webcast: July 31, 2019 (https://bit.ly/30xdk2K)
- Feedback requested by COB August 15, 2019
- Timeline for decision/approval:
  - Wetland WG: September 10th
  - Presentation to Urban Stormwater WG: Sept 17th
  - Presentation to Agriculture WG: Sept 19th
  - Watershed Technical WG: October 3rd
  - WQGIT & HGIT: November 12th

Key Definitions

The Starting Point – Frame of Reference

BMP Category /Applicable NRCS Practice Standard	**CBP Definition (for Phase 6 CBWM)**	**CBP will count the BMP acres as...**	**Operational Definitions**
Restoration Applicable NRCS Practice 657	Re-establish The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland.	Acreage gain *(toward Watershed Agreement outcome of 85,000 acre wetland gain and in Phase 6 annual progress runs)*	• No wetland currently exists • Hydric soils present • "Prior converted" • **Result**: Wetland acreage and functional gain
Creation Applicable NRCS Practice 658	Establish (or Create) The manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exist at a site.	Acreage gain *(toward Watershed Agreement outcome of 85,000 acre wetland gain and in Phase 6 progress runs)*	• No wetland currently exists • Hydric soils not present • **Result**: Wetland acreage and functional gain

Key Definitions

The Starting Point – Frame of Reference

BMP Category /Applicable NRCS Practice Standard	CBP Definition (for Phase 6 CBWM)	CBP will count the BMP acres as...	Operational Definitions
Enhancement Applicable NRCS Practice 659	Enhance The manipulation of the physical, chemical, or biological characteristics of a wetland to heighten, intensify, or improve a specific function(s).	Function gain *(toward 150,000 acre outcome and Phase 6 annual progress runs)*	• Wetland present • Some functions may be suboptimal • **Result**: Gain in wetland function
Rehabilitation May include some NRCS Code 657 practices.[1]	Rehabilitate The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded wetland.	Function gain *(toward 150,000 acre outcome and Phase 6 annual progress runs)*	• Wetland present • Wetland conditions/functions degraded • **Result**: Gain in wetland function

Summary of Recommendations of the Wetland Creation, Rehabilitation and Enhancement Expert Panel

Summary of Recommendations

- Revised efficiency values for Wetland Creation and Wetland Rehabilitation BMPs, based on panel's multiple methods and best understanding of water quality "uplift"
- Panel agreed that wetland enhancement could not be supported as a BMP for water quality
- Recommended efficiency values and upland treated acres:

	TN removal (%)	TP removal (%)	TSS removal (%)	Upland acres treated per acre of BMP
Restoration*	*42*	*40*	*31*	*Varies by HGMR*
Creation	30	33	27	Report drainage area; if not, 1:1 for "other wetlands; 1.5:1 for floodplain wetlands
Rehabilitation	16	22	19	Report drainage area; if not, 1:1 for "other wetlands; 1.5:1 for floodplain wetlands
Enhancement	Not recommended			

**No change to WEP2016 values for Wetland Restoration. The information is provided for reference.*

Wetland Enhancement

- Panel recommends that wetland enhancement is not an eligible BMP for water quality
- Panel recognizes the value of wetland enhancement to achieve other Agreement outcomes where the benefit of enhancement supports wildlife and improved habitat
- Recommendation is based on three key factors:
  - Definition of enhancement does not guarantee a focus on water quality and its improvement
  - Typical techniques associated with enhancement may result in the increase in nutrient loads, or a change in resource
  - Relatively small, if any (net) water quality improvement
  - ➢ Results in large uncertainty on the outcome of this BMP

Methods, Results and Key Findings to inform the development of recommendations

- Multiple lines of evidence approach
  - Conceptual Models I and II
  - Literature Review
  - Expert Elicitation (Modified Delta Approach)
  - Riparia Database Analysis

Results

Wetland BMP Type	TN (%)	TP (%)	TSS (%)	Source	Notes
All Wetland BMPs	39	32	43, 36[1]	Updated Literature Review	Unable to differentiate amongst the different BMP types (see Table 4 in report)
Creation	29.8	27	32.5	Expert Elicitation	Results from EE survey (see Table 5 in report)
Rehabilitation	21	22.8	20.8		
Creation	30	33	27[1]	Riparia database analyses	See Table 10 in report
Rehabilitation	16	22	19[1]		

[1] *The average TSS percent reduction from all studies in the literature review database is 36%. The Riparia database analyses was repeated using this value to adjust the TSS retention efficiency values.*

Recommendations

- Panel agreed that wetland enhancement could not be supported as a BMP for water quality
- Recommended efficiency values and upland treated acres:

	TN removal (%)	TP removal (%)	TSS removal (%)	Upland acres treated per acre of BMP
Creation	30	33	27	Report drainage area; if not, 1:1 for "other wetlands; 1.5:1 for floodplain wetlands
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Qualifying Conditions

The Basics

- All wetlands BMPs should result in a sustainable, functioning wetland that requires minimal, long-term intervention
- Supplement existing jurisdictional requirements

Location is Key

- Implemented at appropriate sites which improve the ecological function of a wetland or a non-wetland site where a created wetland BMP is implemented.
- All BMPs should avoid adverse impacts to watercourses or wetlands.
- BMP locations should be chosen to ensure hydrology is sufficient for long-term sustainability of the wetland.
- Wetland BMPs in agricultural areas should be designed to promote nutrient and sediment retention to the extent practical.

Conditions and Functions Assessment

- An assessment of pre- and post BMP conditions
- Avoid negative impacts to the functions and/or values of existing wetland systems and high-quality or rare non-wetland ecosystems should not be pursued.
- Changing the functions of existing high-quality wetlands should not be pursued.

Partnership Comments & Responses

- Comments received to date included the following categories:
  - Editorial, to clarify understanding
  - Associated issues outside scope of the panel report, e.g., wetlands classification and acreage in Phase 6 model
  - Applicability of the wetland creation and rehabilitation credits (urban sector, stream restoration)
  - Interpretation of the nutrient and sediment retention values
- Subsequent response to comments and revisions did not change the recommendations in the report
- All comments and responses are listed in Appendix I
  - Abridged summary on next 3 slides

Comment	Response
<u>Phase 6 model and wetlands representation and acreage</u>	
• Comment to revise L2W factors	• directed to the Modeling Workgroup (G. Shenk)
• Updating acreage of mapped wetlands through ongoing efforts	• directed to the LUWG/CBP GIS team (P. Claggett)
<u>Applicability of the wetland creation and rehabilitation credits to the urban sector</u>	
• Are the wetland BMPs applicable to the urban sector for load reductions?	• USWG will be asked to provide recommendation on applicability of wetland creation and rehabilitation to the developed load source. The recommended BMPs in this report are voluntary BMPs. Construction wet ponds or wetlands engineered for stormwater treatment *are not applicable* and would follow the existing credit protocols
• Clarification for qualifying conditions for use of the recommendations applicable for compensatory mitigation	• Edits made to the report stating that compensatory mitigation projects remain ineligible for reported and credit towards the TMDL goals

Comment	Response
<u>Applicability of the wetland BMP credits and to stream restoration</u> • How does the new wetland report intersect with Protocol 3 stream restoration credit (Floodplain Reconnection)?	• Request “USWG Stream Restoration Group 4” may provide a determination • Important consideration is to avoid double-counting of credit • Encourage SR projects that increase wetland acreage report it to the Partnership
• Comment received suggesting wetland enhancement receive credit given interpretation of stream restoration projects as enhancement	• Response provided clarification on the definitions and application of wetland enhancement as defined by the Partnership vs stream restoration

Comment

Response

<u>Interpretation of the nutrient and sediment retention values</u>

- Comment pertaining to local context for how a wetland rehabilitation project is defined/determined

- Acknowledge wide-range of performance of individual wetland BMPs report and influence of local, site specific conditions and management efforts. Generalities and assumptions made to accommodate a Bay-wide crediting protocol
- Rehabilitation credit applies to an existing degraded wetland and retention (%) value represents the 'lift' or added benefit as a result of management action

- Comment requesting to revisit the upland treated acres for wetland restoration

- Wetland restoration credits outside the scope of the current Panel. Wetland creation and rehabilitation have the option to report actual drainage area, and if not reported a default of 1:1 or 1.5:1 is assigned.

- Uncomfortable with not allowing enhancement of Phragmites …

- Added reference to recent publication on the tradeoffs of Phragmites management in wetlands (Bansal et al 2019)

Thank you!

Questions or comments, please contact:
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Extra Slides

Unintended Consequences

- Underscore importance stated by WEP (2016) for the need to identify appropriate sites for wetland BMPs
  - Avoid impact to or alteration of high-quality wetlands. Changing the structure and function of existing high-quality or rare wetland systems should be avoided due to potential unintended adverse impacts and tradeoffs.
  - By removing enhancement as a potential BMP, the potential for unintended consequences of impacting fully functioning and high quality wetlands should be somewhat reduced.
- The potential to improve nutrient and sediment function of wetland should not overlook or take priority over other functions provided by the wetland; tradeoffs of functions should generally be avoided. Mindful consideration and evaluation by wetland professionals/practitioners is needed
- The location of management actions to implement wetland BMPs should be targeted where the need for water quality may be most beneficial; areas of high pollutant loadings/export.
- Avoid double counting of wetlands created in the floodplain for water quality credit from the implementation of stream restoration projects that reconnect streams to the floodplain.
  - It is recommended that the acreage of wetland created from such stream restoration effort be tracked and reported to the relevant State agency, and subsequently the Chesapeake Bay Program as part of the Agreement Outcomes.

Illustration of how the term ‘efficiency’ - *the difference in the output loads pre- and post-treatment*

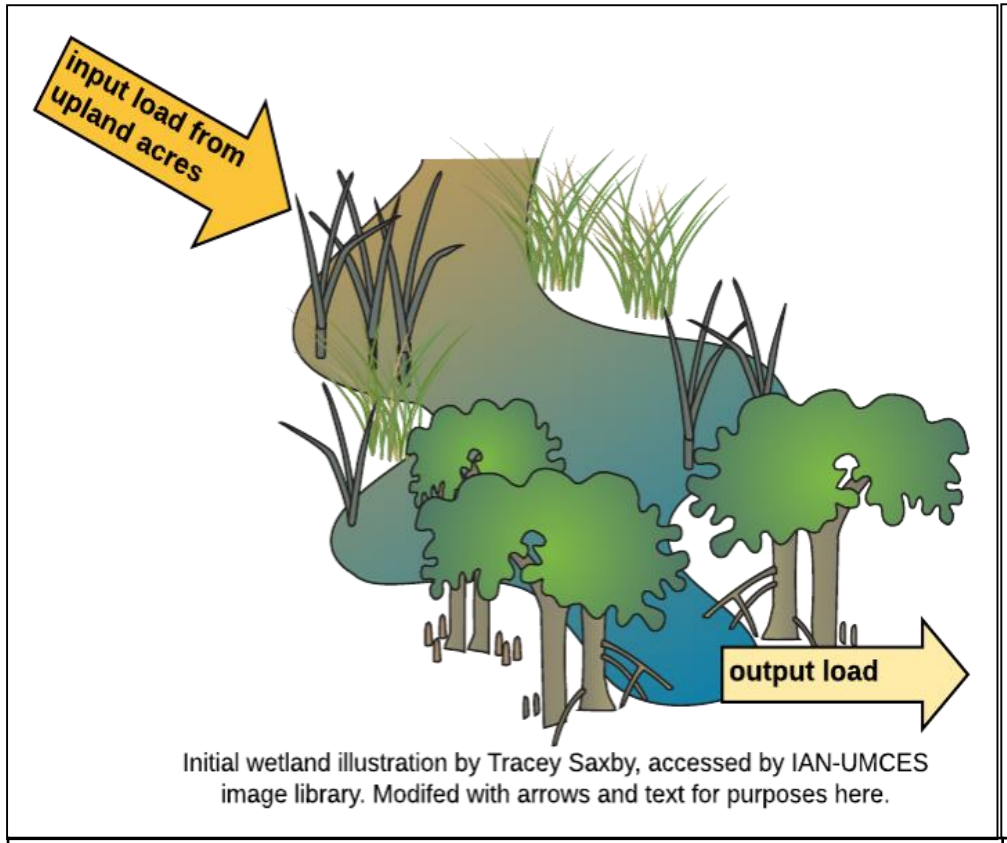


Figure D-1. Baseline or pre-treatment condition, with wetland present but conditions are degraded.

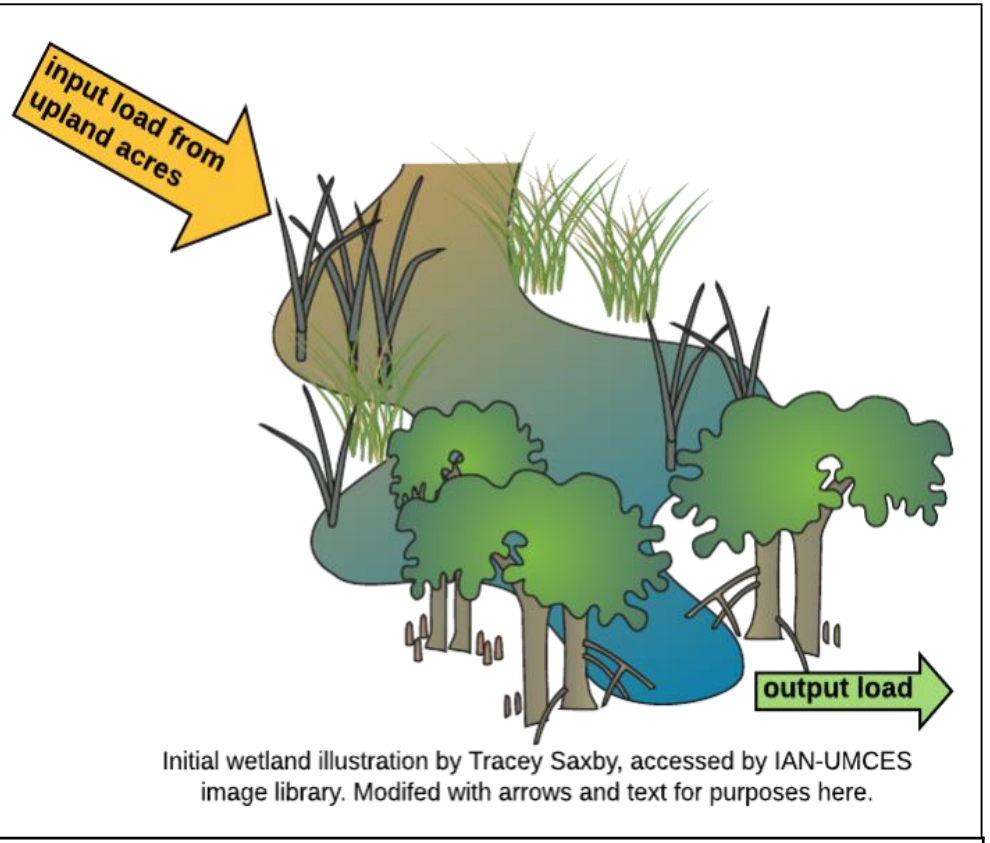


Figure D-2. Post-treatment, or desired outcome for a degraded wetland to repair functions to natural or historic functions (e.g. rehabilitated).

Pollutant Removal Efficiencies for Wetland Creation and Rehabilitation

- Panel consideration of the results from the literature review, expert elicitation survey and Riparia database analysis provide the following pollutant removal efficiencies (Table 11 in report)

Wetland BMP Type	TN (%)	TP (%)	TSS (%)
Restoration[1]	42	40	31
Creation	30	33	27
Rehabilitation	16	22	19
Enhancement	Not recommended		

[1] The wetland restoration efficiencies are provided for reference and the values are from WEP (2016).

Upland Treated Acres

- Recommend to report the drainage area of the wetland BMP as part of the water quality benefit (credit).
- If a drainage area for the wetland creation or rehabilitation BMP is not reported to the State agency, a default ratio will be applied for reporting to the Chesapeake Bay Program.
  - A default 1:1 ratio will be applied to non-floodplain wetland creation and rehabilitation BMPs
  - A default 1.5:1 ratio for floodplain wetland creation and rehabilitation BMPs in acknowledgement of the influence of landscape position (flatter topography, lower in drainage area) and hydrological connectivity to upland sources on retention efficiency of a wetland.
- The Panel further recommends an upper limit for reported upland acres treated of 4:1 for non-floodplain wetland creation and rehabilitation and 6:1 for these wetland BMPs in the floodplain, using the same ratios recommended for the restoration BMP by WEP 2016.

Literature Review

Method 2

Literature Review – Key Findings

Average Retention Efficiencies (%) for Natural and Wetland BMPs from the Literature Review, (n= number of studies).

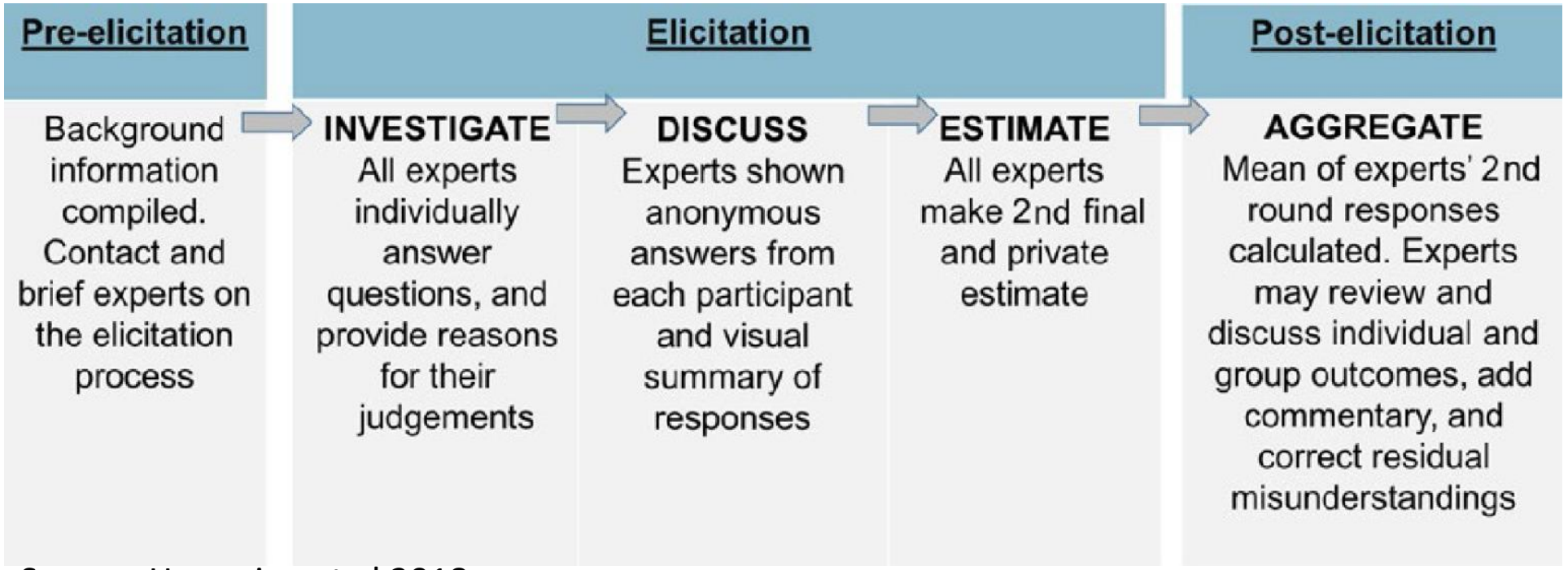
Wetland Type	TN % (n)	TP % (n)	TSS %(n)
Natural wetlands	45 (15)	42 (17)	n/a
Wetland BMPs	39 (21)	42 (46)	43 (12)
Existing Wetland Restoration Efficiency	42	40	31

Expert Elicitation

Method 3

An Expert Elicitation Approach

- Used when insufficient information available to evaluate specific topic of interest (see Hemming et al 2018, Spiers-Bridge et al 2010)
- Solicit expert judgement to quantify the relative, average annual efficiencies



Source: Hemming et al 2018

Results

- Provided a quantitative value for all 4 wetland BMP types
- "Loose" relative ranking generally consistent with Panel expectations for TN and TSS
  - Restoration and Creation provide greater retention benefits compared to Rehabilitation and Enhancement
- Panel members assumed wetland enhancement results in water quality benefits
- Wide range in individual responses attributed to uncertainty about baseline or pre-treatment conditions (i.e., retention efficiencies for degraded wetland conditions)

		Efficiency (%), expressed as a net improvement or "lift"		
Parameter	**BMP Type[1]**	**Mean (%)**	**COV[2]**	**Adapted Range[3] (%)**
TN	Restoration	32	0.48	0.9 – 57.6
	Creation	29.8	0.64	9.1 – 59.9
	Rehabilitation	21.0	0.55	-5.5 – 50.7
	Enhancement	17.5	0.85	-14.5 – 47.1
TP	Restoration	23.5	0.64	-11.0 – 49.0
	Creation	27.0	0.63	0.6 – 56.0
	Rehabilitation	22.8	0.50	-12.8 – 50.5
	Enhancement	25.6	0.80	-18.4 – 49.5
Sediment	Restoration	34.5	0.68	-3.6 – 49.0
	Creation	32.5	0.69	0.9 – 54.4
	Rehabilitation	20.8	0.63	-2.3 – 45.8
	Enhancement	17.3	0.93	-10.5 – 45.6

[1] The values for the wetland restoration BMP are the existing efficiencies as recommended by WEP(2016) and provided for context.

[2] COV is the coefficient of variation is used to describe the relative measure of variation amongst the individual responses

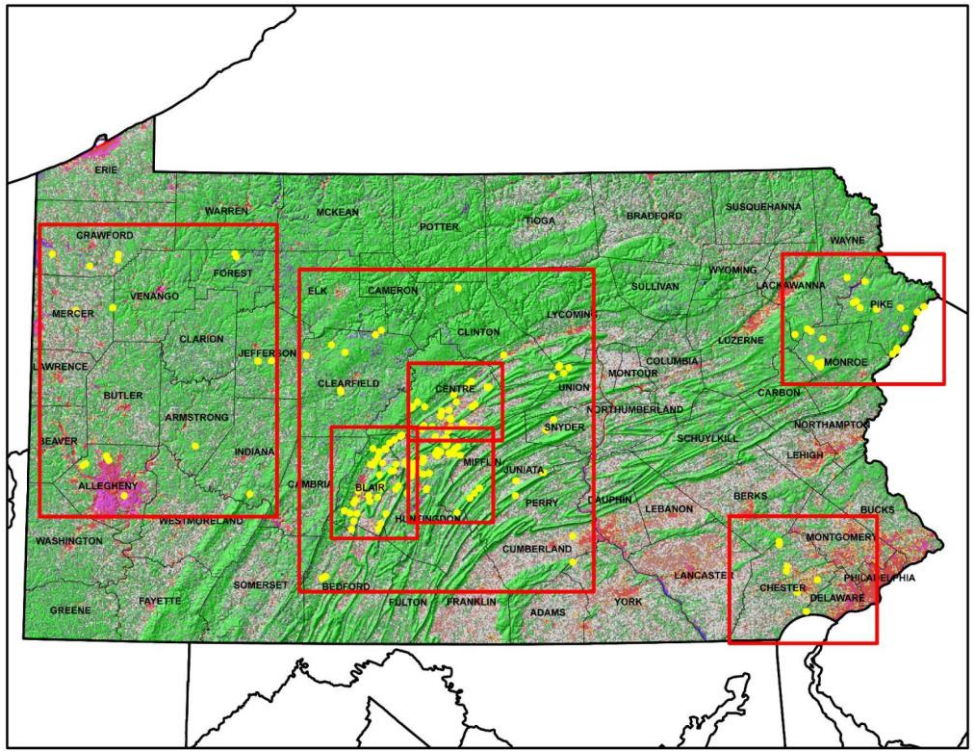
3 The adapted range takes into account the confidence associated with individual responses

Riparia Database Analysis

Method 4

Riparia Database Analysis - Method

- Riparia Reference Wetland Database (Riparia) includes 222 natural wetland sites surveyed across PA, including the Ridge & Valley and Piedmont regions (Brooks et al., 2016)
- Pennsylvania Created Wetlands Dataset includes 107 wetlands surveyed (Gebo and Brooks, 2012)
- The WEP2019 analysis focused on Riverine, Headwater and Isolated Depressions wetlands (HGM classification)
  - Used subset of data that described the water quality functions of wetlands
  - Efficiency values were calculated using the relative value or score from these databases along with literature review results.
  - Assumptions applied to approximate other wetland BMP types (i.e., restoration, rehabilitation)



Map image, Riparia website, 7/30/19: https://riparia.psu.edu/files/2018/04/cwc_pa_extent-17fqori.jpg

Riparia Database Analysis - Method

Mean Scores from the HGM Functional Assessment Models for Headwater Wetlands for Each Wetland Type

Wetland Type	Wetland BMP State Represented	Scores (Headwater Wetlands)		
		F5. Inorganic Nitrogen	F6. Solute Adsorption	F7. Inorganic Particulates
Reference	Post-BMP for Rehabilitation and Restoration	0.56	0.51	0.50
Created	Created	0.42	0.41	0.38
10th percentile for Reference Wetlands[1]	Pre-BMP Condition for Rehabilitation	0.41	0.24	0.24

[1] This value is estimated assuming a normal distribution, and the mean and standard deviation provided for each score.

Resulting BMP efficiencies for wetland restoration, creation and rehabilitation

Wetland BMP	TN (%)	TP (%)	TSS (%)
Creation	30	33	35
Rehabilitation	16	22	23

Comparison of all methods to quantify wetland BMP retention efficiencies

Basic Approach

$$E = E_{base} \times F$$

Where:

E	=	Efficiency for a particular wetland state and pollutant
E_{base}	=	"Base" efficiency represented as the mean value for wetland BMPs (from Table 2)
F	=	Factor used to scale the efficiency (derived from HGM Scores)

- F, a scaling factor is defined using the scores or values from the databases and multiplied by a retention efficiency from the literature review

As an example calculation, the scaling factor, (F) Ratio for Inorganic Nitrogen Retention for Created wetlands is calculated as:

$F_{F5\text{-}Created}$ = (F5 HGM Score for Created) /(F5 HGM Score for Reference)

= 0.42 /0.56

= 0.75

- The mean TN efficiency from the literature review for wetland BMPs is 39%

0.75 X 39

= 29.25% (use 30%)

Wetlands and the Phase 6 Model

Recommendations from the 2016 Wetlands Expert Panel and their implementation in the Phase 6 Model

First Wetland Expert Panel (WEP2016; convened 2014 to 2016)

- Full report approved December 2016
  - https://www.chesapeakebay.net/documents/Wetland_Expert_Panel_Report_WQGIT_approved_December_2016.pdf
- Two land uses for nontidal wetlands in Phase 6, lowest loading rates, equal to pristine Forest
  - Floodplain
  - Other
- Described four BMP categories:
  - Restoration
  - Creation*
  - Enhancement*
  - Rehabilitation*
- Defined reductions for Restoration BMP based on framework described in report; other 3 categories (*) required another panel

Summary of P6 Wetland Restoration BMP Function across the CB Watershed

	% Efficiency			Upland Acres Treated	
Physiographic Province	**TN**	**TP**	**TSS**	**Other Wetlands**	**Floodplain Wetlands**
Appalachian Plateau	**42**	**40**	**31**	**1**	**2**
Appalachian Ridge and Valley				**1**	**2**
Blue Ridge				**2**	**3**
Piedmont				**2**	**3**
Inner Coastal Plain				**4**	**6**
Outer Coastal Plain- Poorly Drained				**1**	**2**
Outer Coastal Plain- Well Drained				**2**	**3**
Coastal Plain Lowland				**2**	**3**
Karst Terrain				**2**	**3**

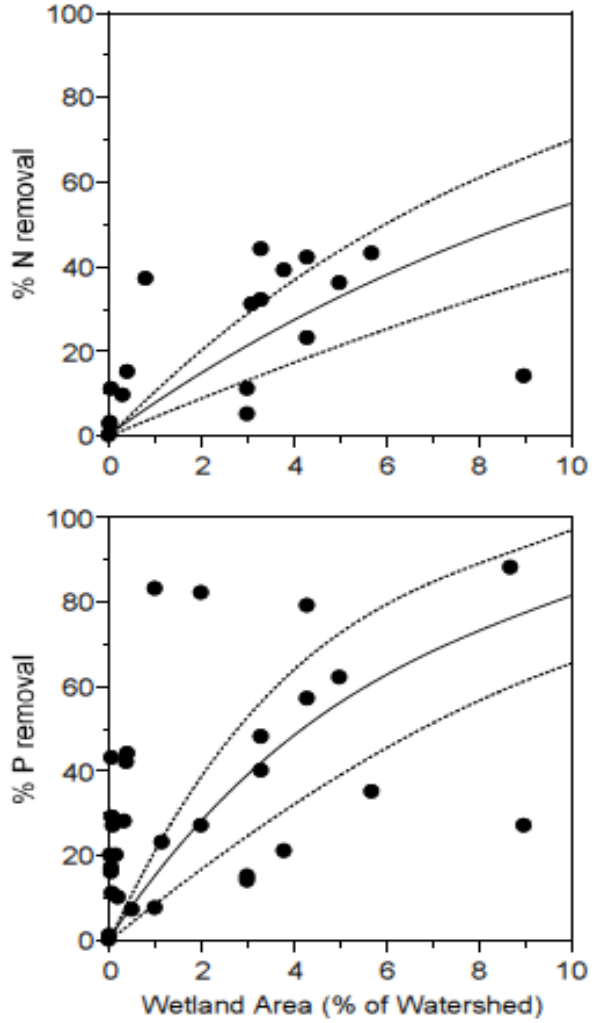
Efficiency values currently in Phase 6 CBWM

- Placeholder efficiencies were adopted for the Rehabilitation, Creation and Enhancement BMP categories in 2016. The efficiency rate was an average of the Phase 5.3.2 Watershed Model efficiency for "wetland restoration" BMP. Creation had additional reduction associated with land use change.

	TN removal (%)	TP removal (%)	TSS removal (%)	Upland acres treated per acre of BMP
Restoration	42	40	31	Varies by HGMR
Creation	**16.75**	**32.18**	**9.82**	**1**
Rehabilitation	**16.75**	**32.18**	**9.82**	**1**
Enhancement	**16.75**	**32.18**	**9.82**	**1**

Average from CBP5.3 retention efficiencies by region

Review of Wetland Retention Efficiencies: Phase 5 Wetland Restoration BMP



Geomorphic Province	TN Removal Efficiency	TP Removal Efficiency	TSS Removal Efficiency
Appalachian	7%	12%	4%
Piedmont and Valley	14%	26%	8%
Coastal Plain	25%	50%	15%
Average	16.75%	32.18%	9.82%

- Reduction efficiencies based on kinetic equation for TN and TP; fit to literature data. 15% rate set for sediment on CP, adjusted based on TP rate.
- 1%, 2% and 4% wetland area is assumed for each respective HGMR

Figure 2. Literature review data points for wetland nutrient removal efficiency based on the wetland area as a proportion of the watershed. (STAC 2008).

Comparison of WEP16 Adopted Efficiencies and Current WEP Recommendations

WEP2016, CBP Adopted Retention Efficiencies:

	TN removal (%)	TP removal (%)	TSS removal (%)	Upland acres treated per acre of BMP
Restoration	42	40	31	Varies by HGMR
Creation	**16.75**	**32.18**	**9.82**	**1**
Rehabilitation	**16.75**	**32.18**	**9.82**	**1**
Enhancement	**16.75**	**32.18**	**9.82**	**1**

WEP2019, Proposed Retention Efficiencies:

	TN removal (%)	TP removal (%)	TSS removal (%)	Upland acres treated per acre of BMP
Restoration	42	40	31	Varies by HGMR
Creation	**30**	**33**	**27**	**Report drainage area; if not, 1:1**
Rehabilitation	**16**	**22**	**19**	**Report drainage area; if not, 1:1**
Enhancement	**Not recommended**			