REVISITING THE STREAM RESTORATION PROTOCOLS

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THE ORIGINAL STREAM RESTORATION PROTOCOLS

HISTORY OF THE 2014 STREAM RESTORATION EXPERT PANEL REPORT

HISTORY OF CBP STREAM RESTORATION CREDITING

- Expert Panel Report approved in 2013
- Report was revised after a "test-drive" period in 2014
- Changes in how streams and sediment are simulated in CAST in 2017
- USWG approves SR Protocol FAQ document in early 2018
- 5 Groups formed to revisit Protocols in mid-2018

KEY ELEMENTS OF THE ORIGINAL REPORT

- 3 Protocols to address different pollutant removal pathways
- Qualifying conditions to define eligible practices
- Emphasis on functional uplift and comprehensive restoration
- No “mud-slinging” at other design approaches

THE STREAM RESTORATION PROTOCOLS

1. Prevented sediment

2. In-stream denitrification

3. Floodplain reconnection

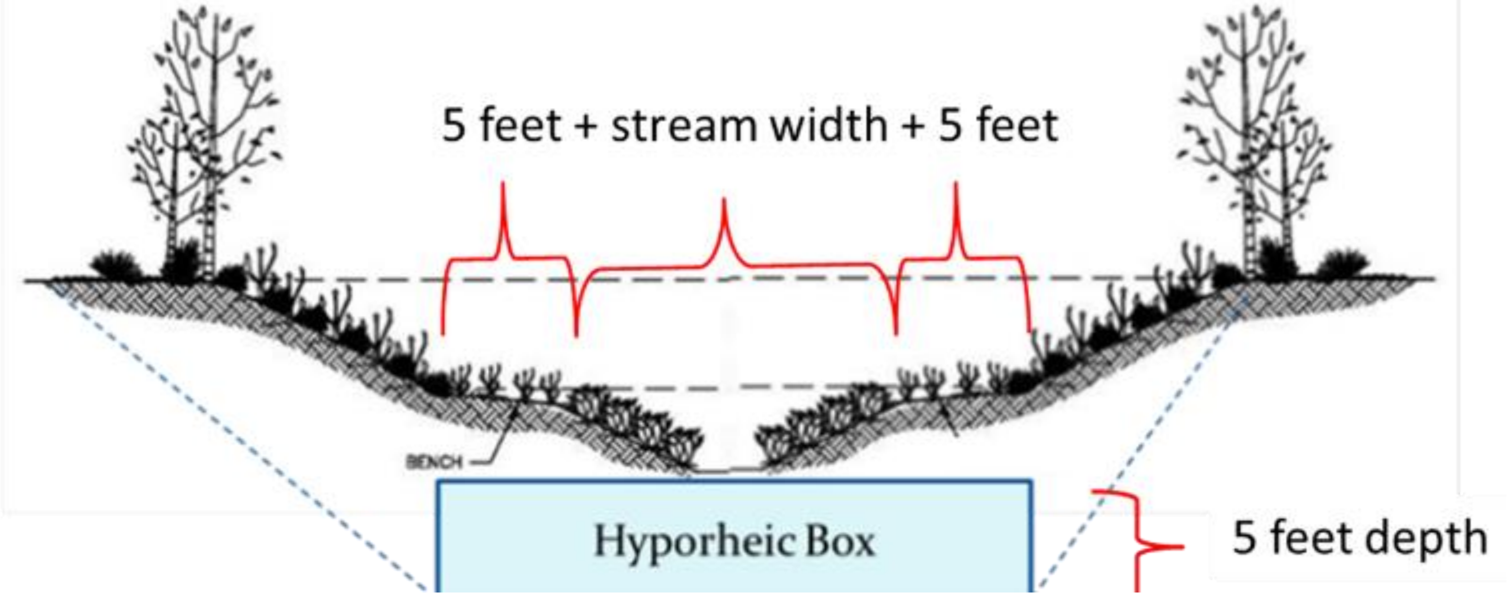
4. The "tweener" Dry Channel RSC

PROTOCOL 1: PREVENTED SEDIMENT

Load Reduced = Annual Streambank Erosion Rate × Soil Nutrient Concentration × 50% Efficiency Factor

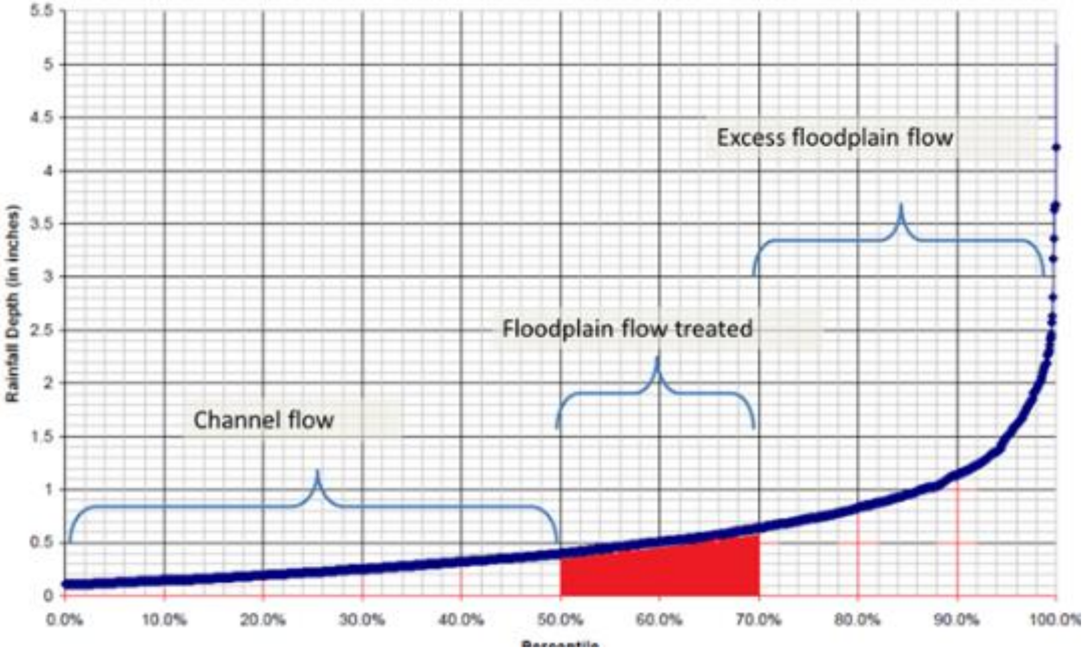
PROTOCOL 2: DENITRIFICATION DURING BASEFLOW

Load Reduced = Define HB Volume × Multiply by Bulk Density for Soil Mass × Unit Denit Rate for Soil Mass



PROTOCOL 3: FLOODPLAIN RECONNECTION

Define Project Area and Elevations → **Compute Contributing Flows or Loads** → **Compute Flow Vol Diverted to Floodplain** → **Define Effect of Floodplain Treatment**



Courtesy: Jeff Hartranft

THE DESIGN APPROACHES

There are three major stream restoration design approaches

- NCD: Natural Channel Design
- LSR: Legacy Sediment Removal
- RSC: Regenerative Stormwater Conveyance

No single design approach is superior, as any project can fail if it is inappropriately located, assessed, designed, constructed, or maintained.

QUALIFYING CONDITIONS

- Stream restoration projects that are primarily designed to protect public infrastructure by bank armoring or rip rap **do not** qualify for a credit.
- The urban stream reach must be greater than 100 feet in length.
- The project must utilize a comprehensive approach to stream restoration design, involving the channel and banks.
- Stream restoration project must **provide functional lift** and be part of a **comprehensive watershed management plan.**
- No removal credit will be granted for any project that is built to offset, compensate, or otherwise mitigate for an impact to a stream or waterway elsewhere in the watershed.

ENVIRONMENTAL CONSIDERATIONS

- Stream restoration should not be implemented for the sole purpose of nutrient or sediment reduction.
- Stream restoration should be **directed to areas of more severe stream impairment**, and the use and design of a proposed project should also consider the level of degradation, the restoration needs of the stream, and the potential functional uplift.
- Before credits are granted, stream restoration projects will need to meet post-construction monitoring requirements, document successful vegetative establishment, and conduct initial project maintenance.
- A qualifying project must demonstrate that it will **maintain or expand riparian vegetation** in the stream corridor, and compensate for any project-related tree losses in project work areas.
- All qualifying projects must have a designated authority responsible for development of a project maintenance program that includes routine and long-term maintenance.

REVISITING THE PROTOCOLS

STREAM RESTORATION IN THE CHESAPEAKE

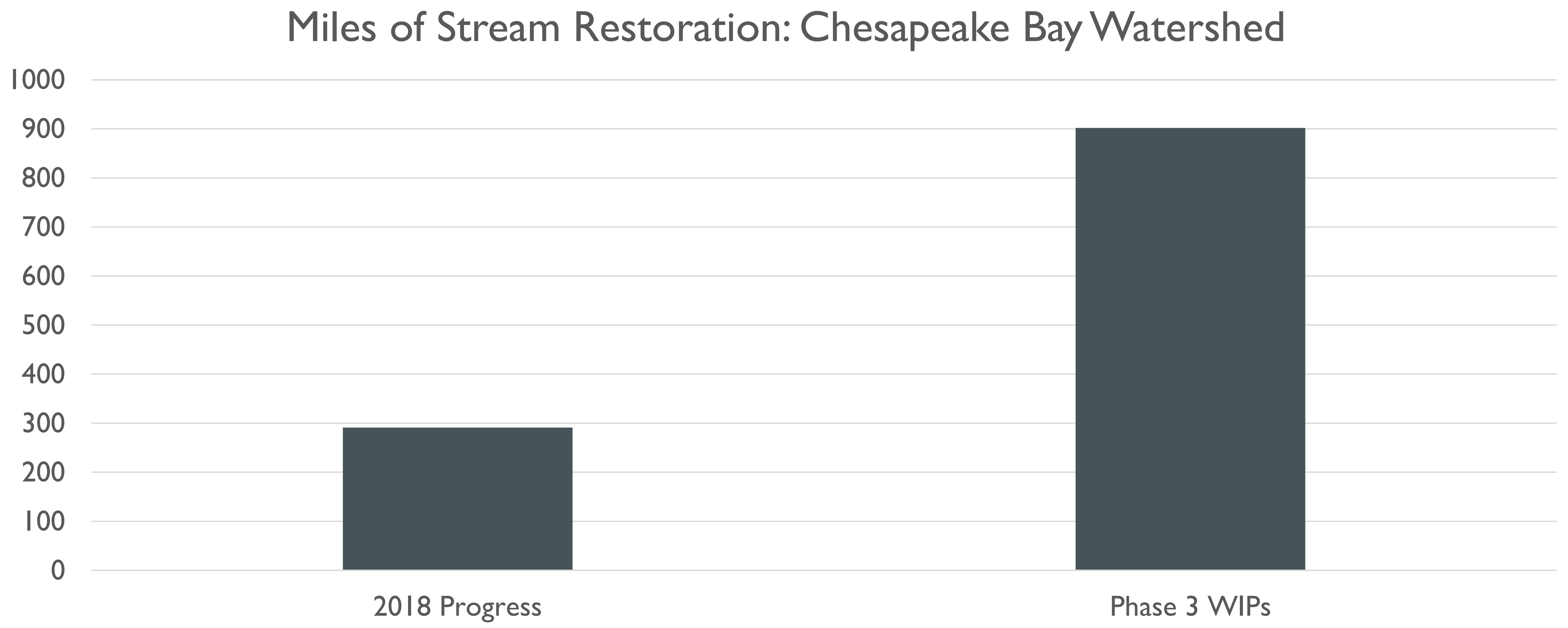
Cost Effective ($/lb)

Hundreds of Miles in the Pipeline

Rapidly Evolving Market

Little Guidance on Post-Construction Monitoring or Inspection

HUNDREDS OF MILES IN THE PIPELINE



THE IMPORTANCE OF SITE LEVEL DATA

Courtesy: Stantec

REVISITING STREAM RESTORATION

The USWG formed 5 groups to revisit the stream restoration expert panel report:

- Group 1: Verifying Stream Restoration Practices
- Group 2: Outfall and Gully Stabilization Practices
- Group 3: Establishing Standards for Applying Protocol 1
- Group 4: Adjusting Protocol 2/3 to Capture Floodplain Restoration
- "Team" 5: Floodplain Reconnection with Legacy Sediment Removal

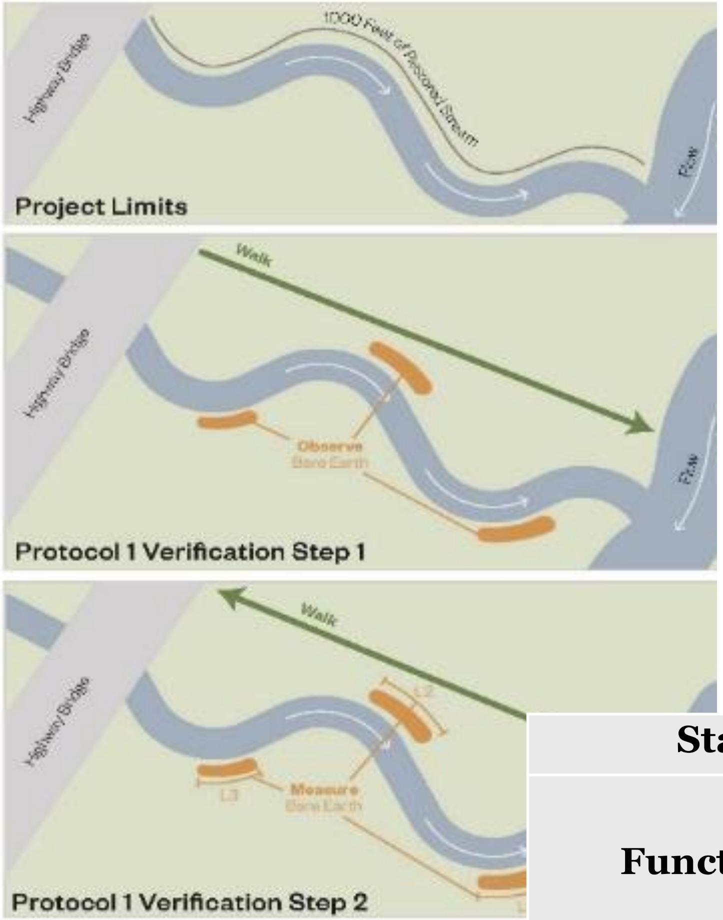
OUR 60+ STREAM EXPERTS

Rich Starr, Kathy Hoverman, Tim Schueler, Kip Mumaw, Neely Law, Meghan Fellows, Sandra Davis, Jennifer Rauhofer, Josh Burch, Scott Cox, Drew Altland, Lisa Fraley-McNeal, Joe Berg, Josh Running, Jeff White, Matt Meyer, Reid Cook, Ralph Spagnolo, Tess Thompson, Joe Sweeney, Ray Bahr, Steven Reiling, Tracey Harmon, Brock Reggi, Karen Coffman, Ryan Cole, Bill Brown, Liz Ottinger, Carrie Traver, Allison Santoro, Ted Brown, Chris Stone, Erik Michelsen, Neil Weinstein, Nick Noss, James Kaiser, Bill Stack, Scott Lowe, John Hottenstein, Jeremy Hanson, Sujay Kaushal, Joel Moore, Jens Geratz, Sean Crawford, Jeff Hartranft, Denise Clearwater, Paul Mayer, Aaron Blair, Durelle Scott, Greg Noe, Chris Becraft, Barbara Doll, David Wood, Art Parola, Benjamin Ehrhart, Ward Oberholtzer, Kelly Lennon, Megan McCollough, Cory Anderson

GROUP 1: VERIFICATION GUIDANCE

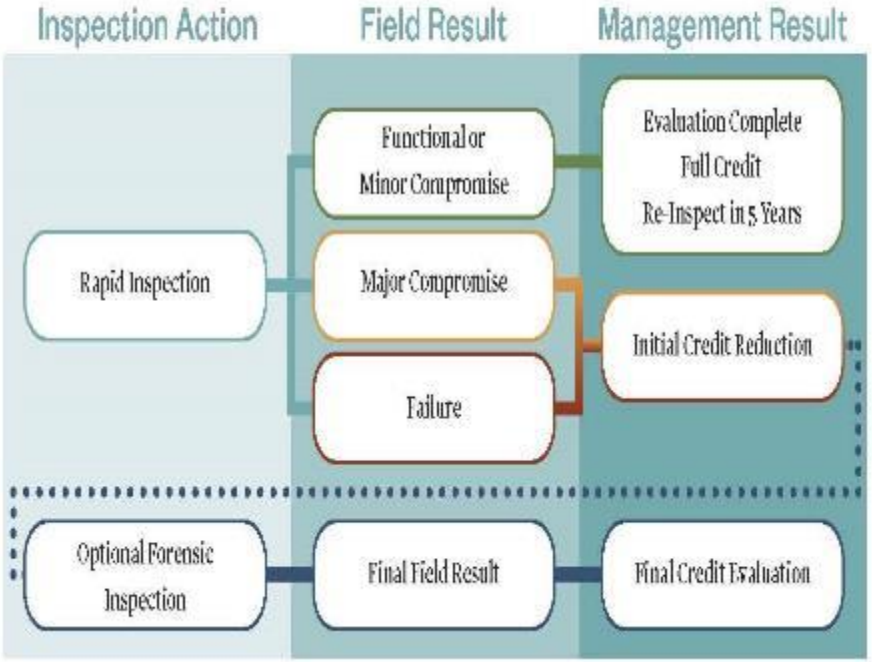
APPROVED: JUNE 2019

FULL REPORT: HTTPS://CHESAPEAKESTORMWATER.NET/DOWNLOAD/9621/



Defining Loss of Pollutant Reduction Function for Protocol 1	
Criteria for Loss	**Key Visual Indicators**
Evidence of bank or bed instability such that the project delivers more sediment downstream than designed,	• Severe bank undercutting (bare earth exposed) • Incising bed (bed erosion evident) • Flanking or downstream scour of channel structures • Failure or collapse of bank armoring practices

Status	% Failing *
Functioning	0 to 10% of reach
Showing Major Compromise	20 to 40% of reach
Project Failure	50% or more of reach




MINOR HEADCUT MIGRATION


Structure Flanking


Lateral Erosion/Migration


"Uh Oh"

GROUP 2: OUTFALL AND GULLY STABILIZATION

APPROVED: OCTOBER 2019

FULL REPORT: HTTPS://CHESAPEAKESTORMWATER.NET/DOWNLOAD/9714/

PRIMARY PURPOSE

Addressing erosion driven by vertical incision.

Often caused by:

- Uncontrolled runoff upstream,
- Migrating nick points,
- Poor slope stabilization or energy dissipation structures.

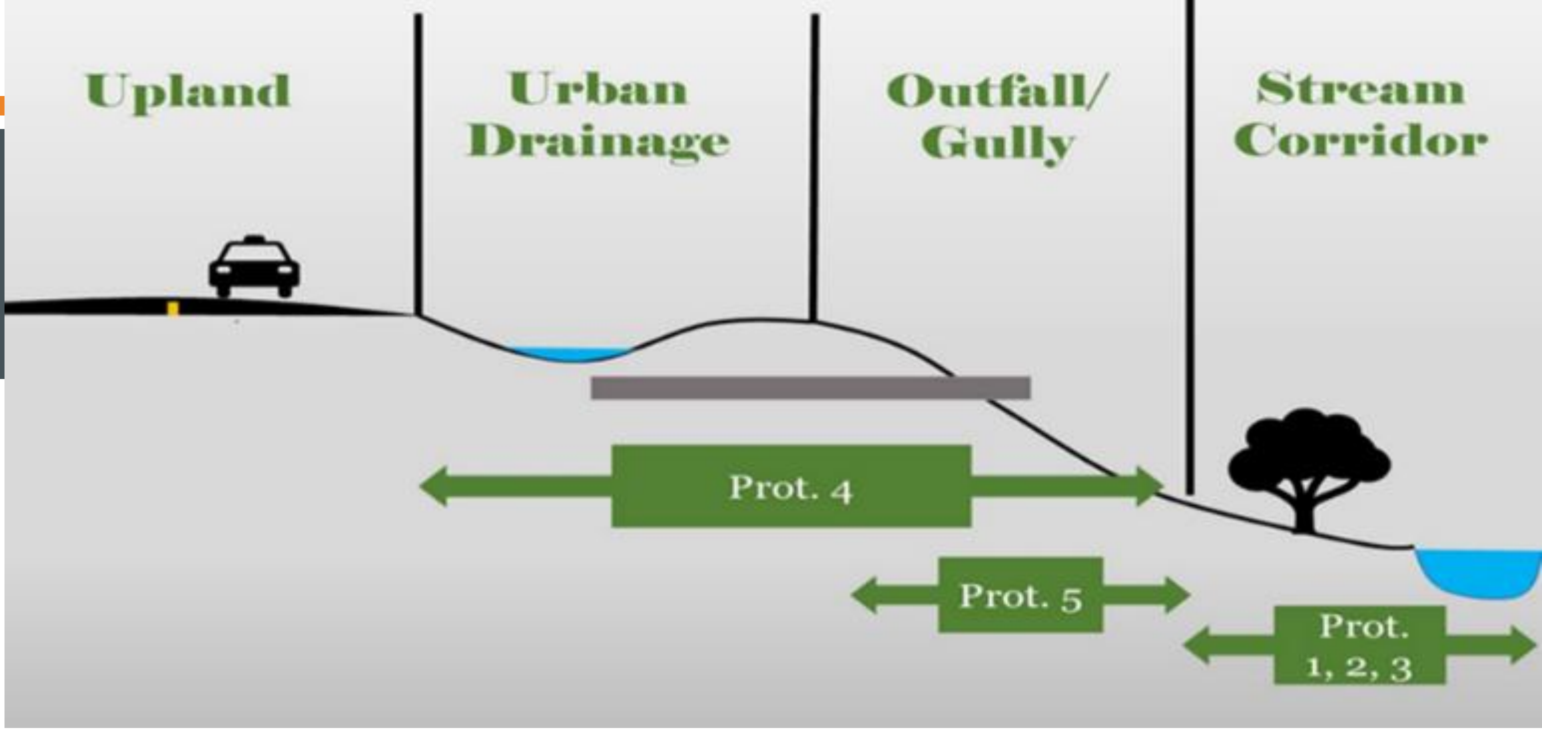
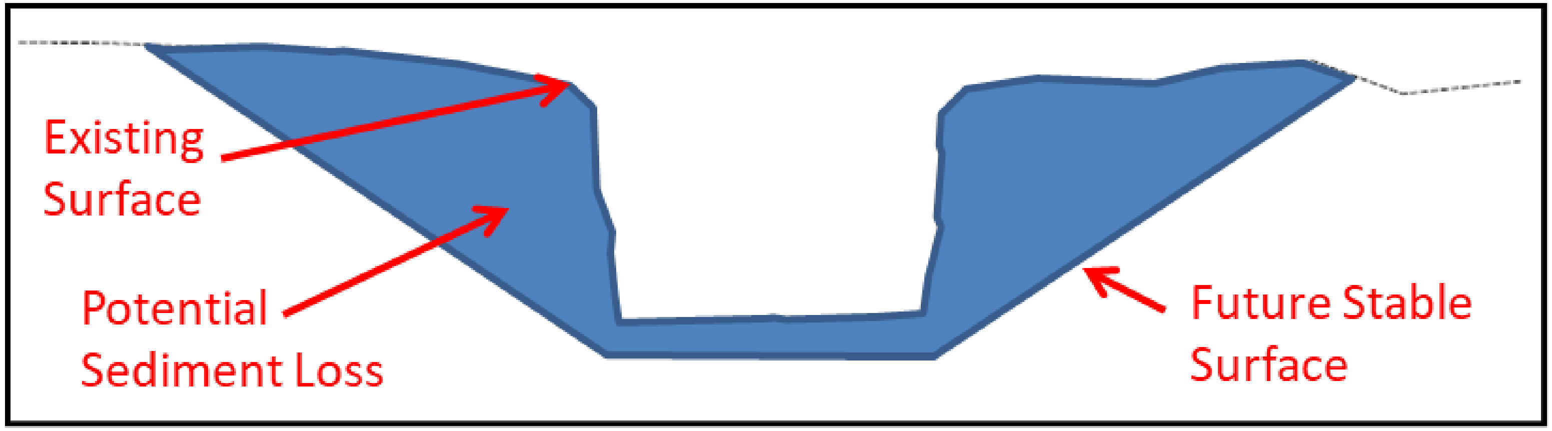


Figure 2. Examples of Severe Outfall Erosion in the Headwater Transition Zone

1.

2.

THE OUTFALL PROTOCOL



- Assess Existing Conditions
- Identify Equilibrium/Stable Conditions
- Determine Expected Sediment Loss on an Annualized Basis

GROUP 3: PREVENTED SEDIMENT (PROTOCOL 1)

APPROVED: FEBRUARY 2020

FULL REPORT: HTTPS://CHESAPEAKESTORMWATER.NET/DOWNLOAD/9928/

THE RECOMMENDATIONS

- Clear definition of bank armoring
- Emphasis on site-specific data collection
- Clear guidance for monitoring and modeling approaches
- Recommended ways of "calibrating" BANCS assessments

Source	TP AVG	TP Range	TN AVG	TN Range
Land Studies 2005*	1.43	0.93-1.87	4.41	2.8-6.8
Baltimore DPW 2006*	0.439	0.19-0.9	--	--
Walter et al 2007*	1.05	0.68-1.92	2.28	0.83-4.32
Stewart 2012*	1.78	--	5.41	--
Merritts et al 2010	1.2	0.9-1.5	2.6	1.7-3.5
Stantec 2013	0.33	0.02-4.24	0.62	0.06-3.12
Tetra Tech 2013	0.46	0.004-2.8	1.78	0.0066-19.6
Doll et al 2018	0.56	0.30-1.57	1.34	1.01-2.64

*Referenced in original Expert Panel Report.

THREE ARMORING CATEGORIES

Non-Creditable Armoring	***Creditable w/ Limits***	***Creditable Armoring***
• Concrete Retaining Wall • Sheet Piling/Planking • Gabion • Engineered Block Walls • A-Jacks • Dumped Rip Rap	• Localized stone toe protection • Boulder Revetments • Non-biodegradable soil stabilization mats • Imbricated Rip Rap	• Root wad Revetments • Live stakes/coir logs • Soil lifts • Riffle-weir series (including cobble in appropriate physiographic regions) • Berm-pool cascades • J-hooks and cross-veins

DEALING WITH THE DEFAULTS

Original EPR

- Nutrient Concentration Default Rates
- Bulk Density Example Being Used as Default
- Over-Use of Default Nutrient and Sediment Reductions

Group 3 Memo

- Site Specific Monitoring for Bulk-Density and Nutrient Concentration
- Recommended Field and Lab Methods
- Stronger language on need to use the Protocols
- Separate section on recommendations for planning level estimates

Bulk Density	lbs/ft^3
Expert Panel Report Case Study Example (Schueler and Stack 2014)	125
Carroll County, VA (average of 5 sites and 39 samples)	56
James Madison University Arboretum, Virginia (Mumaw 2015)	80
Paxton Creek, PA (range of 9 samples)	67-76
Case Study Projects in North Carolina (Doll et al. 2018)	52-88

Source	TP Avg	TP Range	TN Avg	TN Range	Location
Land Studies 2005*	1.43	0.93-1.87	4.41	2.8-6.8	Pennsylvania
Baltimore DPW 2006*	0.439	0.19-0.9	--	--	Maryland
Walter et al 2007*	1.05	0.68-1.92	2.28	0.83-4.32	Pennsylvania
Stewart 2012*	1.78	--	5.41	--	Maryland
Merritts at al 2010	1.2	0.9-1.5	2.6	1.7-3.5	Pennsylvania
Stantec 2013	0.33	0.02-4.24	0.62	0.06-3.12	Virginia
Tetra Tech 2013	0.46	0.004-2.8	1.78	0.0066-19.6	North Carolina
Doll et al 2018	0.56	0.30-1.57	1.34	1.01-2.64	North Carolina

MONITORING GUIDANCE

Original EPR

- Allows for use of "alternative monitoring and modeling approaches" to estimate sediment loss along a proposed reach
- Allows monitoring to be used to demonstrate better pollutant removal than 50% efficiency

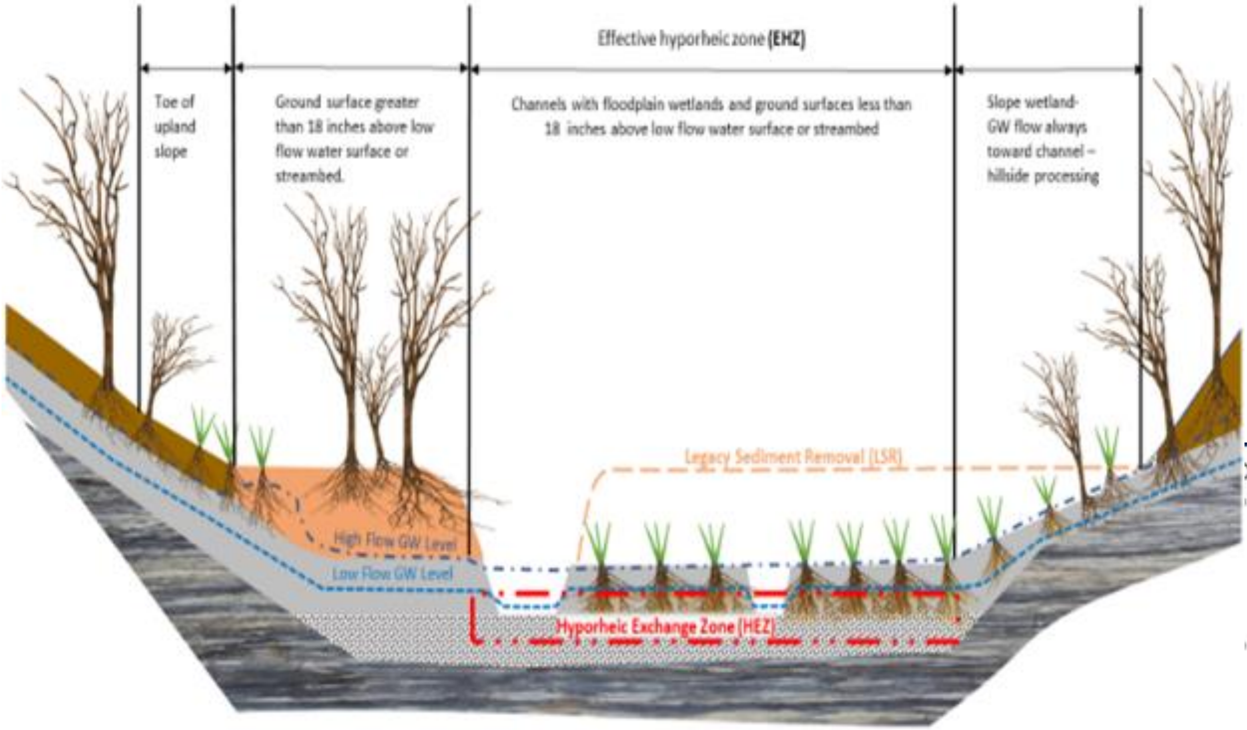
Group 3 Memo

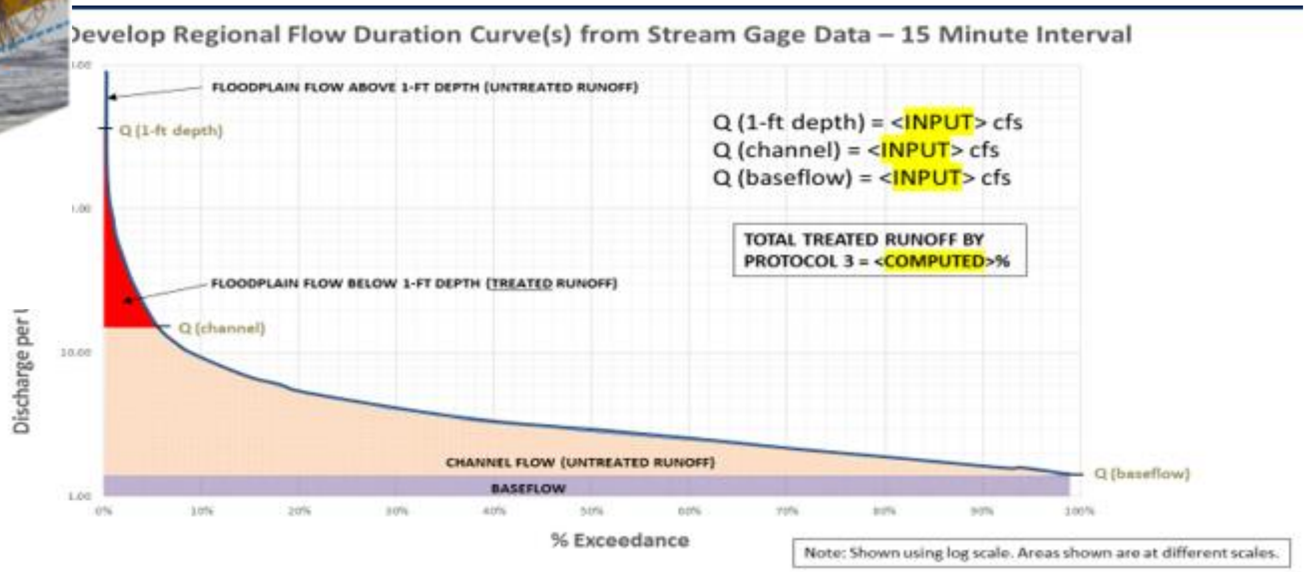
- Describes Bank Pin Monitoring, Permanent Cross Sections and Bank Profile Methods
- Describes DEM Differencing Methods
- Provides guidance on monitoring necessary to demonstrate efficiencies higher than 50%

GROUP 4: FLOODPLAIN RECONNECTION (PROTOCOLS 2 & 3)

FULL REPORT: COMING IN SUMMER 2020

PROTOCOL 2 & 3


Effective hyporheic zone (EHZ)
Toe of upland slope
Ground surface greater than 18 inches above low flow water surface or streambed.
Channels with floodplain wetlands and ground surfaces less than 18 inches above low flow water surface or streambed
Slope wetland-GW flow always toward channel – hillside processing
Legacy Sediment Removal (LSR)
High Flow GW Level
Low Flow GW Level
Hyporheic Exchange Zone (HEZ)


Develop Regional Flow Duration Curve(s) from Stream Gage Data – 15 Minute Interval
FLOODPLAIN FLOW ABOVE 1-FT DEPTH (UNTREATED RUNOFF)
Q (1-ft depth)
Q (1-ft depth) = <INPUT> cfs
Q (channel) = <INPUT> cfs
Q (baseflow) = <INPUT> cfs
TOTAL TREATED RUNOFF BY PROTOCOL 3 = <COMPUTED>%
FLOODPLAIN FLOW BELOW 1-FT DEPTH (TREATED RUNOFF)
Q (channel)
Discharge per
CHANNEL FLOW (UNTREATED RUNOFF)
BASEFLOW
Q (baseflow)
% Exceedance
Note: Shown using log scale. Areas shown are at different scales.

ANTICIPATED CHANGES

Report will be released for public review and comment next week

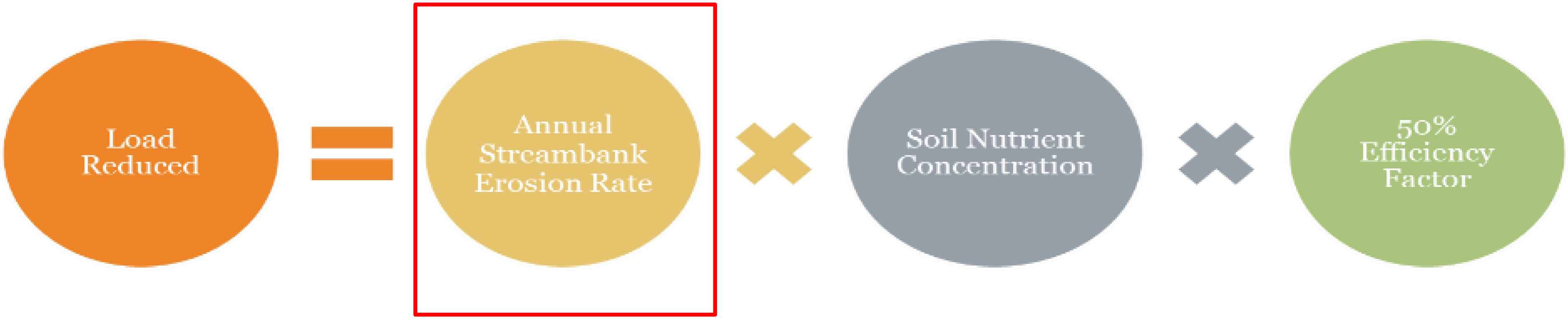
- Updated definition of Expanded Hyporheic Zone (P2)
- Updated denitrification rate (P2)
- New method for estimating flow diverted into the floodplain (P3)
- Updated floodplain removal rates from new Wetland Expert Panel reports (P3)
- Overview of best practices and unintended consequences of Stream Restoration

A QUICK EXAMPLE

EXAMPLE PROJECT OVERVIEW

- Project meets all qualifying conditions
- 500 ft length of stream (1,000 feet of total banks)
- NCD design w/ single meandering channel, riffle grade control and floodplain reconnection
- Sewer line protection adjacent to a 100 ft stretch of right bank used stacked gabion baskets

PROTOCOL 1 CALCULATION



$S = \Sigma(cAR) / 2{,}000$

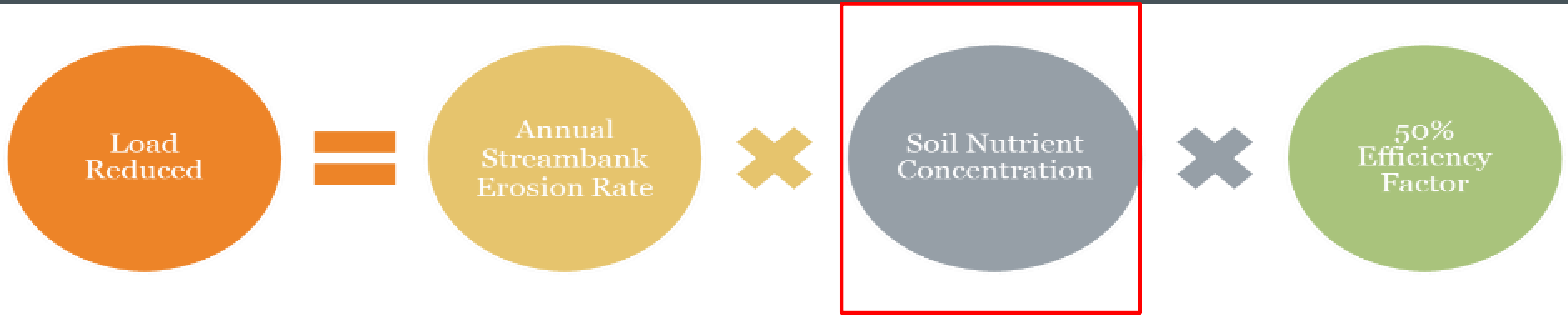
where: S = sediment load (ton/year) for reach or stream
c = bulk density of soil (lbs/ft3)
R = bank erosion rate (ft/year)
A = eroding bank area (ft2)
2,000 = conversion from pounds to tons

For this example:

- Bulk Density: 5 samples (every 200 ft, including from each soil horizon)
  - 75lbs/ft3
- Bank Erosion Rate: Bank Pins
  - 2.4 ft/year
- Eroding Bank Area (subtract out sewer protection)
  - 900 ft

S= 81 ton/year

PROTOCOL 1 CALCULATION

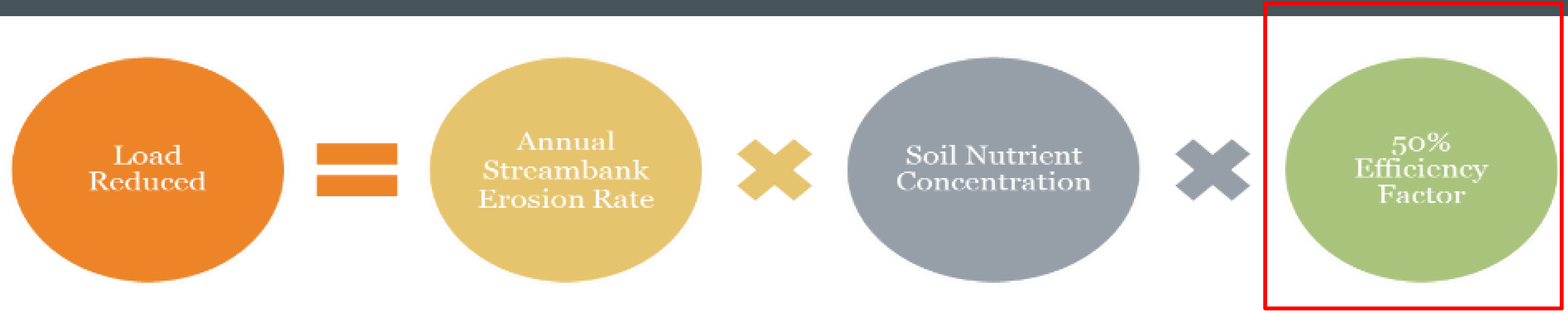


For this example:

- Soil Nutrient Concentration : 5 samples (every 200 ft, including from each soil horizon)
  - 0.5 lb TP/ ton TSS
  - 1.7 lb TN/ton TSS

TP= 40.5 lb/year
TN= 137.7 lb/year

PROTOCOL 1 CALCULATION



Multiply by default 50%:

- TSS= 81,000 lb
- TP= 20.25 lb
- TN= 68.9 lb

Do NOT multiply by delivery factor before reporting

Or:

- 3 years of post-restoration monitoring (Bank Pins in this case)
- New bank erosion rate = 0.4 ft/year
- For simplicity, bulk density and nutrient concentrations measured and they were the same
- Efficiency is now 83% (13.5 ton/year vs 81 ton/year erosion rate)

Re-report new values:

- TSS= 135,000 lb
- TP= 33.7 lb
- TN= 114.7 lb

QUESTIONS?