NORTHERN VIRGINIA STREAM RESTORATION BANK

“EVERYTHING YOU WANT TO KNOW ABOUT STREAM RESTORATION NORTH OF THE TOLL ROAD”

Presented by Michael S. Rolband
P.E., P.W.S., P.W.D.

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# Northern Virginia Stream Restoration Bank

**Colvin Run Community Meeting**  
**March 27, 2010**

## Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Topics</th>
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<tbody>
<tr>
<td>9:30 AM – 9:45 AM</td>
<td>• Breakfast / Introductions</td>
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<tr>
<td>9:45 AM – 10:45 AM</td>
<td>• Mitigation Banking and Why Reston?</td>
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<td>• The Urban Watershed Problem and Solutions</td>
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<td>• Colvin Run Watershed – Existing Conditions</td>
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<tr>
<td>10:45 AM – 11:00 AM</td>
<td>• Break</td>
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<td>11:00 AM – 12:00 AM</td>
<td>• Data Collection and Design</td>
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<td>• Technical Review, Monitoring, Maintenance, and Funding</td>
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<td>• Summary</td>
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<tr>
<td>12:00 PM</td>
<td>• Lunch / Questions</td>
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</table>
Wetland Studies and Solutions, Inc.

- Natural & Cultural Resource consulting firm
- 75 Staff
  - Archeology, Engineering, Environmental Science & Ecology, Environmental Technology, Compliance, GIS, Regulatory, Surveying, & Wildlife Biology
• Mitigation Experience
  – Developed 17 mitigation bank sites
  – ± 900 acres of wetlands
  – 140,000 lf of stream
OUTLINE

• Mitigation Banking and Why Reston?
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Why a Stream Bank in Reston?

- Community members are actively involved in protecting local natural resources
  - They recognized the degraded state of the streams

Why a Stream Bank in Reston?

- Degrading streams are located in preserved corridors (without stormwater management).
- Mostly controlled by a single entity (Reston Association).
- Community of Reston includes entire watersheds.
- There is a demand for stream mitigation in the region (funding source).
A Public Works Agency or private landowner needs to impact streams on their property. In the past, they would have had to restore streams as compensation, either on- or off-site.

By purchasing stream credits from the Bank Sponsor, the mitigation requirements of a permit for stream impacts is satisfied. Stream restorers use this pooled money to create much larger, well-designed, & ecologically valuable conservation projects.

Adapted from The Washington Post, February 15, 1996
THE APPROVAL PROCESS

Wetland Studies – Reston Association

July 2000
• Watershed white paper published (identifies need to improve watersheds).

March 2002
• Reston Watershed Plan published

October 2003
• Letter of Intent signed with Reston
• Mitigation Banking Review Team (MBRT) Meeting requested.

December 2003
• MOA signed
• $250,000 Donation for Reston
THE APPROVAL PROCESS

MITIGATION BANKING INSTRUMENT

June 2004:
• Public Notice for Prospectus for the NVRSB.

October 2004 – February 2006:
• MBRT Review Process (COE, EPA, DEQ, & USFWS)

July 2005:
• Executive Order 90 Issued – “Improving Stream Health and Water Quality by Restoring Streams Throughout the Commonwealth”

February 2006:
• DEQ & COE sign MBI for Phase I (~14 miles).
• Phase II approximately 15 additional miles.

June 2006:
• Concept Plan Approved by DEQ & COE
Since February 2008, over 33,000 lf of restoration completed

• Snakeden Branch
• The Glade, Reaches 1-4B
• Portion of The Glade, Reach 6

**Reach**: A section of stream having relatively uniform physical attributes, such as:

- Flow
- Dimension
- Pattern
- Profile
- Dominant bed material
- Tributary confluences
- Culvert crossings

For this project, reaches range in length from 500’ to 4,000’
Restoration Progress – Reach 13

Pre-Construction (March 2008)

Post-Construction (October 2009)
RESTORATION PROGRESS – REACH 4A

Pre-Construction (September 2009)

Post-Construction (November 2009)
Wetland Restoration Progress - Reach 4A

Pre-Construction (September 2009)

Post-Construction (November 2009)
RESTORATION PROGRESS – TRIBUTARY TO REACH 4A

Pre-Construction (September 2009)

Post-Construction (December 2009)
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THE URBAN WATERSHED PROBLEM

Source: The Federal Interagency Stream Restoration Working Group

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THE URBAN WATERSHED PROBLEM IN RESTON

1954 - Northeast Reston

1988 - Northeast Reston
The Urban Watershed Problem In Reston

1954 – Lake Anne Area

1988 – Lake Anne Area
THE URBAN WATERSHED PROBLEM IN RESTON

1954 – Lake Newport Area

2000 – Lake Newport Area
**Problem: Urban Stream Syndrome (USS)**

- Total Phosphorus (TP), Total Nitrogen (TN), and Total Suspended Solids (TSS) flows downstream

Eroding meander bend adjacent to Wiehle Ave in Reston
CORRECTING THE PROBLEM

Option 1: Watershed Improvements - remove impervious areas

- Retrofit hard surfaces with pervious pavements - pervious concrete or pavers
- Retrofit buildings with green roofs

A reduction in impervious area results in a reduction in runoff
**CORRECTING THE PROBLEM**

**Option 2: Watershed Improvements – stormwater management**

- Provide conventional stormwater management facilities throughout the watershed
- Install low-impact development features - swales, rain gardens, green roofs, and pervious pavements

![Conventional dry pond in Fairfax County](image1)

![Green roof at WSSI](image2)

![Water quality swale at WSSI](image3)

![Rain Garden at WSSI](image4)
**Correcting the Problem**

**Option 3:** Restore streams to handle these flowrates

Lowering the floodplain results in a larger project area

![Diagram showing many trees removed and large cut volumes resulting in waste material.](image1)

Raising the bed is much less disruptive.

![Diagram showing fewer trees removed and balanced cut and fill volumes resulting in less waste.](image2)
Correcting the Problem
Conventional Stormwater Scenario
(Example in the Glade)

Assumptions:

- Storage volume based on 3,000 cubic ft per developed acre (1 yr, 24-hr release / 2 & 10 yr control)
- Average depth of 3 feet
- 20 foot grading/dam outside storage area
CORRECTING THE PROBLEM
CONVENTIONAL STORMWATER SCENARIO

Results
(The Glade)
- 75 ponds
- 29.3 acres disturbance from grading

The Glade Watershed
CORRECTING THE PROBLEM
BIO-RETENTION SCENARIO
(EXAMPLE IN THE GLADE)

Assumptions:
- WQ Storage volume based on capturing $\frac{1}{2}$ inch of run-off per impervious area
- Underground detention for quantity control
- Maximum ponding depth of 6 inches
- Maximum drainage area of 1 acre
- Average drainage area of $\frac{2}{3}$ acre (developed)
- 10 foot grading/berm outside of storage area
Correcting the Problem
Bio-Retention Scenario

Results (The Glade)

• 830 Bio-retention facilities
• 36.7 acres disturbance from grading
WHY RESTORE?

Reconnect to the existing floodplain to:

- Slow velocities
- Increase evapotranspiration
- Remove pollutants (TP, TN, and TSS)
- Improve riparian habitat
- Restore groundwater levels

UVA Research Park – Charlottesville, VA

After planting - 1999

Stream relocation - 1999

2007
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**Design Methodology for Urban Streams**

- Natural Channel Evolution -

Evolutionary process considers the channel’s incision, bank stability, & sedimentation load (aggrading or degrading)

Severe → Poor → Marginal → Suboptimal → Optimal

Severe Channel Condition

Optimal Channel Condition

South Lakes High School

Ellanore Lawrence Park
**Urban Stream - Design Realities**

1. Significantly more flow than rural streams.
2. Significantly more “bankfull” events than in rural watersheds.
3. Given site constraints, reinforcement is necessary.
   - Rock structures – using native diabase rock
   - Reinforced bed
   - Heavy planting densities – native vegetation only

Snakeden Branch – Reach 3 (after 16 months)  
McLean Place (after 4.5 yrs)
**RESTORATION APPROACHES**

*Priority 1 Restoration* - Raise stream to reconnect with the floodplain.

- Fewer trees removed
- Balanced cut and fill volumes result in less waste

Snakeden Branch Reach 2 – Priority 1 Restoration
**Restoration Approaches**

**Priority 2 Restoration** – Excavate floodplain at lower elevation.

Many trees removed

Large cut volumes result in waste material

**Priority 3 Restoration** – Confined stream valleys.
RESTORATION APPROACHES

Priority 4 Restoration – Stabilize in-place

Snakeden Branch Reach 2 (2003, by others) –
Long-term stability not achieved using this approach.
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Existing Conditions In Colvin Run

Bennington Woods South
Existing Conditions in Colvin Run

Vantage Hill

Exposed Manhole
**Existing Conditions In Colvin Run**

Forest Edge North
Existing Conditions In Colvin Run

Forest Edge South

Exposed utility and manhole
Existing Conditions In Colvin Run

Wiehle North

Exposed utility
Colvin Run Restoration Priorities

<table>
<thead>
<tr>
<th>Priority</th>
<th>Reach Name and Adjacent Clusters</th>
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<tbody>
<tr>
<td>1</td>
<td>Forest Edge (North, South)</td>
</tr>
<tr>
<td></td>
<td>• Hillcrest Cluster</td>
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<tr>
<td></td>
<td>• Forest Edge Cluster</td>
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<tr>
<td></td>
<td>Vantage Hill</td>
</tr>
<tr>
<td></td>
<td>• Hickory Cluster</td>
</tr>
<tr>
<td></td>
<td>• Vantage Hill Condo</td>
</tr>
<tr>
<td></td>
<td>Bennington Woods (North, South)</td>
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<tr>
<td></td>
<td>• Bennington Square Cluster</td>
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<tr>
<td>2</td>
<td>Lake Anne (East, West)</td>
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<tr>
<td></td>
<td>• Waterview Cluster</td>
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<tr>
<td></td>
<td>• Sunderbriar Cluster</td>
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<td>• Northgate Condo</td>
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<td>3</td>
<td>Wiehle (North, South)</td>
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<td>• Forest Edge Cluster</td>
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<td></td>
<td>• Regency Square Cluster</td>
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<td></td>
<td>Tall Oaks</td>
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<td>4</td>
<td>Lake Newport (North, Middle, West)</td>
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<td></td>
<td>• Hampton Point Condo</td>
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<td></td>
<td>• Ashley Court Cluster</td>
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<td></td>
<td>• Lantern Cluster</td>
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<td>5</td>
<td>Buttermilk</td>
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<td></td>
<td>• Hunt Club Cluster</td>
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<tr>
<td>6</td>
<td>Baron Cameron</td>
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<td>Lake Newport (South)</td>
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March 2010
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**Data Collection**

- Obtained aerial photography and topography of Phase I watersheds.
- Investigated stream valleys for potential archeological sites.
- Survey located & tagged **nearly 35,000** trees (≥ 4” dbh) *so far!*
- Surveyed channel profile and cross-sections.
- Performed geomorphic analyses.
- Performed wetland delineations and obtained Jurisdictional Determinations (JD’s).
- Installed water level and rain gages to aid in design.
Two Types Required

1. **Deed of Temporary Easement**: to allow for construction access and 10-yrs of monitoring and maintenance.

2. **Restoration Easement**: to protect the stream and buffer in perpetuity.
**EXISTING CONDITIONS**

Survey and walk existing stream corridor, including infrastructure and trees.

**THE DESIGN PROCESS**

Determine Bankfull Width and Bankfull Area to convey current flows.

Apply Bankfull Width to reference ranges of sinuosity and meander radii.

(Continued)

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**Snakeden at Soapstone Drive**

- **Wb kf = 18.0’**
- **Rc = 25’**

**Reference Range**

- Sinuosity: 1.0 – 1.7
- Rc/Wb kf: 1.3 – 3.7

**Rural Cross-Section (14.8 sf)**

- **Wb kf = 34’**
- **Rc = 65’**

**Urban Cross-Section (64.8 sf)**

- **Sinuosity = 1.2**
- **Rc = 30’**

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**EXISTING CONDITIONS**

Survey and walk existing stream corridor, including infrastructure and trees.

**THE DESIGN PROCESS**

Determine Bankfull Width and Bankfull Area to convey current flows.

Apply Bankfull Width to reference ranges of sinuosity and meander radii.

(Continued)
Stream Restoration Design & Minimizing Tree Impacts

The Design Process, Continued

Layout initial design and avoid high value trees and existing infrastructure (utilities, trails, etc.).

Revise restoration design to further minimize tree impacts (typically several iterations).

Arborist and contractor field review to make final avoidance assessment.

Iterative Design Process

Also, determine access - preferably by existing trails and sewers to minimize impacts.
STREAM RESTORATION DESIGN & MINIMIZING TREE IMPACTS

TREE IMPACT CONSIDERATIONS

Ecological / Habitat Value

- Size / Diameter
- Higher - Climax species: Oaks, Hickory, Holly (*mast producers, long-lived; 12% of existing*).
- Lower – Early successional species: Maples, Poplar (*fast-growing, short-lived; 65% of existing species*).

Existing Condition

- Undercut by stream, high proportion of exposed roots, short life expectancy
- Dead, dying, diseased, or damaged trees that pose a human safety hazard
- Impacting or pending impact to infrastructure (*utilities, roads, trails, etc.*)

Proposed Condition

- Drip line heavily impacted during restoration, minimal chance of survival, AND
- Human safety hazard to trails, houses, bridges, etc.
**Stream Restoration Design & Minimizing Tree Impacts**

**SHORT TERM IMPACT FOR LONG TERM BENEFIT**

- **Cleared trees “recycled”** as in-stream habitat, grade control, wood-chip trails, habitat “brush” piles, firewood
- **Restoration raises the water table**, (raises stream bed) which increases stream access to floodplain and nutrient delivery to roots.
- **Healthier ecosystem will develop** with the density and species variety of replacement plantings
  - Mosquito population control via predator habitat
  - Dense streambank planting will provide shade, reduce water temperatures, increase oxygenation, increase fish survivability
  - Dragonfly larva molting access via heavily planted streambank with shallower slope
- **Canopy loss will close** as remaining trees adjust and react to increased sunlight, growing to fill in openings

**FEWER TREES CUT = LOWER RESTORATION COST**

- **Tree-climbing removal method** vs. traditional forestry timbering *(minimize impacts to neighboring trees)* is expensive.
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CONSTRUCTION – THE GLADE REACH 4A

Pre-Construction (August 2009)

Construction (October 2009)
CONSTRUCTION – THE GLADE REACH 4A

Pre-Construction (September 2009)

Construction (October 2009)
CONSTRUCTION – THE GLADE REACH 4A

Pre-Construction (August 2009)

Construction (October 2009)
Snakeden Reach 1

Pre-Construction

Construction

Post Construction

4 Months After Construction
Snakeden Reach 2

Pre-Construction

Construction

Post Construction

4 Months After Construction
Snakeden Reach 2

Pre-Construction

Construction

Wall

Post Construction

5 Months After Construction
Snakeden Reach 3

Pre-Construction

Post Construction

15 Months After Construction
The Glade Reach 1

Pre-Construction

Days After Construction

Construction

1 Month After Construction
THE GLADE BRIDGES
PLANTING – TREES & SHRUBS

Split into 2 planting zones:

- Riparian
  - 1 gallon containers (planted at 640 plants/acre)
  - Both trees & shrubs
- Streamside
  - live stakes/tubelings (planted 1ft o.c.)
  - shrubs (planted 3 ft o.c.)

EXAMPLE TOTAL PLANTINGS:

Glade, Reach 1 (1939 lf) - 2,371 Trees, 3,296 Shrubs
Glade, Reach 2 (1901 lf) - 2,215 Trees, 3,013 Shrubs
Glade, Reach 3 (3576 lf) - 4,168 Trees, 6,077 Shrubs

- **Tree Species:** Pin Oak, Willow Oak, White Oak, Swamp White Oak, Northern Red Oak, Sweet Gum, Black Gum, River Birch, Sycamore, Red Maple, Box Elder, and Black Willow.

- **Shrub Species:** Silky Dogwood, Southern Arrowwood, American Holly, Service-Berry, Black-Haw, Eastern Redbud, Elderberry, Flowering Dogwood, and Brookside Alder, Hazelnut, Northern Spicebush, Black-Haw, Winterberry.
PLANTING - RIPARIAN SEED MIX

- Applied at a rate of 125 lbs/acre
- Custom mix
- Consists of native species found in a healthy, diverse NOVA ecosystem:

• **Tree Species**
  – Musclewood
  – Black Gum
  – American Sycamore
  – Red Maple
  – Eastern Redbud
  – Flowering Dogwood

• **Forbs**
  – Oxeye Sunflower
  – Joe-Pye Weed
  – Grass Leaved Goldenrod
  – PLUS 24 additional species!

• **Shrub Species**
  – Witch Hazel
  – Winterberry
  – Southern Arrow Wood
  – Northern Spicebush
  – Canadian Serviceberry
  – Black Chokeberry
  – Black-Haw

• **Grass Species**
  – Squarrose Sedge
  – Riverbank Wild Rye
  – Foxtail Millet
  – PLUS 8 additional species!
GREATERR WILDLIFE SPECIES RICHNESS

- Mature forest continues to provide habitat for raptors, woodpeckers, bats and deer

- Recently planted areas provide habitat for small mammals, song birds, fox and deer

- All species benefit from the “edge effect”

- Restored stream allows detrital input to be processed, thus increasing stream health and function
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TECHNICAL REVIEW

• US Army Corps of Engineers
• Virginia Department of Environmental Quality
• Virginia Department of Conservation and Recreation (for E&S)
• Fairfax County Department of Public Works and Environmental Services
• Camp Dresser McKee (Monthly Inspections for Lender)
  – Internationally recognized environmental engineering firm with approximately 4,000 employees and over 100 offices worldwide
Monitoring and Maintenance

10-Year Monitoring Program

- Streambed surveys
- Structure surveys
- Vegetation surveys
- Biological Surveys

- Must meet success criteria outlined in MBI – or fix!
Monitoring / Maintenance and Catastrophic Event Fund

Catastrophic Event

• 5% of all sale proceeds placed in interest bearing account.
• $5 million, plus interest.
• Available for RA use after 10-yr monitoring period.
• Currently no funds available unless paid with RA dues.

Monitoring and Maintenance

• 15% of all sales proceeds ($15 million value).
• 1/10 released per year if stream criteria achieved.
TROPICAL STORM HANNA (9/06/08)

100-YR EVENT (6.22” IN 9 HOURS)
TROPICAL STORM HANNA

2 - DAYS LATER

High Water Mark
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Conclusion

1. Reston streams are seriously degraded due to urbanization – a situation made even worse by a lack of stormwater management. An ideal place to establish the NVSRB.

2. Fully restored streams will provide long-term stability & financial benefits to the community:
   - Phase I: $70 million Restoration
   - $450,000 to Reston Association
   - $950,000 to Friends of Reston
   - $3 million of new bridges for Reston
   - Reduced dredging costs for RA lakes
   - $5 million Catastrophic Event Fund

3. Short-term construction disturbance will provide long-term societal and ecological benefits to a heavily used, urban stream valley network.
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