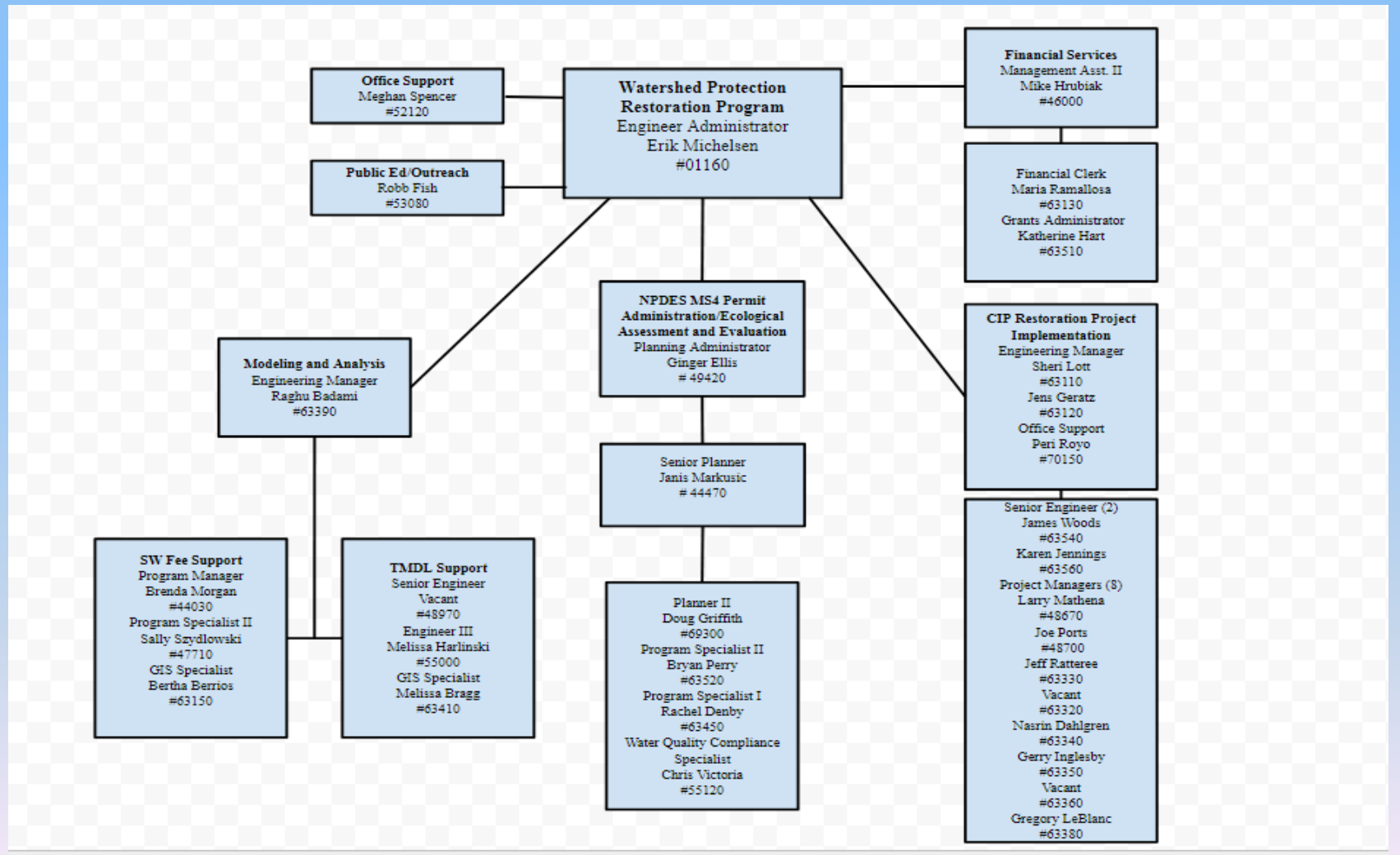
Crediting Protocols and Data Requirements for Restoration Projects in Anne Arundel County

Anne Arundel County WATERSHED Protection & Restoration PROGRAM

Modeling and Analysis Unit, WPRP
July 16, 2018

WPRP Org Chart



Why do we need the data?

- 20% Imp Restoration Goal
- Chesapeake Bay TMDL
- Local watershed TMDLs
- Project Documentation, MOU, etc.
- BMP database – Inspections and verification

Nutrition Facts
Serving Size 1 tsp. (0.5g)
Servings Per Container 550

Amount Per Serving

Calories 0

	% Daily Value*
Total Fat 0g	**0%**
Sodium 0mg	**0%**
Total Carbohydrate less than 1g	**0%**
Protein 0g	

Not a significant source of calories from fat, saturated fat, trans fat, cholesterol, dietary fiber, sugars, vitamin A, vitamin C, calcium and iron.

*Percent Daily Values are based on a 2,000 calorie diet.

INGREDIENTS: Maltodextrin, Sucralose.

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Project Reporting

- Fiscal year cycle
- Report a project to claim credit
- GIS Coverages
- Drainage area maps
- Design, Under Construction and Complete
- Metrics - BMP Table, Stream form, Shoreline
- Small projects – not to make it onerous
- Collaborative effort

<u>Take home: 1. BMP metrics 2. Plans, reports 3. GIS files (if available)</u>

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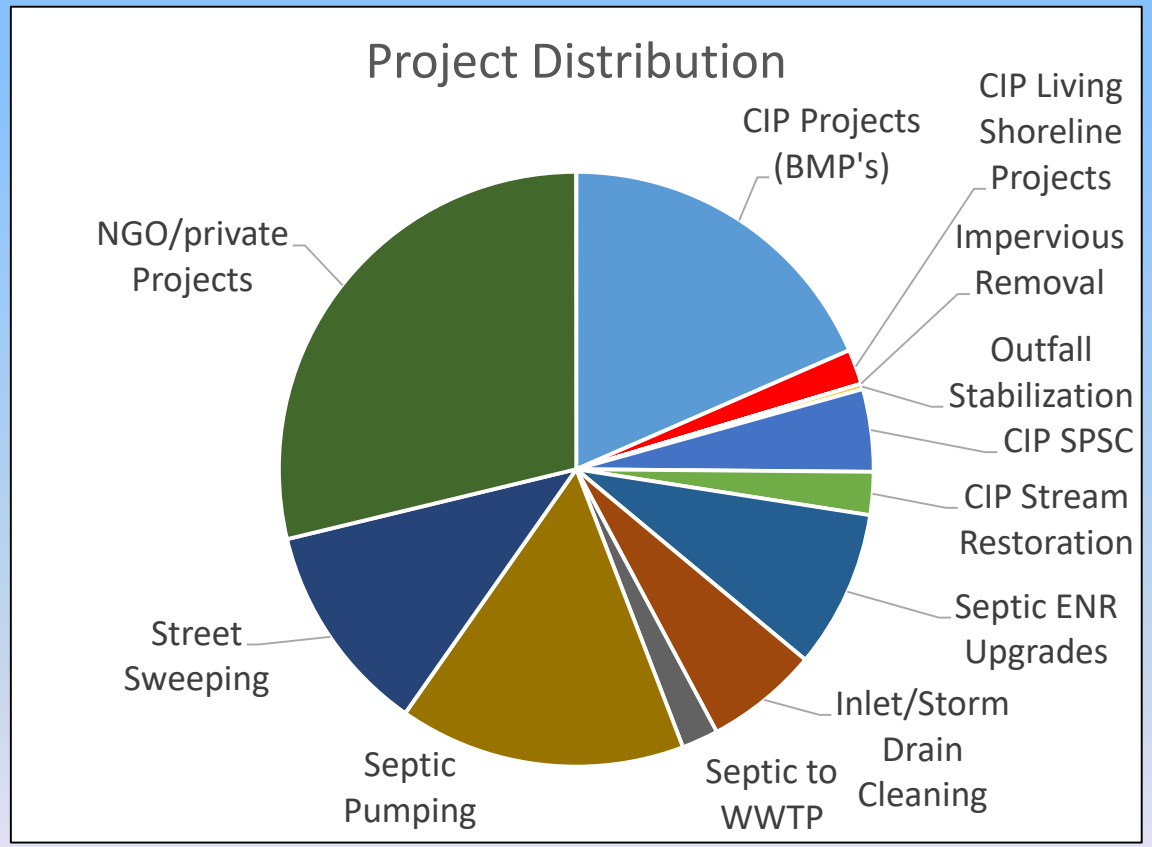
Toolbox



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BMP Class

- S- Structural (ponds, basins, etc)
- *A- Alternative (Stream, Shoreline, etc)
- E- ESD (runoff reduction)

Table 5. Classification of BMPs Used in Maryland[1]

Runoff Reduction (RR) Practices	Stormwater Treatment (ST) Practices
All ESD Practices in Manual[2]: • Alternative Surfaces • Nonstructural Practices • Micro-Scale Practices	Structural Practices in Manual[2] • Wet Ponds • Wetlands • Filtering Practices (ex. Bioretention) • Wet Swales
Structural Practices in Manual[2]: • Infiltration Practices • Bioretention Filters • Dry Swales	

Structural BMPs		
Ponds (P)		
S	PWED	Extended Detention Structure, Wet
S	PWET	Retention Pond (Wet Pond)
S	PMPS	Multiple Pond System
S	PPKT	Pocket Pond
S	PMED	Micropool Extended Detention Pond
Wetlands (W)		
S	WSHW	Shallow Marsh
S	WEDW	ED – Wetland
S	WPWS	Wet Pond – Wetland
S	WPKT	Pocket Wetland
Infiltration (I)		
S	IBAS	Infiltration Basin
S	ITRN	Infiltration Trench
Filtering Systems (F)		
S	FBIO	Bioretention
S	FSND	Sand Filter
S	FUND	Underground Filter
S	FPER	Perimeter (Sand) Filter
S	FORG	Organic Filter (Peat Filter)
S	FBIO	Bioretention
Open Channels (O)		
S	ODSW	Dry Swale
S	OWSW	Wet Swale

From: *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated, Guidance for National Pollutant Discharge Elimination System Stormwater Permits*, MDE, August 2014

*Credits for "A" are calculated based on approved protocols

BMP data Forms– BMP, Stream, Shoreline, etc.

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Credits

Restoration BMPs

- Impervious Area Equivalent = Runoff Depth Treated × Impervious Area

Shoreline Stabilization

- Impervious Area Equivalent = Length of Stabilization (feet) × 0.04

Stream Restoration

- Impervious Area Equivalent = Length of Restoration (feet) × 0.01

Impervious Removal (impervious to grass)

- Impervious Area Equivalent = Impervious Area Removed (acres) × 0.75

Outfall Stabilization (max 200 feet)

- Impervious Area Equivalent = Length of Stabilization (feet) × 0.01

Nutrient and TMDL Credits

- Approved Expert Panels/MDE Guidance

<u>Protocols and BEHI (if applicable) information always required</u>

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BMP Table

7. A completed drainage area data table for each standard Best Management Practice (BMP) (with exception of Living Shoreline and Stream Restoration practices):

MDE Classification of Practice and BMP Code (ESD, Runoff Reduction, Structural, or Alternative)	
Total Drainage Area (in acres):	
Total Impervious Coverage within Drainage Area (in acres):	
Total Forested Coverage within Drainage Area (in acres):	
Total Open Space (permeable surface) within Drainage Area (in acres):	
Volume of Water Captured by BMP (in cubic feet):	
Surface Area of BMP (in square feet):	
Storm Event Treated by BMP (in inches):	

**The above drainage table is not needed for living shoreline or stream restoration projects. Contact the Trust for a stream restoration or shoreline data table that will help with calculations required below.*

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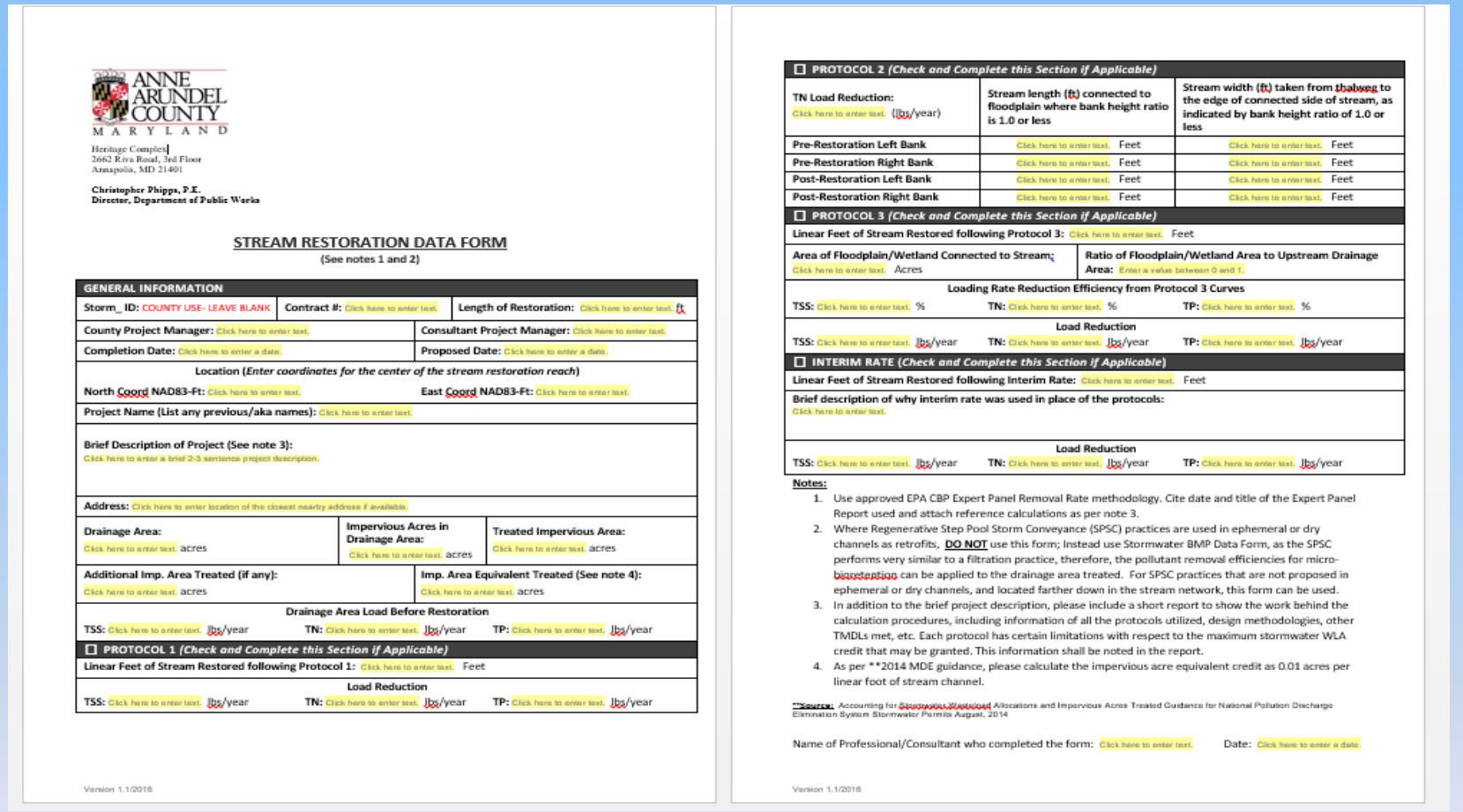
Each BMP information should be provided separately

Stream Data Form



ANNE ARUNDEL COUNTY MARYLAND

Heritage Complex
2662 Riva Road, 3rd Floor
Annapolis, MD 21401

Christopher Phipps, P.E.
Director, Department of Public Works

STREAM RESTORATION DATA FORM

(See notes 1 and 2)

GENERAL INFORMATION		
Storm_ID: COUNTY USE- LEAVE BLANK	**Contract #:** Click here to enter text.	**Length of Restoration:** Click here to enter text. ft
County Project Manager: Click here to enter text.	**Consultant Project Manager:** Click here to enter text.	
Completion Date: Click here to enter a date.	**Proposed Date:** Click here to enter a date.	

Location (*Enter coordinates for the center of the stream restoration reach*)

North Coord NAD83-Ft: Click here to enter text. **East Coord NAD83-Ft:** Click here to enter text.

Project Name (List any previous/aka names): Click here to enter text.

Brief Description of Project (See note 3):
Click here to enter a brief 2-3 sentence project description.

Address: Click here to enter location of the closest nearby address if available.

Drainage Area: Click here to enter text. acres	**Impervious Acres in Drainage Area:** Click here to enter text. acres	**Treated Impervious Area:** Click here to enter text. acres
Additional Imp. Area Treated (if any): Click here to enter text. acres	**Imp. Area Equivalent Treated (See note 4):** Click here to enter text. acres	

Drainage Area Load Before Restoration

TSS: Click here to enter text. lbs/year **TN:** Click here to enter text. lbs/year **TP:** Click here to enter text. lbs/year

☐ **PROTOCOL 1 *(Check and Complete this Section if Applicable)***

Linear Feet of Stream Restored following Protocol 1: Click here to enter text. Feet

Load Reduction

TSS: Click here to enter text. lbs/year **TN:** Click here to enter text. lbs/year **TP:** Click here to enter text. lbs/year

Version 1.1/2016

☐ **PROTOCOL 2 *(Check and Complete this Section if Applicable)***

TN Load Reduction: Click here to enter text. (lbs/year)	**Stream length (ft) connected to floodplain where bank height ratio is 1.0 or less**	**Stream width (ft) taken from thalweg to the edge of connected side of stream, as indicated by bank height ratio of 1.0 or less**
Pre-Restoration Left Bank	Click here to enter text. Feet	Click here to enter text. Feet
Pre-Restoration Right Bank	Click here to enter text. Feet	Click here to enter text. Feet
Post-Restoration Left Bank	Click here to enter text. Feet	Click here to enter text. Feet
Post-Restoration Right Bank	Click here to enter text. Feet	Click here to enter text. Feet

☐ **PROTOCOL 3 *(Check and Complete this Section if Applicable)***

Linear Feet of Stream Restored following Protocol 3: Click here to enter text. Feet

Area of Floodplain/Wetland Connected to Stream: Click here to enter text. Acres	**Ratio of Floodplain/Wetland Area to Upstream Drainage Area:** Enter a value between 0 and 1.

Loading Rate Reduction Efficiency from Protocol 3 Curves

TSS: Click here to enter text. % **TN:** Click here to enter text. % **TP:** Click here to enter text. %

Load Reduction

TSS: Click here to enter text. lbs/year **TN:** Click here to enter text. lbs/year **TP:** Click here to enter text. lbs/year

☐ **INTERIM RATE *(Check and Complete this Section if Applicable)***

Linear Feet of Stream Restored following Interim Rate: Click here to enter text. Feet

Brief description of why interim rate was used in place of the protocols:
Click here to enter text.

Load Reduction

TSS: Click here to enter text. lbs/year **TN:** Click here to enter text. lbs/year **TP:** Click here to enter text. lbs/year

Notes:

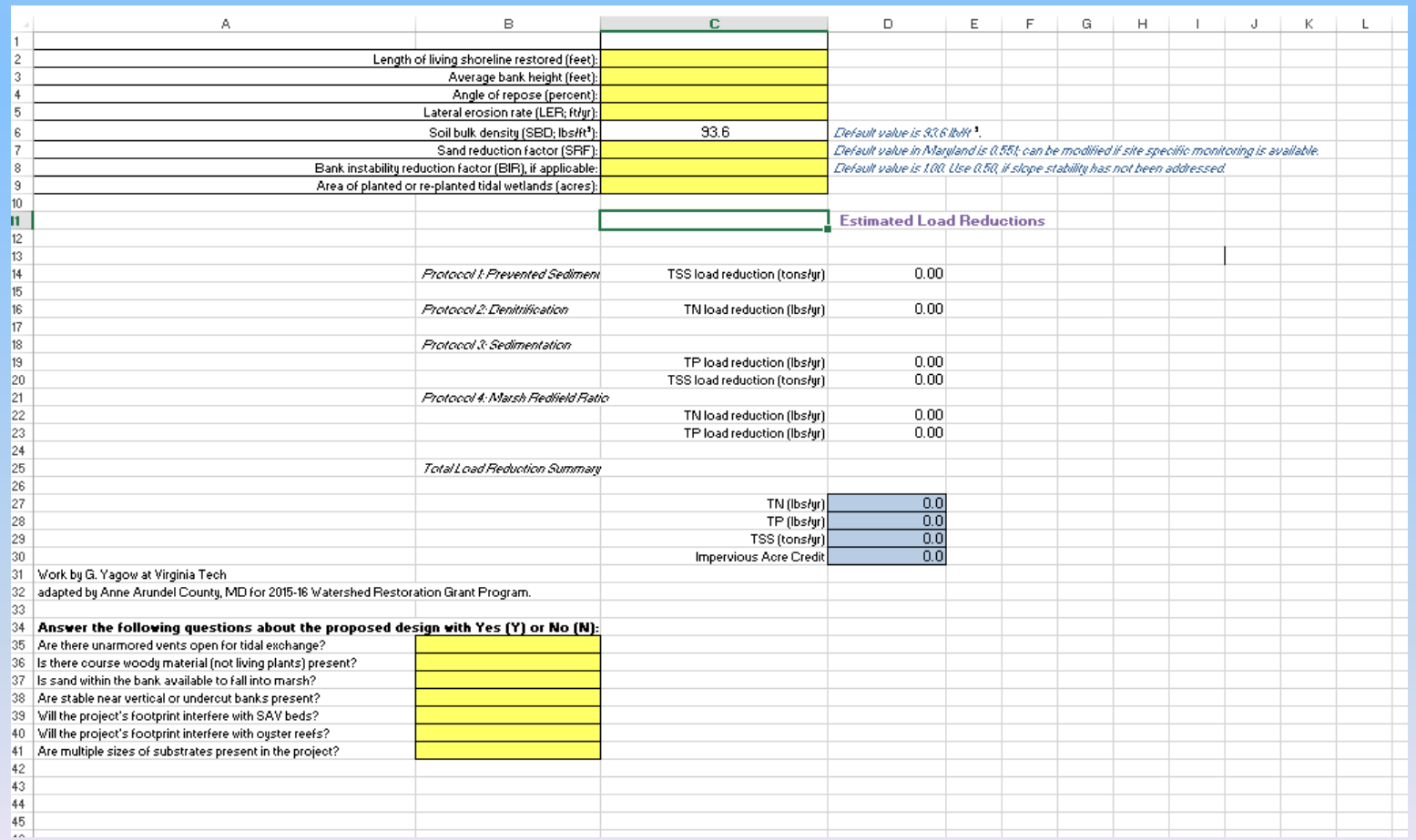
1. Use approved EPA CBP Expert Panel Removal Rate methodology. Cite date and title of the Expert Panel Report used and attach reference calculations as per note 3.
2. Where Regenerative Step Pool Storm Conveyance (SPSC) practices are used in ephemeral or dry channels as retrofits, **DO NOT** use this form; Instead use Stormwater BMP Data Form, as the SPSC performs very similar to a filtration practice, therefore, the pollutant removal efficiencies for micro-bioretention can be applied to the drainage area treated. For SPSC practices that are not proposed in ephemeral or dry channels, and located farther down in the stream network, this form can be used.
3. In addition to the brief project description, please include a short report to show the work behind the calculation procedures, including information of all the protocols utilized, design methodologies, other TMDLs met, etc. Each protocol has certain limitations with respect to the maximum stormwater WLA credit that may be granted. This information shall be noted in the report.
4. As per **2014 MDE guidance, please calculate the impervious acre equivalent credit as 0.01 acres per linear foot of stream channel.

Source: Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollution Discharge Elimination System Stormwater Permits August, 2014

Name of Professional/Consultant who completed the form: Click here to enter text. Date: Click here to enter a date.

Version 1.1/2016

Shoreline Reporting



		Length of living shoreline restored (feet):		
		Average bank height (feet):		
		Angle of repose (percent):		
		Lateral erosion rate (LER; ft/yr):		
		Soil bulk density (SBD; lbs/ft³):	93.6	*Default value is 93.6 lbs/ft³.*
		Sand reduction factor (SRF):		*Default value in Maryland is 0.55; can be modified if site specific monitoring is available.*
		Bank instability reduction factor (BIR), if applicable:		*Default value is 1.00. Use 0.50, if slope stability has not been addressed.*
		Area of planted or re-planted tidal wetlands (acres):		
				Estimated Load Reductions
	Protocol 1: Prevented Sediment	TSS load reduction (tons/yr)	0.00	
	Protocol 2: Denitrification	TN load reduction (lbs/yr)	0.00	
	Protocol 3: Sedimentation			
		TP load reduction (lbs/yr)	0.00	
		TSS load reduction (tons/yr)	0.00	
	Protocol 4: Marsh Redfield Ratio			
		TN load reduction (lbs/yr)	0.00	
		TP load reduction (lbs/yr)	0.00	
	Total Load Reduction Summary			
		TN (lbs/yr)	0.0	
		TP (lbs/yr)	0.0	
		TSS (tons/yr)	0.0	
		Impervious Acre Credit	0.0	

Work by G. Yagow at Virginia Tech
adapted by Anne Arundel County, MD for 2015-16 Watershed Restoration Grant Program.

Answer the following questions about the proposed design with Yes (Y) or No (N):

Are there unarmored vents open for tidal exchange?	
Is there course woody material (not living plants) present?	
Is sand within the bank available to fall into marsh?	
Are stable near vertical or undercut banks present?	
Will the project's footprint interfere with SAV beds?	
Will the project's footprint interfere with oyster reefs?	
Are multiple sizes of substrates present in the project?	

Stream Restoration Crediting Protocols

Basic Conditions to be Met

- ✓ Bank armoring and riprap to protect infrastructure do not count
- ✓ Reach > 100 feet
- ✓ Comprehensive approach to address long term stability
- ✓ Reconnection of floodplain encouraged

North Cypress Branch

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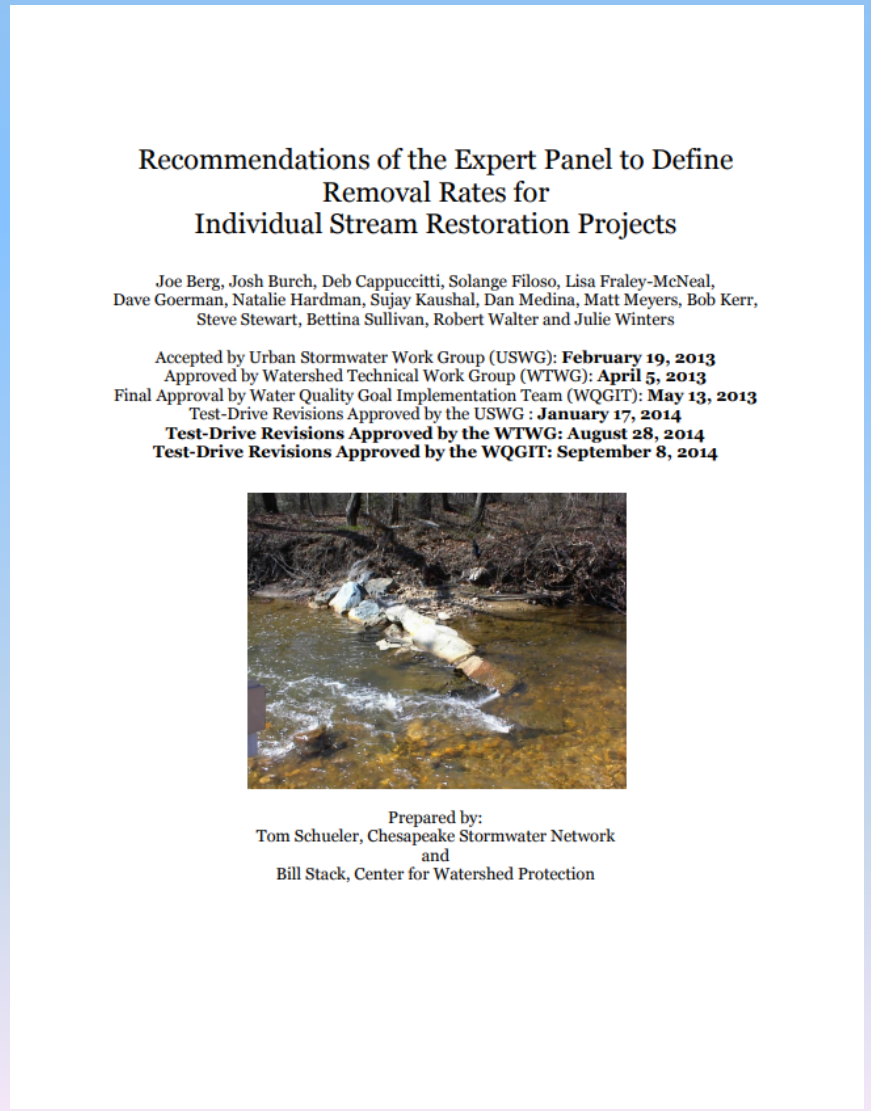
Stream Restoration Crediting Protocols

Four Protocols

- Intermittent & Perennial Channels
  - Protocol 1: Prevented Sediment**
  - Protocol 2: Instream Denitrification
  - Protocol 3: Floodplain Reconnection
- Ephemeral Channels
  - Protocol 4: Dry Channel RSC as a Retrofit*

*Combined Protocol 1 and 4 credits could be claimed

** Provide BEHI data



Recommendations of the Expert Panel to Define
Removal Rates for
Individual Stream Restoration Projects

Joe Berg, Josh Burch, Deb Cappuccitti, Solange Filoso, Lisa Fraley-McNeal,
Dave Goerman, Natalie Hardman, Sujay Kaushal, Dan Medina, Matt Meyers, Bob Kerr,
Steve Stewart, Bettina Sullivan, Robert Walter and Julie Winters

Accepted by Urban Stormwater Work Group (USWG): **February 19, 2013**
Approved by Watershed Technical Work Group (WTWG): **April 5, 2013**
Final Approval by Water Quality Goal Implementation Team (WQGIT): **May 13, 2013**
Test-Drive Revisions Approved by the USWG : **January 17, 2014**
Test-Drive Revisions Approved by the WTWG: August 28, 2014
Test-Drive Revisions Approved by the WQGIT: September 8, 2014

Prepared by:
Tom Schueler, Chesapeake Stormwater Network
and
Bill Stack, Center for Watershed Protection

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Regenerative Step Pool Storm Conveyance (SPSC)

Can be grouped in either category

- Intermittent & Perennial Streams
  - Stream Restoration Crediting Protocol 1,2,3**
- Ephemeral Channels
  - Stream Restoration Crediting Protocol 4*
    - Drainage Area
    - Impervious Area
    - WQv Provided
    - Runoff Depth Treated

*Combined Protocol 1 and 4 credits could be claimed

** Provide BEHI data

R

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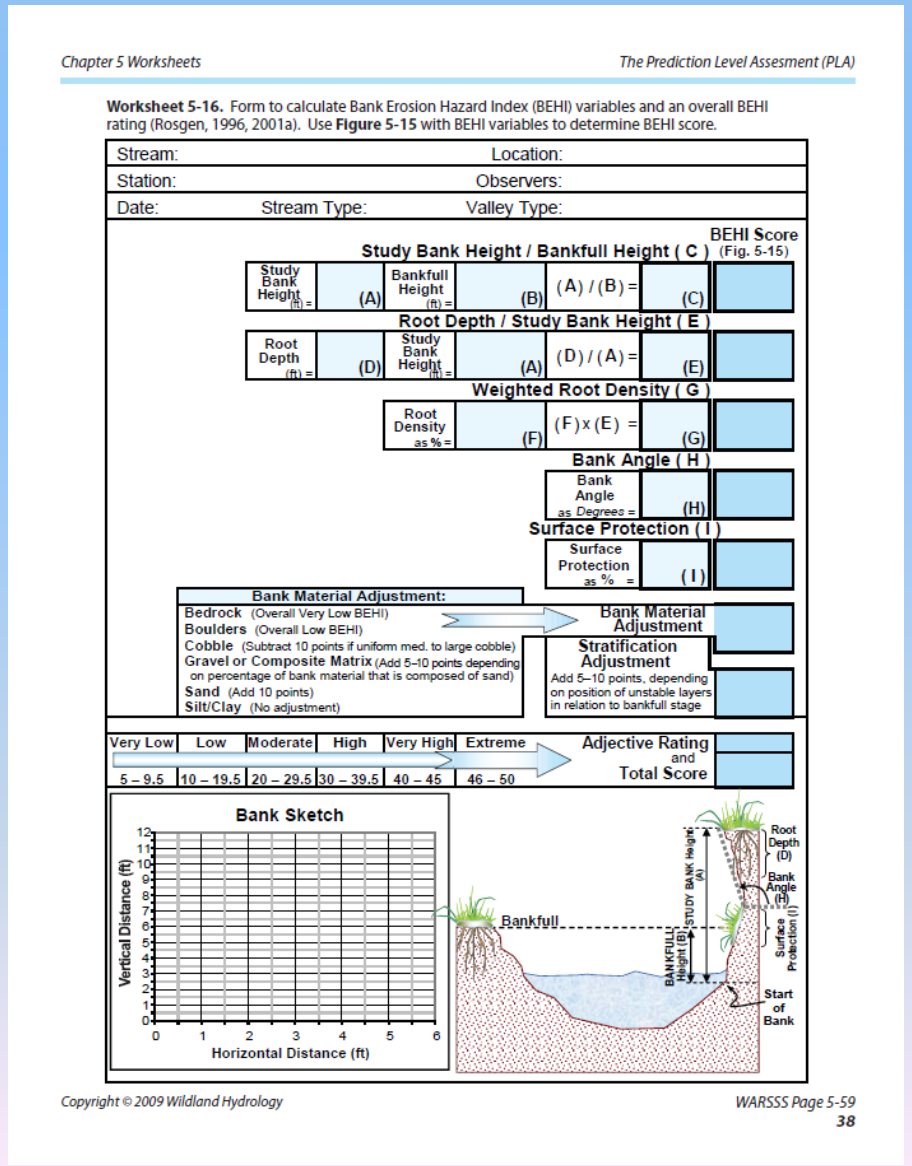
Protocol 1: Prevented Sediment

Gives Credit for projects that prevent bank and bed erosion

1. Estimate erosion rates and annual sediment loadings
   - Bank Erosion Hazard Index and Near Bank Stress Method combine to get sediment loadings (BANCS method)
2. Convert erosion rates to nitrogen and phosphorus loadings
   - 1.05 lbs P/ton
   - 2.28 lbs N/ton
3. Estimate reduction in loadings with restoration
   - 50% effective



Chapter 5 Worksheets — The Prediction Level Assesment (PLA)

Worksheet 5-16. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001a). Use **Figure 5-15** with BEHI variables to determine BEHI score.

Stream: Location:
Station: Observers:
Date: Stream Type: Valley Type:

BEHI Score (Fig. 5-15)

Study Bank Height / Bankfull Height (C)
Study Bank Height (ft) = (A) / Bankfull Height (ft) = (B) = (A) / (B) = (C)

Root Depth / Study Bank Height (E)
Root Depth (ft) = (D) / Study Bank Height (ft) = (A) = (D) / (A) = (E)

Weighted Root Density (G)
Root Density as % = (F) = (F) x (E) = (G)

Bank Angle (H)
Bank Angle as Degrees = (H)

Surface Protection (I)
Surface Protection as % = (I)

Bank Material Adjustment:
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform med. to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (No adjustment)

Bank Material Adjustment

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score

Bank Sketch

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Protocol 2: Instream and Riparian Nutrient Processing during Base Flow

Credit for projects that promote denitrification during base flow

1. Length of restored stream with bank height ratio 1.0 or less
2. Determine dimensions of box
3. Multiply hyporheic box mass by unit denitrification rate (1.06 X 10^{-4} lbs/ton/day)

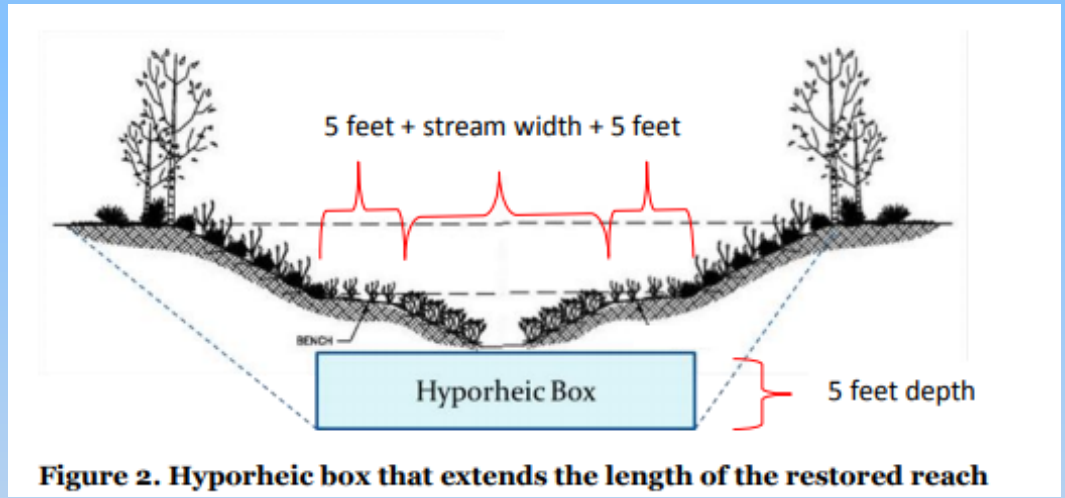

Figure 2. Hyporheic box that extends the length of the restored reach

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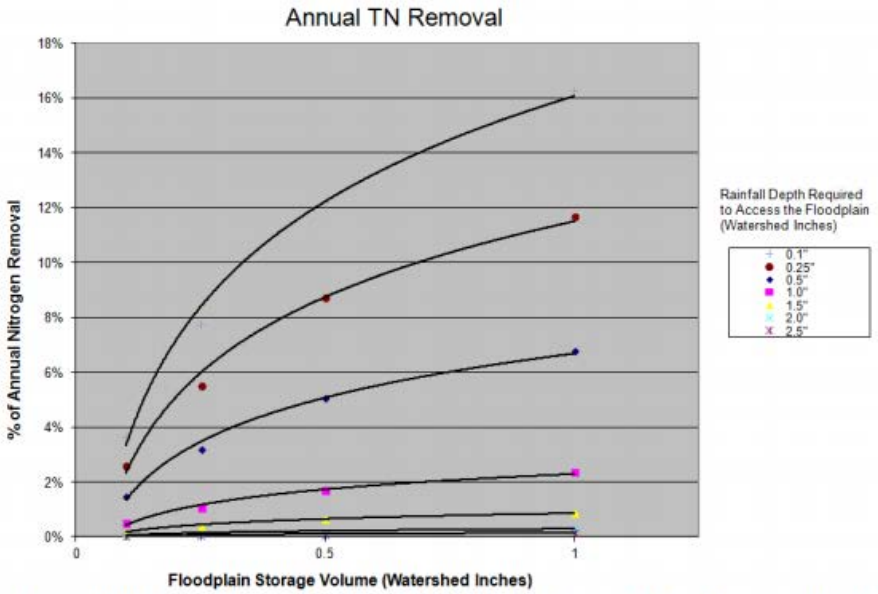
Protocol 3: Credit for Floodplain Reconnection Volume

Credit for projects that reconnect stream channels to their floodplain over a wide range of storm events

1. Estimate the floodplain connection volume
   - Survey of additional runoff that can be diverted from stream to floodplain during storm events
   - Detailed H&H modeling required
2. Estimate the nitrogen and phosphorus removal rate
3. Compute annual N, P, and TSS load delivered to project
4. Multiply pollutant load by removal rate to get reduction credit



3.

Figure 3. Annual TN removal as a function of floodplain storage volume for several rainfall thresholds that allow runoff to access the floodplain.

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Summary of Credits

Summary of Stream Restoration Credits for Individual Restoration Projects [1, 2]					
Protocol	*Name*	*Units*	*Pollutants*	*Method*	*Reduction Rate*
1	Prevented Sediment (S)	Pounds per year	Sediment TN, TP	Define bank retreat using BANCS or other method	Measured N/P content in streambed and bank sediment
2	Instream Denitrification (B)	Pounds per year	TN	Define hyporheic box for reach	Measured unit stream denitrification rate
3	Floodplain Reconnection (S/B)	Pounds per year	Sediment TN, TP	Use curves to define volume for reconnection storm event	Measured removal rates for floodplain wetland restoration projects
4	Dry Channel RSC as a Retrofit (S/B)	Removal rate	Sediment TN, TP	Determine stormwater treatment volume	Use adjustor curves from retrofit expert panel

[1] Depending on project design, more than one protocol may be applied to each project, and the load reductions are additive.
[2] Sediment load reductions are further reduced by a sediment delivery ratio in the CBWM (which is not used in local sediment TMDLs)
S: applies to stormflow conditions, B: applies to base flow or dry weather conditions

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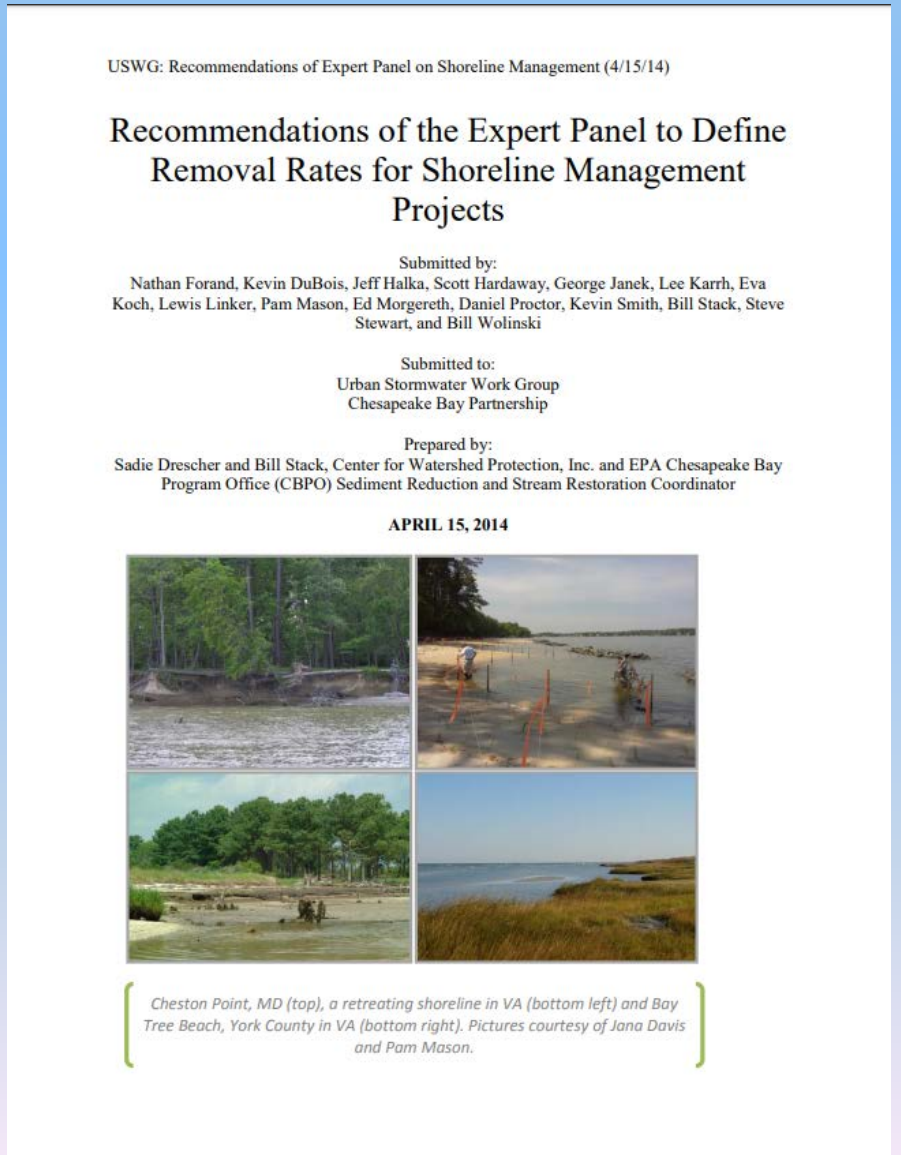
Shoreline Management Crediting Protocols

Basic Qualifying Conditions

- ✓ Preferred method is living shoreline (must prove why it can't be done)
- ✓ Active erosion
- ✓ Water quality benefit
- ✓ Consider shoreline habitat (existing and proposed marsh)



USWG: Recommendations of Expert Panel on Shoreline Management (4/15/14)

Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects

Submitted by:
Nathan Forand, Kevin DuBois, Jeff Halka, Scott Hardaway, George Janek, Lee Karrh, Eva Koch, Lewis Linker, Pam Mason, Ed Morgereth, Daniel Proctor, Kevin Smith, Bill Stack, Steve Stewart, and Bill Wolinski

Submitted to:
Urban Stormwater Work Group
Chesapeake Bay Partnership

Prepared by:
Sadie Drescher and Bill Stack, Center for Watershed Protection, Inc. and EPA Chesapeake Bay Program Office (CBPO) Sediment Reduction and Stream Restoration Coordinator

APRIL 15, 2014

Cheston Point, MD (top), a retreating shoreline in VA (bottom left) and Bay Tree Beach, York County in VA (bottom right). Pictures courtesy of Jana Davis and Pam Mason.

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Qualifying Conditions

Table 7. Criteria for Chesapeake Bay TMDL pollutant load reduction for shoreline management practices. These are the basic qualifying conditions.

Shoreline Management Practice	The Practice Must Meet these Criteria for TMDL Pollutant Load Reduction[1]
Living Shoreline – a) nonstructural; b) hybrid system including a sill; and c) hybrid system including a breakwater	1. The site is currently experiencing shoreline erosion or is replacing existing armor. The site was graded, vegetated, and excess sediment was removed or used.[2] AND 2. When a marsh fringe habitat (a or b) or beach/dune habitat (c) is created, enhanced, or maintained.
Revetment AND Breakwater system without a living shoreline	1. The site is currently experiencing shoreline erosion. The site was graded, vegetated, and excess sediment was removed or used.[2] AND 2. A living shoreline is not technically feasible or practicable as determined by substrate, depth, or other site constraints. AND 3. When the breakwater footprint would not cover SAV, shellfish beds, and/or wetlands.
Bulkhead/Seawalls	1. The site is currently experiencing shoreline erosion. AND 2. The site consists of port facilities, marine industrial facilities, or other marine commercial areas where immediate offshore depth (e.g., depths deeper than 10 feet 35 feet from shore) precludes living shoreline stabilization or the use of a breakwater or revetment.
[1]Projects that impact the Chesapeake Bay Preservation Act protected vegetation without mitigation receive no Chesapeake Bay TMDL pollutant load reduction. [2]Bank analysis that demonstrates the site has bank stability and does not have erosion can	

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Qualifying Conditions

Four Protocols

1. Prevented sediment
2. Denitrification
3. Sedimentation
4. Marsh Redfield Ratio

South River Farm Park

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Protocol 1: Prevented Sediment

Gives credit for projects that prevent bank erosion

1. Estimate shoreline erosion rate
   - Maryland Department of Natural Resources Coastal Atlas website, use *Shoreline Rates of Change* layer
2. Convert shoreline erosion to sediment load (equation V=LEB)
   - Volume of sediment (V) = Length of shoreline (L) X shoreline recession rate (E) X bank height (B)
   - Convert cubic feet to pounds using soil bulk density of 93.6 lb/ft^3, then convert to tons
3. Estimate shoreline restoration efficiency
   - 100% effective

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Protocol 2: Denitrification

Gives credit for projects that incorporate marsh planting areas

1. Determine the net increase in marsh plantings (in acres)
2. Multiply acres of marsh plantings x 85 lbs total Nitrogen/acre/year (denitrification rate)

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Protocol 3: Sedimentation

Gives credit for sediment trapping abilities of marsh plantings and sediment deposition behind structures

1. Determine the net increase in marsh plantings (acres)
2. Multiply acres of marsh planting by 6,959 lbs total suspended solids/acre/year (unit sedimentation value)
3. Total Phosphorus load removed = acres of marsh plantings X 5.29 lbs total phosphorus/acre/year

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Protocol 4: Marsh Redfield Ratio

Gives <u>one time credit</u> for first year based upon vegetative uptake of nutrients for marsh grass growth

1. Determine the net increase in marsh plantings (acres)
2. Multiply acres of marsh planting by unit marsh Redfield ratio value (6.83 lbs total nitrogen/acre and 0.3 lbs total phosphorus/acre.

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Shoreline Management Summary

Table 1. Summary of shoreline management pollutant load reduction for individual projects.

Protocol	*Name*	*Units*	*Pollutants*	*Reduction Rate*
1	Prevented Sediment	Pounds per year	Sediment TN, TP	• Measured TSS, TN and TP content in sediment prevented. • Calculated based on shoreline erosion with reductions for sand content and bank instability
2	Denitrification	Pounds per year	TN	• Measured TN removal for denitrification rate associated with vegetated area. • 85 lbs TN/acre/yr
3	Sedimentation	Pounds per year	Sediment and TP	• Measured TSS and TP removal rates associated with vegetated area. • 6,959 lbs TSS/acre/yr • 5.289 lbs TP/acre/yr
4	Marsh Redfield Ratio	Pounds	TN, TP	• Measured TN and TP removal rates associated with vegetated area. • Note that this is a one-time credit. • 205 lbs TN/acre • 9 lbs TP/acre

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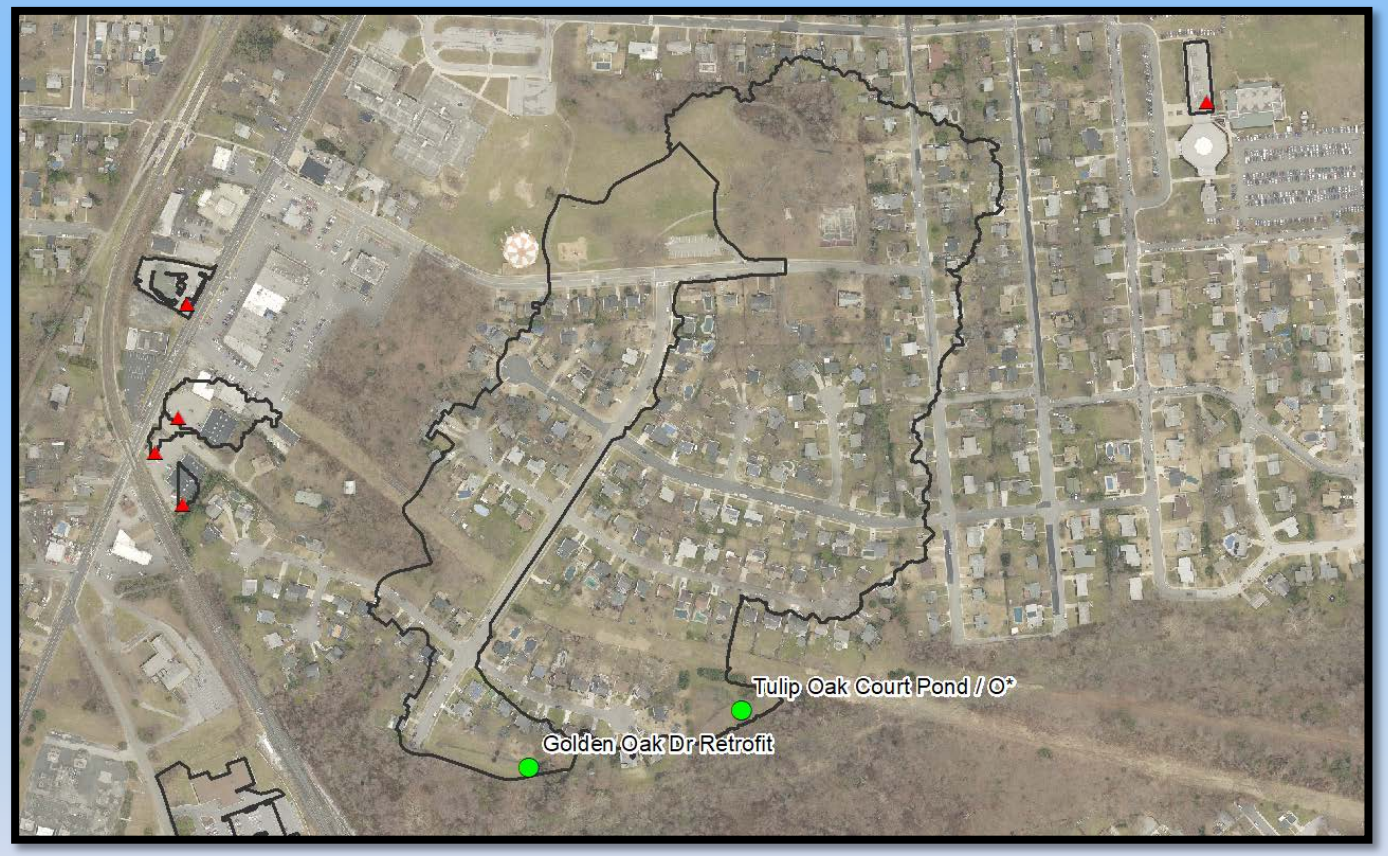
GIS Files

<u>What we need from you</u>

- Project location
- Line Feature
  - Stream Restoration, SPSCs, Outfall Stabilization
  - Represents the Linear Footage (LF) of the BMP
  - Also represents which Protocols are applied to which line segment
- Polygon Feature
  - All other Restoration BMPs
  - Represents the footprint of the restored BMP
- Drainage area



GIS coverage - Shapefile Instructions For NGOs Version 1.0

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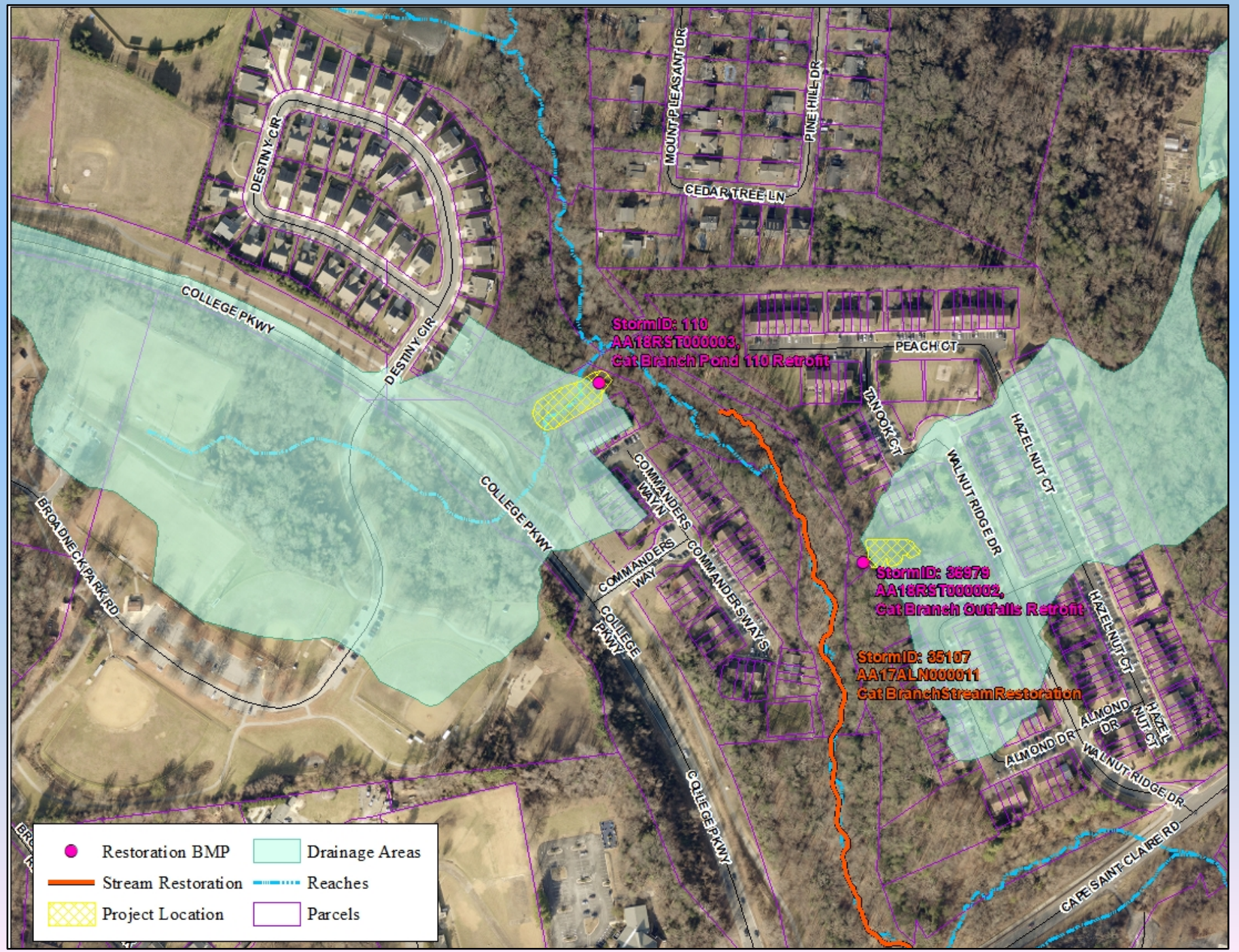
Example:

Project Location

- Polygon or Point
- Line

Drainage Area

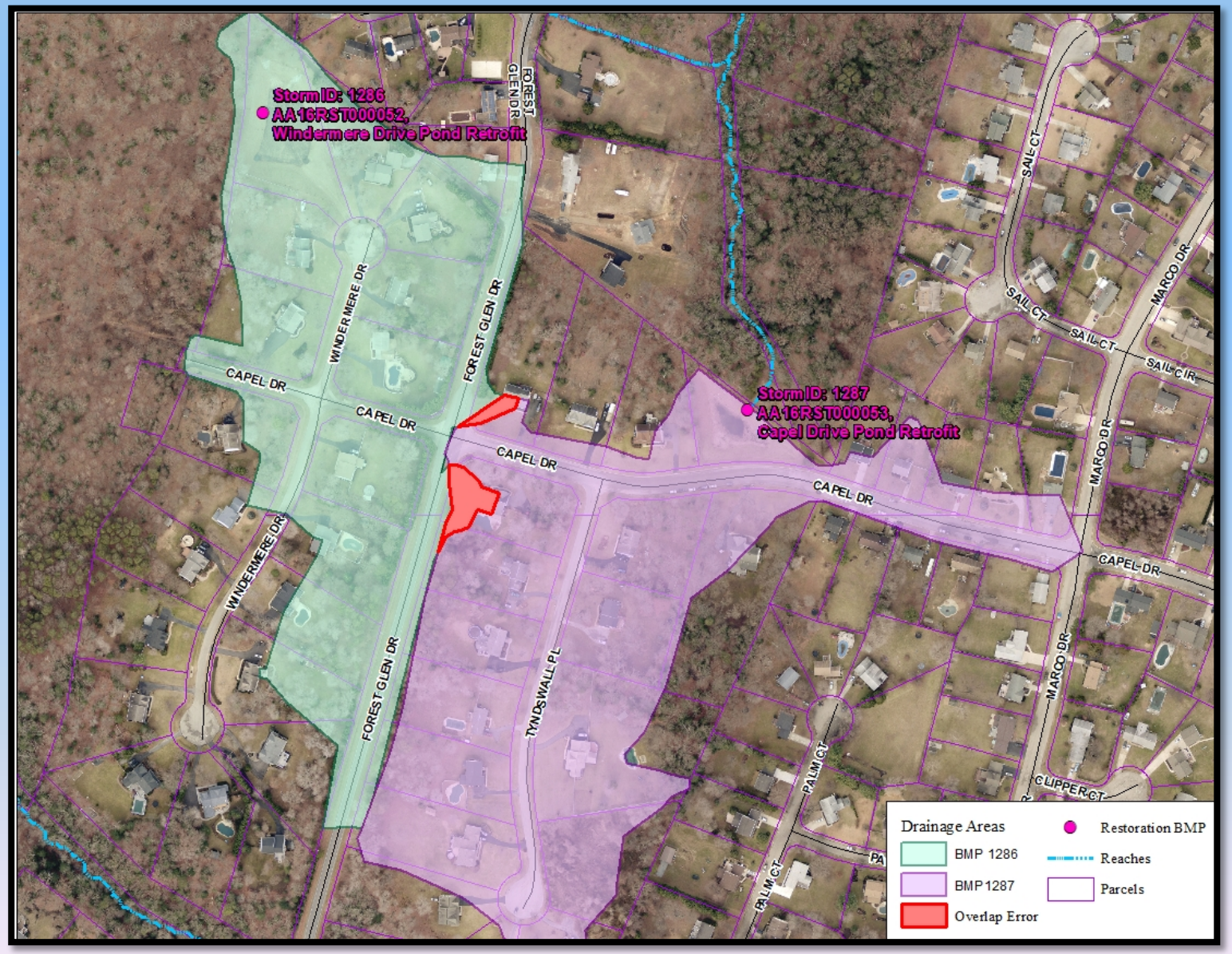


Anne Arundel County WATERSHED Protection & Restoration PROGRAM

GIS

QA/QC

- Drainage areas do not overlap
- Area of the polygon should equal the Drainage Area on the BMP Data Form



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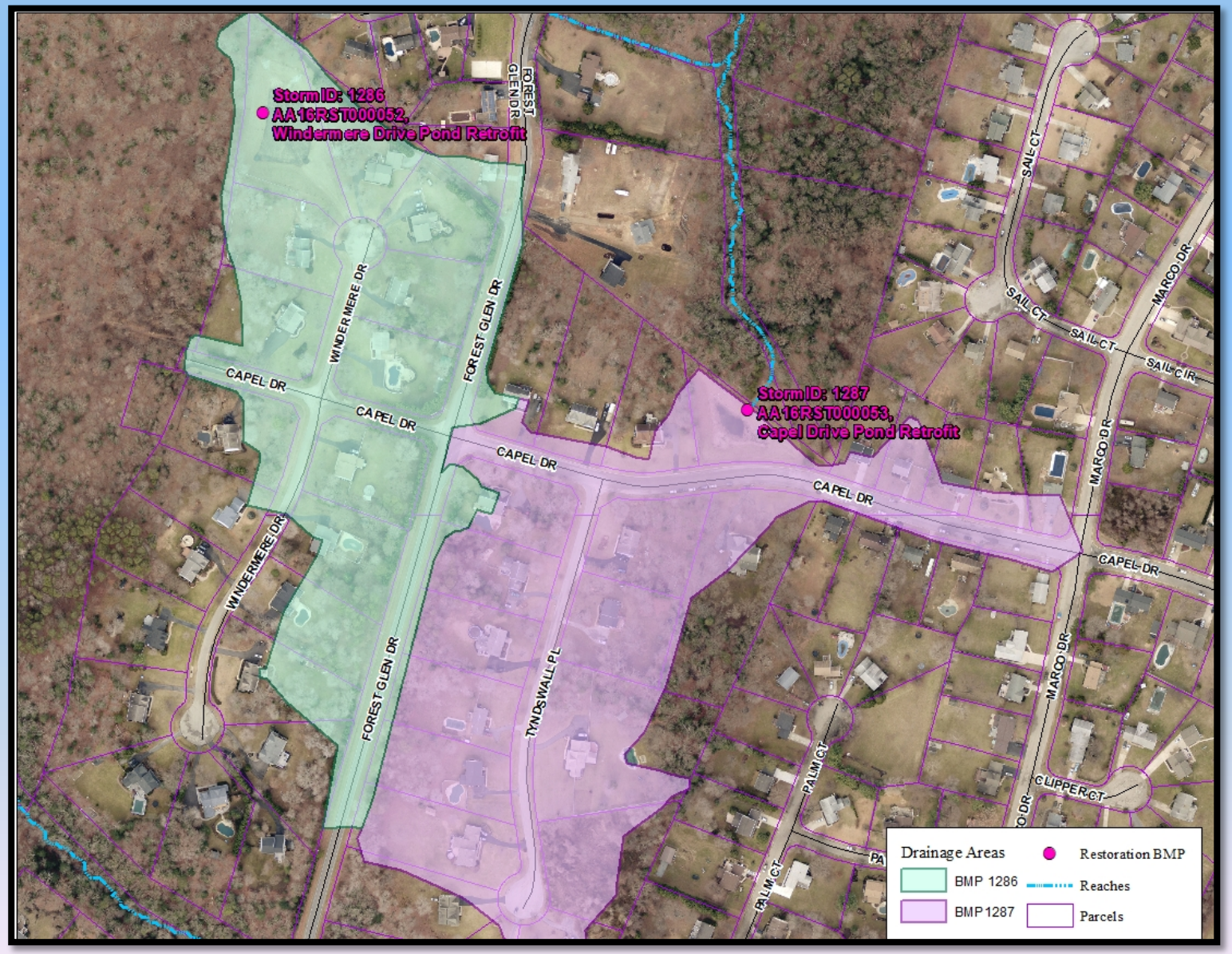

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Project Coordination

- Storm ID (Unique ID) Assignment will be assigned by the County for all BMPs (ponds, streams restoration, shoreline, etc.)
- All project documents should reference the Storm ID as the BMP identifier
- Project Contact

<u>Timing</u>

- Completed[1]
- Under Construction
- 30% Phase

[1]Need Confirmation and As-builts

- Construction complete (or substantially complete) or
- Construction final inspection/approval or
- Conditional Acceptance

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Take Home Points

- Metrics for each BMP
- As-builts, design plans and reports
- Design Protocol Information
- BEHI data
- GIS files[1]
- Coordination – Project Contact
- Drainage area maps

[1] NA for small ESD practices (Drainage area maps required)

Anne Arundel County WATERSHED Protection & Restoration PROGRAM

Links

1. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects http://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2013/10/stream-restoration-short-version.pdf
2. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Documents/NPDES%20MS4%20Guidance%20August%2018%202014.pdf
3. MDE Stormwater Design Manual http://mde.maryland.gov/programs/Water/StormwaterManagementProgram/Pages/stormwater_design.aspx
4. Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects https://www.chesapeakebay.net/documents/Shoreline_Management_Protocols_Final_Approved_07132015-WQGIT-approved.pdf

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Questions?

Raghu Badami, PE
pwbada78@aacounty.org
Melissa Harlinski
pwharl45@aacounty.org
Melissa Bragg
pwbrag47@aacounty.org

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