Metropolitan Washington COG Stream Restoration Technical Session:

Stream Restoration Design and Program Considerations for Crediting and Tracking Benefits

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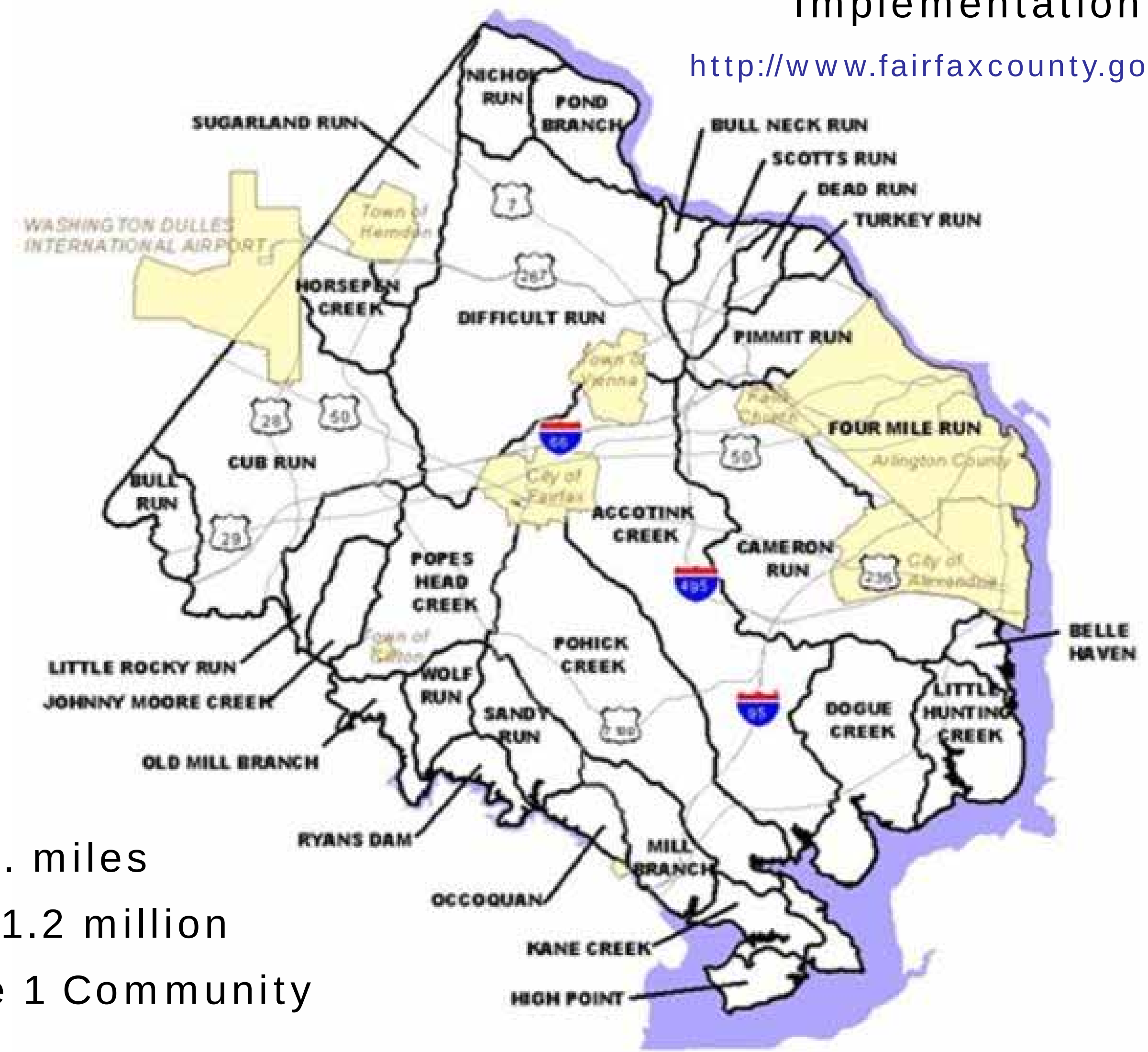
Watershed Planning and Implementation Program

http://www.fairfaxcounty.gov/dpwes/watersheds/



Size: 395 sq. miles

Population: 1.2 million

MS4 - Phase 1 Community

Stream Conditions

GOOD

UGLY

BAD

Stream Restoration Management Considerations

- Watershed-based Approach
- Local vs. Chesapeake Bay Benefits
- MS4 vs. Stream
- Design Techniques
- Cost Effectiveness
- Monitoring and Maintenance

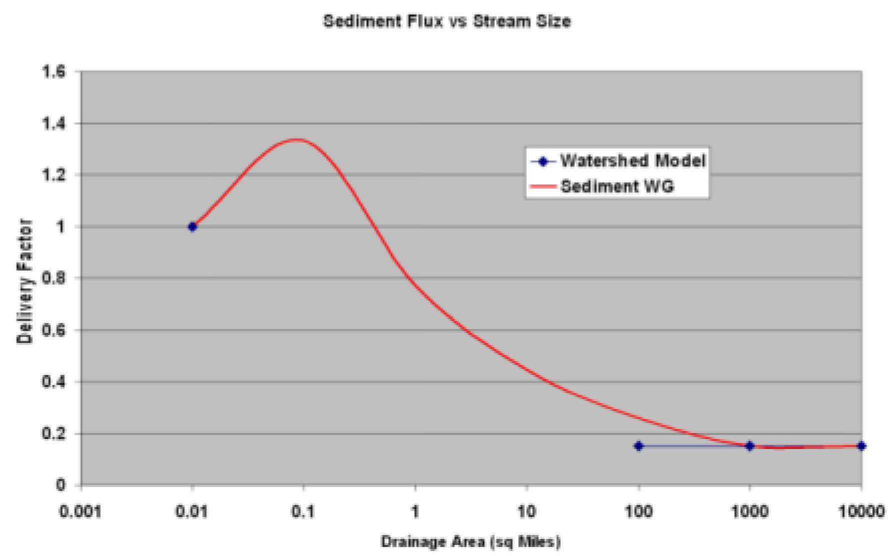


Figure 2. Edge of Stream Sediment Delivery Curve in CBWM

Local TMDLs

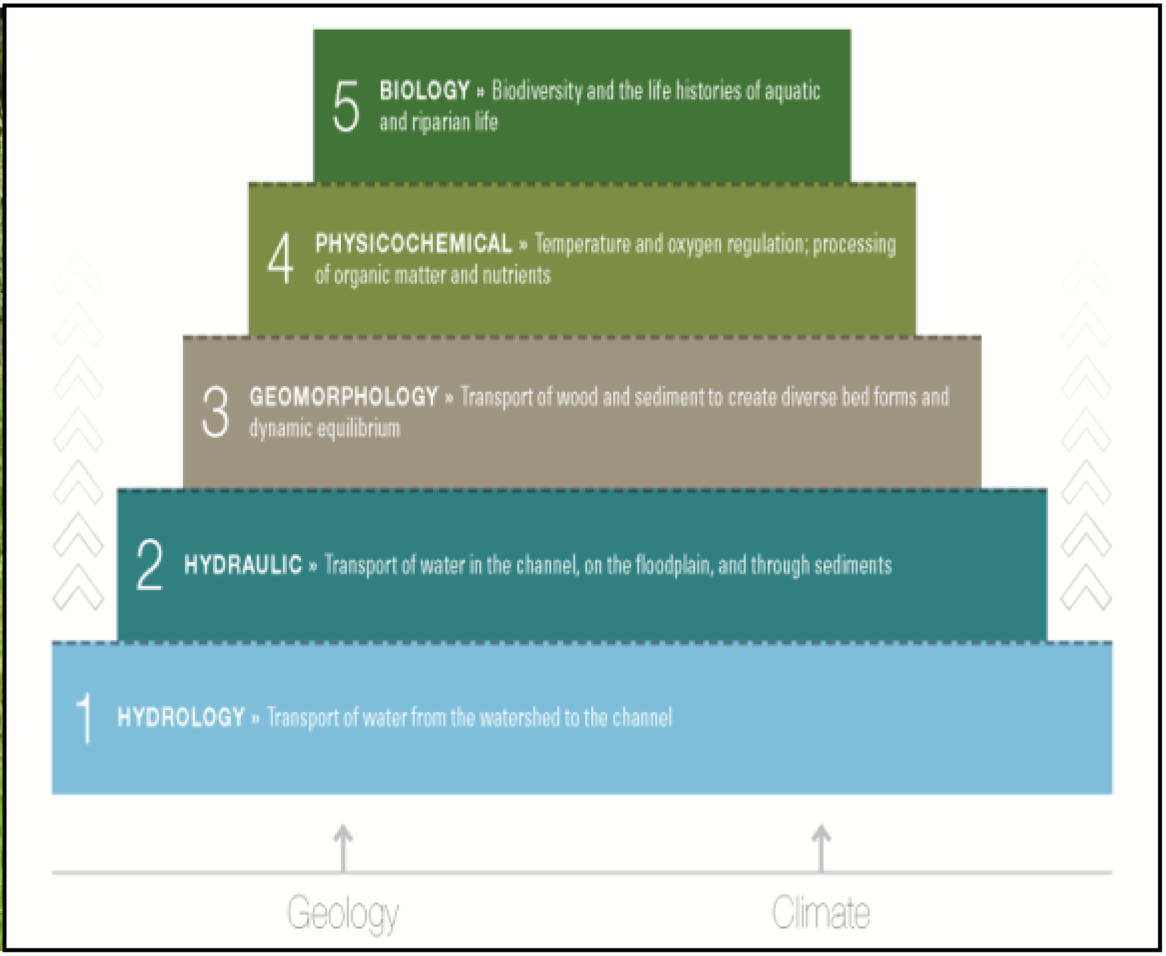
- 72 Impaired Waters (2010)
  - 52 Streams
  - 3 Reservoirs
  - 17 Tidal Embayments

- 10 TMDLs to Date
  - 6 Bacteria
  - 3 Sediment
  - 1 PCB

Considerations

- MS4 Outfall improvement
  - Approximately 7,000 outfalls
  - Regenerative stormwater conveyance system
  - Approve standard alternatives
- Headwater vs. Higher Order Streams
  - Focus on 1, 2, and 3 order streams
  - Drainage area less than 1 square mile
  - Challenges with higher order streams

Stream Restoration Functional Uplift
More than a Cup of Beans



Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. *A Function-Based Framework for Stream Assessment and Restoration Projects.* US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006.

Stream Restoration Benefits Protocol Test Drive

- Benefits analysis
  - Identify which protocols apply
  - Review available data
  - Using default values
  - Collecting field data
- Compare to interim rates
- Compare to local monitoring data

Stream Restoration Protocols

1. Prevented sediment approach

2. In-stream denitrification

3. Flood plain reconnection

4. The “tweener” Dry Channel RSC

Benefits Calculations

Required Parameter	Symbol	Value
Project Name		
Project Number		
Watershed Name		
Length of the restored stream (linear feet)	L	
Contributing Drainage Area (acres)	A_{cda}	
Impervious Contributing Drainage Area (acres)	$A_{impervious}$	
Average Bank Height for existing conditions (feet)	H	
Average Baseflow Width (feet)	W	
Bulk Density of Stream Bank Soils (lbs/cf)	γ_{banks}	
Bulk Density of Streambed Material (lbs/cf)	γ_{bed}	
Bank Erosion Rate (feet/year)	R(BEHI, NBS)	0.3
Effectiveness in Reducing Sediment and Nutrients from the Stream Reach	η_{p1}	50%
Nutrient Concentrations Measured in Streambank Sediments (lbs/ton)	c	Table 2
Average Denitrification Rate (lbs/ton/day)	r_d	1.95×10^{-4}
Edge of Stream Unit Loading Rate for Impervious Areas (lbs/acre/year)	$u_{impervious}$	Table 3
Edge of Stream Unit Loading Rate for Pervious Areas (lbs/acre/year)	$u_{pervious}$	Table 3
Storage Volume Available in the Floodplain for the Storm Being Analyzed (cubic feet)	$\forall$	
Rainfall Required to Access the Floodplain (inches)	P	
Total Project Cost (dollars)	Cost	
Design Completion Date		
Construction Completion Date		

- Completed Projects
  - Survey data
  - Photo documentation
  - Assessment
  - Default parameter values
- New Projects
  - Field measurements
  - BEHI/NBS
  - Soil nutrients
  - Soil bulk density

Protocol Test Drive

- Example Projects

Expert Panel - Protocol 1: Prevented Sediment Approach

Stream Restoration Project	Restored Length (linear feet)	Average Stream Bank Height (feet)	Bulk Density of Stream Bank Soils (lbs/cf)	Bank Erosion Rate (feet/year)	TP Removal (lbs/year)	TN Removal (lbs/year)	TSS Removal (lbs/year)
Rabbit Branch Tributary (PC9263)	1,515	4.00	89	0.3	85	184	161,802
Pohick Creek Tributary (PC9257)	1,314	7.00	89	0.3	129	280	245,587
Banks Property	1,142	5.00	89	0.3	80	174	152,457
South Lakes Outfall	660	5.00	89	0.3	46	100	88,110
Total/Average	**4,631**	**5.25**	**89**	**0.3**	**340**	**739**	**647,956**

Expert Panel - Protocol 2: In-stream Denitrification

Stream Restoration Project	Restored Length (linear feet)	Average Stream Bank Width (feet)	Bulk Density of Streambed Material (lbs/cf)	Denitrification Rate (lbs/ton/day)	TN Removal (lbs/year)
Rabbit Branch Tributary (PC9263)	1,515	20.00	125	1.95E-04	1,011
Pohick Creek Tributary (PC9257)	1,314	45.00	125	1.95E-04	1,607
Banks Property	1,142	7.50	125	1.95E-04	445
South Lakes Outfall	660	4.50	125	1.95E-04	213
Total/Average	**4,631**	**19.25**	**125**	**1.95E-04**	**3,276**

Protocol Test Drive

- Summary of Completed Projects from 2009 to Present

			Protocols 1+2			
Project Name	**Cost**	**Lineal Feet Restored**	**Phosphorus Removal (lb/yr)**	**Nitrogen Removal(lb/yr)**	**TSS Removal (lb/yr)**	**Cost/Foot**
Poplar Spring Court	$ 298,200	693	58	507	112,000	$430
Seven Woods Outfall	$ 4,300	185	5	99	10,000	$23
Big Rocky Tributary	$ 191,600	336	21	232	40,000	$570
Dead Run Stream Restoration	$ 594,400	1,400	98	836	186,000	$425
Bridle Path Stream Restoration	$ 898,100	1,308	110	1,027	210,000	$687
Schneider Branch Stream Restoration	$ 631,100	1,000	26	733	50,000	$631
Government Center Stormwater Retrofit	$ 600,000	1,000	66	515	126,000	$600
Sheffield Hunt Outfall and Basin	$ 400,000	940	86	479	164,000	$426
Tripps Run	$ 676,656	1,430	120	1,325	230,000	$473
Sandy Run	$ 211,658	300	8	252	16,000	$706
Beach Mill	$ 318,091	250	11	223	20,000	$1,272
Wolftrap Creek	$ 1,815,000	2,175	95	1,937	180,000	$834
Total:	$ 6,639,105	11,017	704	8,165	1,344,000	$590
Average lb/ft:			0.064	0.741	122	
Revised Interim Rates			0.068	0.075	248	

Pohick Creek Tributary

- [x] Protocol 1: Preventing Sediment
- [ ] Protocol 2: Hyporheic Zone
- [ ] Protocol 3: Floodplain reconnection
- [ ] Protocol 4: Dry channel RSC

Pohick Creek Tributary

Pohick Creek Tributary

Sanitary Sewer

Before: Exposed sanitary sewer line and highly eroded channel.

Approximate location of Sanitary Sewer

After: Before trees and shrubs were planted

Pohick Creek Tributary

First Spring – June 2013

Dead Run

<u>Project Overview</u>:

Approximately 1,400 liner feet of Dead Run stream that runs through McLean Central Park was stabilized with various practices including encapsulated soil lifts, toe protection, stone vanes, compost berms, and fiber log rolls. The stormwater outfall from Dolley Madison library was restored to include a sand filter step-pool system and wetland feature. The entire site was re-vegetated with extensive native plantings of trees, shrubs, grasses and wildflowers.

- ✔ **Protocol 1: Preventing Sediment**
- ✔ **Protocol 2: Hyporheic Zone**
- ☐ **Protocol 3: Floodplain reconnection**
- ✔ **Protocol 4: Dry channel RSC**

Dead Run

Design Considerations

Minimize Impact to Riparian Buffer

Government Center Stream Restoration - before and after

Restoration of 1,000 LF of an unnamed tributary of Difficult Run.

Design Considerations

- Incorporating woody debris and habitat structures

WolfTrap Creek Stream Restoration

Restoration of 2,095 LF located in Wildwood Park in Vienna, Virginia

Design Considerations

- Channel Sizing and Floodplain Reconnection

Figure 1

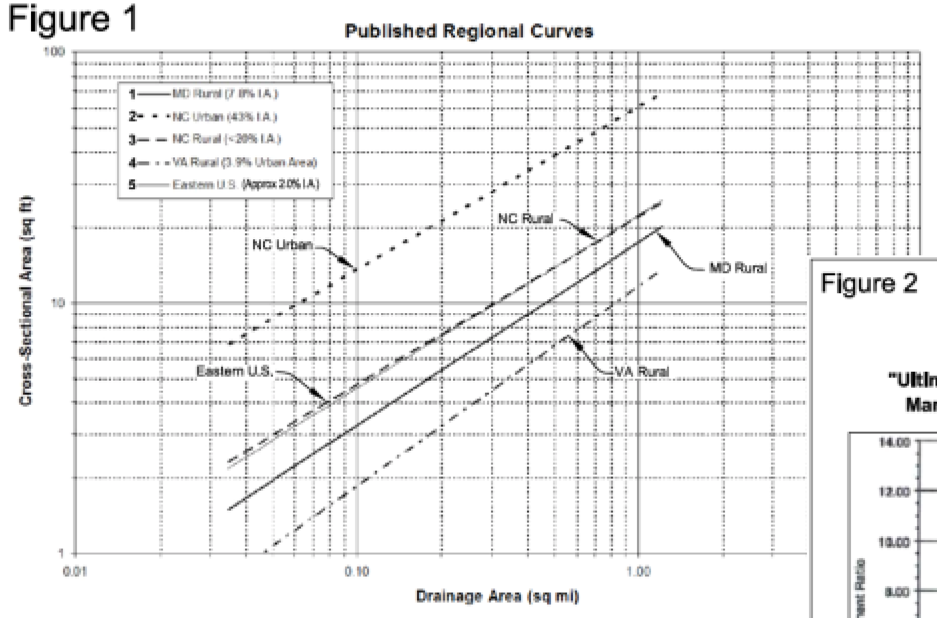
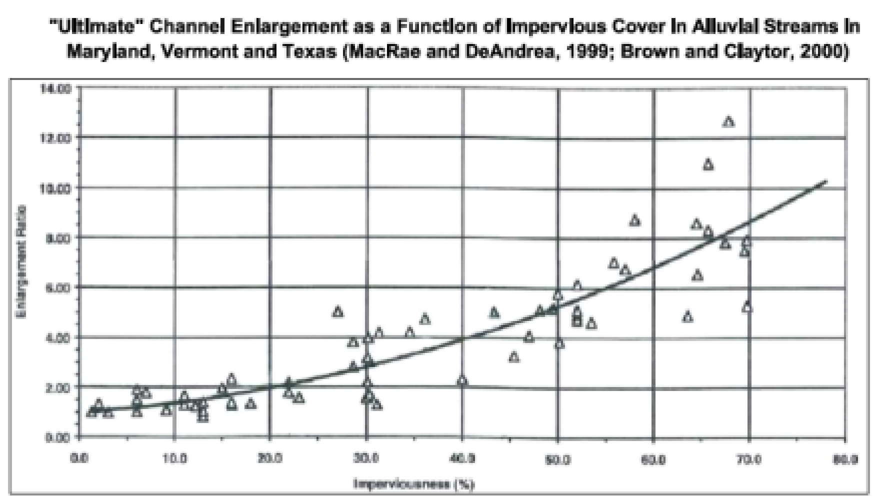


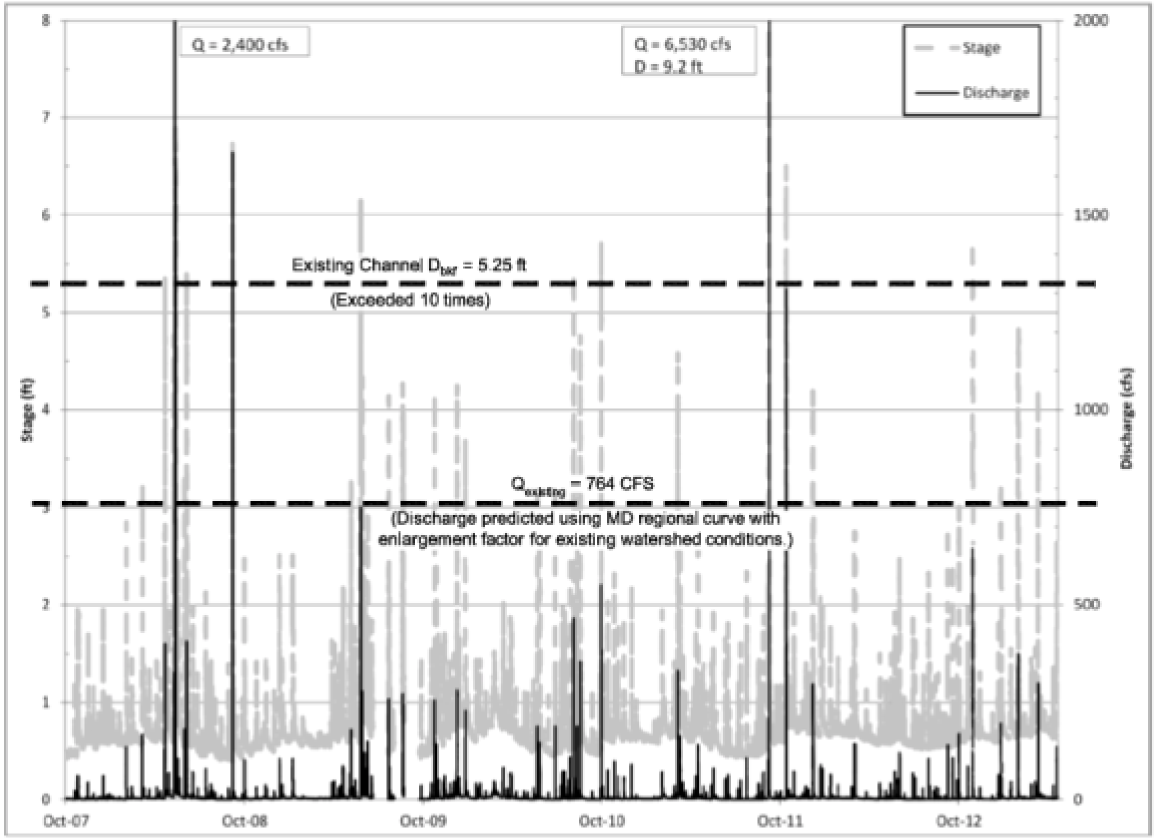
Figure 2



Design Considerations

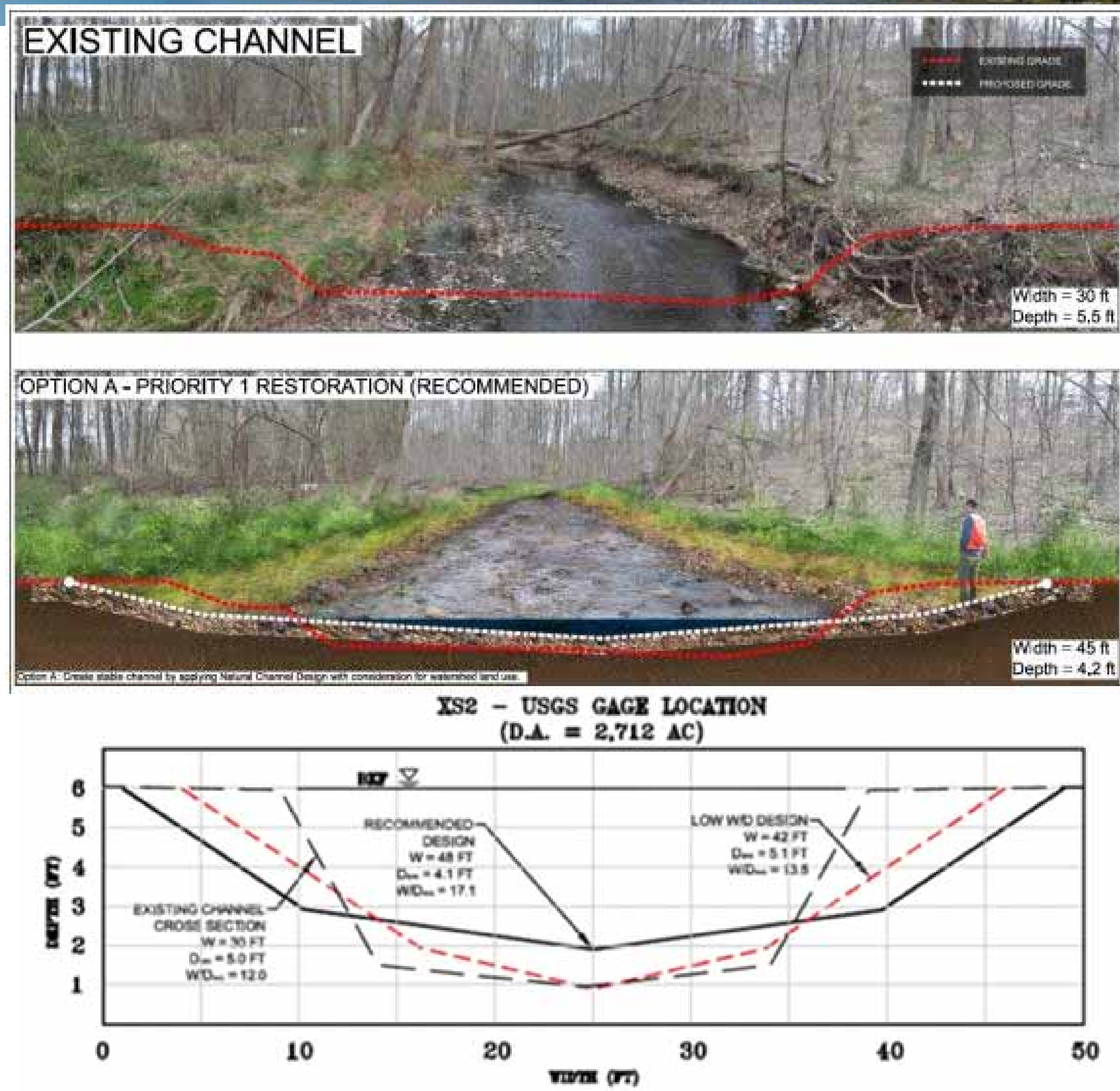
- Floodplain Reconnection

Figure 12 - USGS Flatlick Branch Gaging Station Depth and Discharge [1]



[1] Data in this graph was provided by staff at the USGS Virginia Water Science Center. The graph includes provisional data subject to change.

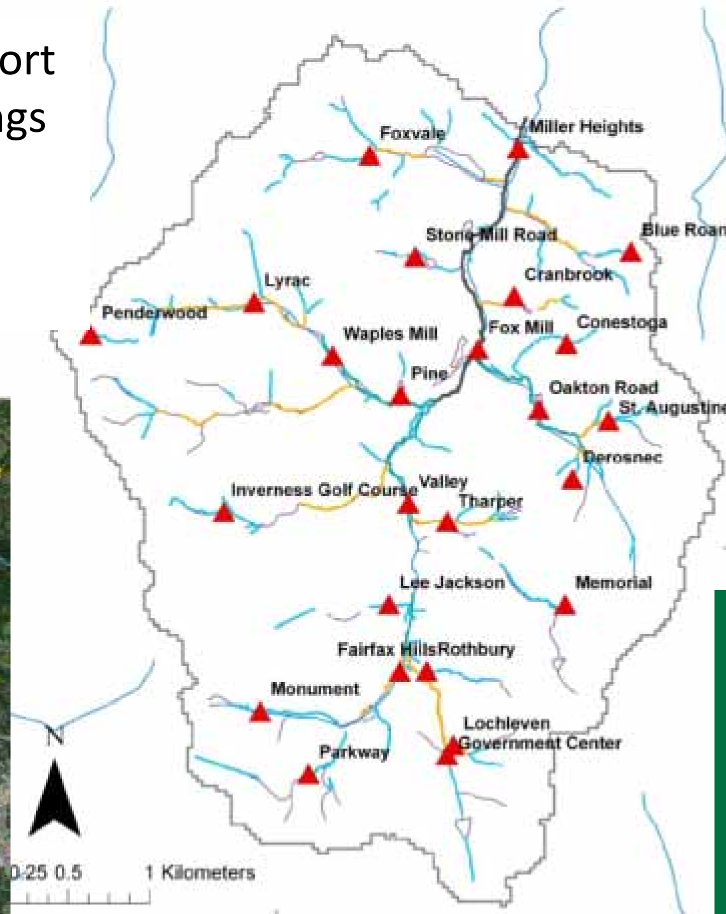
Design Considerations



Flatlick Branch Concept Design Cross-Sections.
Prepared by Wetland Studies and Solutions, Inc.

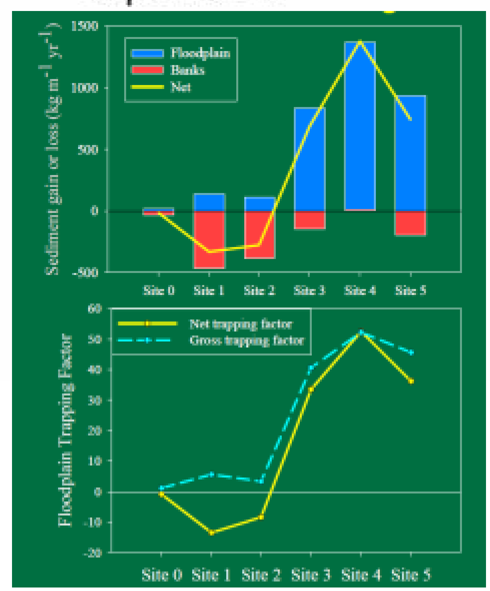
USGS Studies

- Sediment sources and transport
- Sediment and nutrient loadings
- Management strategies
- Restoration potential and effectiveness



38 Reaches to document channel change
-Each reach 2- 4 cross sections

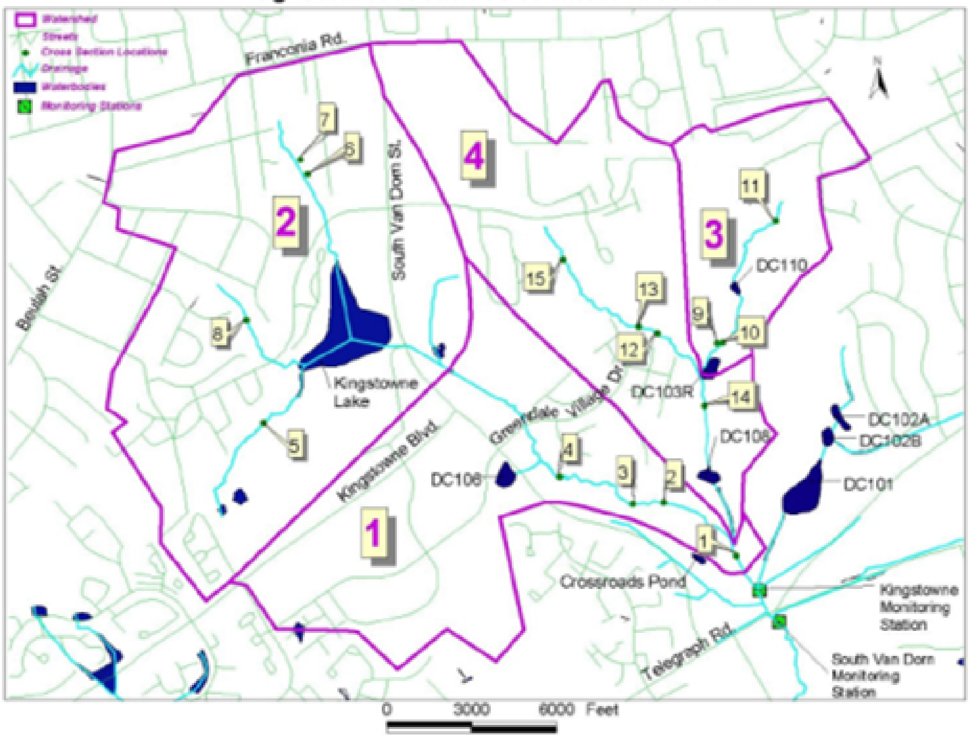
- 482 pins to quantify bank erosion, bar deposition



http://va.water.usgs.gov/projects/ffx_co_monitoring.htm

Kingstowne Monitoring and Lake Sedimentation

Figure 1. Location of Stream Cross Sections



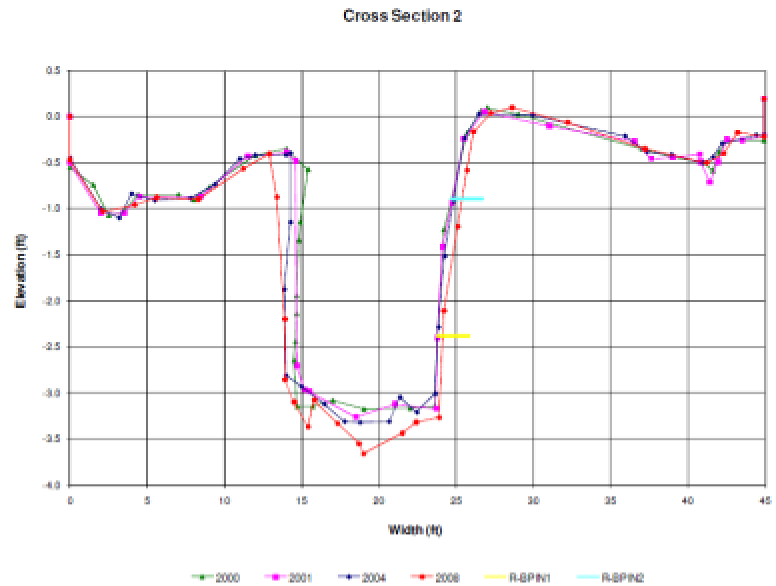


Table 7. Rates of Sediment Loading for All 15 Stream Cross Sections

Year	tons / year	tons / foot / year	tons / acre / year
2000-2001	-461.6	-0.027	-0.558
2001-2004	-619.4	-0.036	-0.749
2004-2008	-1,027.8	-0.057	-1.243
2000-2004	-573.2	-0.033	-0.693
2000-2008	-850.4	-0.050	-1.028

A negative value indicates a loss of sediment (erosion)

Kingstowne Sediment Yields:

- 54 to 114 lbs/ft/year
- 1,116 to 2,486 lbs/acre/year

Lake Sedimentation Rates (PL566 Dams)

- 1,100 to 4,400 lbs/acre/year
- Need to consider trapping efficiency of lake

Questions?

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