Stream Health Workgroup
Chesapeake Bay Program
Draft BMP Verification Protocols Narrative

- **Background narrative on source sector/habitat and importance of verification specific to this source sector/habitat**

  To successfully restore stream, it is necessary to understand stream functions and how these different functions work together and which restoration techniques influence a given function. It is also imperative to understand that stream functions generally occur in a certain order, a functional hierarchy. If this hierarchy/framework is understood, it is easier to establish project goals. And with clearer goals, it is easier to design projects and evaluate their success.

- **Description of existing BMP verification/inspection programs already in place and being built on**

  For years, stream restoration practitioners have struggled with how to effectively monitor projects and determine success. A large number of agencies/jurisdictions within the Chesapeake Bay watershed have developed and conducted a variety of stream restoration monitoring methodologies. However, there is a lack of consistency and appropriate level of detail of what is monitored, and how the success of the project is determined and related back to project goal and objectives.

- **Overview description of recommended verification protocol(s) and the underlying logic behind taking this approach to verification**

  USFWS and EPA collaborated in the development of the "A Function-based Framework for Stream Assessment and Restoration Projects." The framework provides an approach that organizes stream functions in a hierarchical order that can be used in goal setting, stream assessment methodologies and stream restoration to address functions, in a specific order. This helps the practitioner match the project goal with the corresponding stream functions to avoid the problems where practitioners design ineffective projects because they ignore the underlying functions that support higher level functions. Through monitoring, these functions can then be used to determine the overall benefit of the stream restoration project by comparing the baseline functional value to the post restoration value, i.e., the functional lift.

- **Description of the process the workgroup followed in the development of their protocol(s)**

  The Stream Health Workgroup is currently undergoing reorganization with new co-chairs, assembling current members, and recruiting additional members. The workgroup co-chairs consulted with other GIT team members and experts in the stream restoration field to determine existing BMP protocols.

  The workgroup co-chairs selected an existing protocol, "A Function-based Framework for Stream Assessment and Restoration Projects", for their BMP verification. This tool was developed in 2012 as collaborative effort between the USFWS and EPA.

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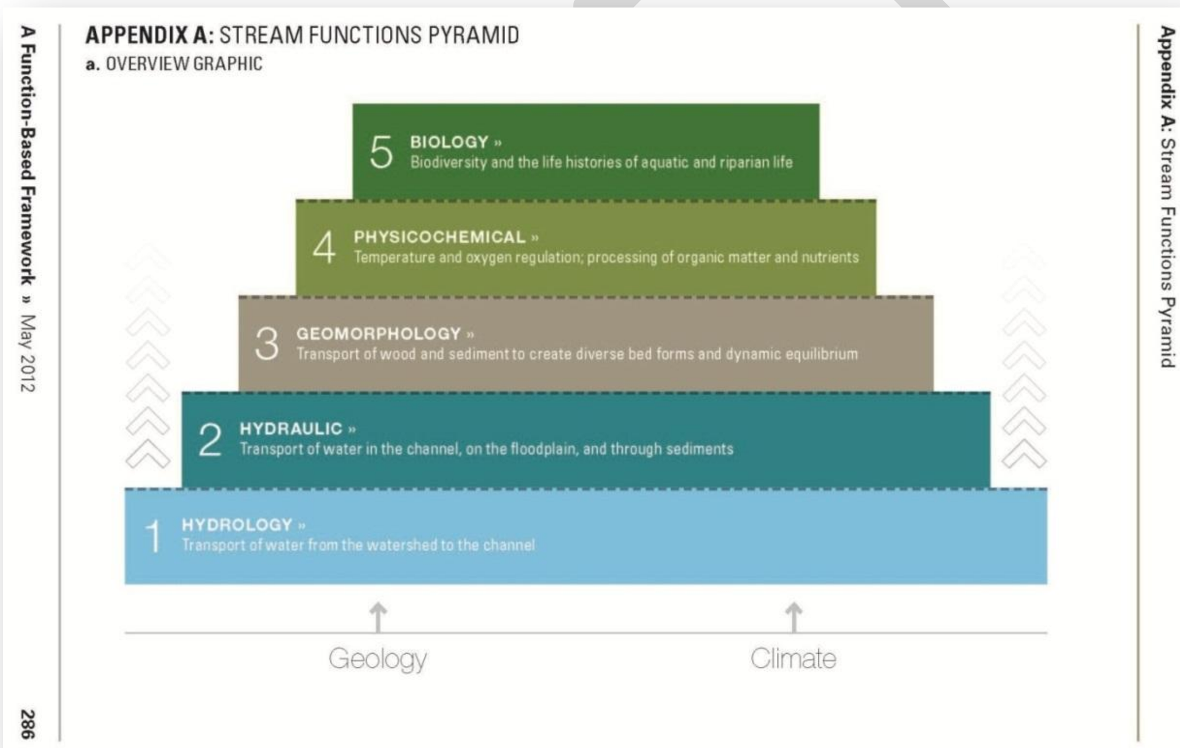
- **Detailed description of the verification protocol(s) and how the jurisdictions would implement the recommended protocol(s)**

Detailed Description
The Stream Functions Framework consists of four components that increase in detail. First, the broad-level view shows the five functional categories (starting from bottom to top) with underlying controlling variables of geology and climate:

1. Hydrology: transport of water from the watershed to the channel
2. Hydraulics: transport of water in the channel, on the floodplain, and through sediments
3. Geomorphology: transport of wood and sediment to create diverse bed forms and dynamic equilibrium
4. Physicochemical: temperature and oxygen regulation; processing of organic matter and nutrients
5. Biology: biodiversity and the life histories of aquatic and riparian life



Second, function-based parameters are provided for each functional category. For example Floodplain Connectivity is one possible parameter under the Hydraulics Functional Category.

APPENDIX A.c. Parameters and Measurement Methods

HYDROLOGY	
Parameter	**Measurement Method**
Channel-Forming Discharge	1. Regional Curves
Precipitation/Runoff Relationship	1. Rational Method 2. HEC-HMS 3. USGS Regional Regression Equations
Flood Frequency	1. Bulletin 17b
Flow Duration	1. Flow Duration Curve 2. Crest Gage 3. Monitoring Devices 4. Rapid Indicators
HYDRAULICS	
Parameter	**Measurement Method**
Floodplain Connectivity	1. Bank Height Ratio 2. Entrenchment Ratio 3. Stage Versus Discharge
Flow Dynamics	1. Stream Velocity 2. Shear Stress 3. Stream Power
Groundwater/Surface Water Exchange	1. Piezometers 2. Tracers 3. Seepage Meters

Third, measurement methods are provided for each function-based parameter. Under Floodplain Connectivity bank height ratio, entrenchment ratio, and stage versus discharge all potential measurement methods.

And fourth, where possible, performance standards are provided for the measurement methods. They are divided into three categories; Functioning, Functioning-At-Risk, and Not Functioning. For example, a bank height ratio of 1.1 would fall in the functioning category.

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Performance Standards
Floodplain Connectivity Example

Measurement Method	Functioning	Functioning-At-Risk	Not Functioning
Bank Height Ratio (BHR)	1.0 to 1.2	1.3 to 1.5	> 1.5
Entrenchment Ratio (ER) for C and E Stream Types	> 2.2	2.0 to 2.2	< 2.0
Entrenchment Ratio (ER) for B and Bc Stream Types	> 1.4	1.2 to 1.4	< 1.2
Dimensionless rating curve	Project site Q/Q_{bkf} plots on the curve	Project site Q/Q_{bkf} plots above the curve	Project site Q/Q_{bkf} of 2.0 plots above 1.6 for $d/_{dbkf}$

Table 11.1 below shows an example of the pre-restoration condition and post-restoration condition for a stream restoration project. The table allows the designers to easily show what the potential functional of a project is at the beginning of a project and to measure success after implementation

TABLE 11.1 FUNCTIONAL LIFT DETERMINATION

LEVEL AND CATEGORY	PARAMETER	MEASUREMENT METHOD	PRE-RESTORATION CONDITION		POST-RESTORATION CONDITION	
			VALUE	RATING	VALUE	RATING
1 – Hydrology	Channel-Forming Discharge	Regional Curves	200 cfs	N/A	200 cfs	N/A Used as an input parameter for Level 2 and 3
2 – Hydraulics	Floodplain Connectivity	Bank Height Ratio	3.0	Not Functioning	1.0	Functioning
		Entrenchment Ratio	1.1	Not Functioning	3.0	Functioning
3 – Geomorphology	Bed Form diversity	Pool-to-pool spacing	> 7	Not Functioning	4 to 5	Functioning
	Channel Evolution	Simon	Stage 2 to 3	Not Functioning	Stage 6	Functioning
	Riparian Vegetation	RBP	Width is 12 meters with some human activity	Functioning-At-Risk	Width is > 18 meters and no human activity	Functioning
	Lateral Stability	BEHI/NBS	High/High	Not Functioning	Low/Low	Functioning
4 – Physicochemical	Water quality	Temperature	Higher than upstream reference reach; does not meet species requirements	Not Functioning	Same as upstream reach and meets species requirements	Functioning
5 – Biology	Macroinvertebrate Communities	Virginia Stream Condition Index	7	Not Functioning	4	Functioning

Implementation

The flexibility of the functional framework allows for a jurisdiction/agency to determine which and how many parameters to select to determine functional lift and monitor for project success. That makes this a very practical tool that could easily be used throughout the watershed to determine success of a project. It also will work with any method of stream restoration (i.e. valley restoration, natural channel design, regenerative design, etc.).

- **Include any applicable matrices/tables illustrating detailed protocols applicable to individual practices or groups of related practices**

  Detailed information on the Stream Functions Framework can be accessed here: http://water.epa.gov/lawsregs/guidance/wetlands/upload/A_Function-Based_Framework.pdf.

  Chapter Four describes the framework in detail and Chapter Eleven outlines potential applications of the framework.

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