NORTHERN VIRGINIA STREAM RESTORATION BANK—BACKGROUND AND STATUS REPORT

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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
Wetland Studies and Solutions, Inc.

Loudoun County Wetlands and Stream Bank - Phase II
August 2008 (9 months after completion)

MITIGATION EXPERIENCE

• Developed 17 Mitigation Bank sites:
  • ± 900 acres of wetlands
  • 140,000 lf of stream
What is Mitigation Banking?
HOW IT WORKS

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.

Under the market-oriented system, they can go to a “bank” created by a Bank Sponsor who has obtained credit for restoring impaired streams elsewhere in the same portion of the rivershed & physiographic province.

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.
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 members are actively involved in protecting local natural resources. Watershed Subcommittee of the Citizen’s Advisory Committee for the Environment and Ecology publishes a white paper in 2000 - “Reston’s Watersheds: An Assessment of Conditions and Management Strategies”

• Watershed Plan published in April 2002.
Why a Stream Bank in Reston?

- Community of Reston includes entire watersheds.
- There is a demand for stream mitigation in the region.
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
• Obtained aerial photography and topography of Phase I watersheds.
• Investigated stream valleys for potential archeological sites.
• Survey located & tagged nearly 30,000 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.
**Data Collection**

**EASEMENTS**

**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.

- Most land in stream valleys owned by RA.
THE URBAN WATERSHED PROBLEM

Source: USDA

Natural Ground Cover
- 40% evapotranspiration
- 25% shallow infiltration
- 25% deep infiltration
- 10% runoff

10%-20% Impervious Surface
- 38% evapotranspiration
- 21% shallow infiltration
- 21% deep infiltration
- 20% runoff

35%-50% Impervious Surface
- 35% evapotranspiration
- 20% shallow infiltration
- 15% deep infiltration
- 30% runoff

75%-100% Impervious Surface
- 30% evapotranspiration
- 10% shallow infiltration
- 5% deep infiltration
- 55% runoff

Source: USDA
**Urban Stream Syndrome (USS)**

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

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*Eroding meander bend adjacent to Wiehle Ave in Reston*

*Exposed sewer manhole – Reach 12 in Snakeden*
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

Pervious concrete at WSSI

Green roof at WSSI

GravelPave2 infiltrating a large rainstorm at WSSI

Pervious pavers at WSSI
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
CORRECTING THE PROBLEM

Option 2: Restore streams to handle these flowrates

Lowering the floodplain results in a larger project area

- Many trees removed
- Large cut volumes result in waste material

Raising the bed is much less disruptive.

- Fewer trees removed
- Balanced cut and fill volumes result in less waste
**Conventional Stormwater Scenario**

**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

Dry Ponds in Fairfax County
CONVENTIONAL STORMWATER SCENARIO

Results

- 75 ponds
- 29.3 acres disturbance from grading
**Bio-Retention Scenario**

**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

*Rain Garden at Mike Rolband's House*
Bio-Retention Scenario

Results
- 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

Stream relocation - 1999

Same stream - 2007
Existing Conditions In The Glade

Reach 1

Exposed utility lines

THE GLADE WATERSHED
Existing Conditions In The Glade

Reach 1

Exposed utility lines
Existing Conditions In The Glade

Reach 1

Riprap washed away – fabric exposed
Existing Conditions In The Glade
Existing Conditions In The Glade

Reach 3
Existing Conditions In The Glade

Reach 4A
Existing Conditions In The Glade

Reach 4A

Sanitary sewer providing grade control – 4’ pool depth
EXISTING CONDITIONS IN THE GLADE

Reach 4A

Exposed utility line
Existing Conditions In The Glade

Reach 4B

THE GLADE WATERSHED
Evolutionary process considers the channel’s incision, bank stability, & sedimentation load (aggrading or degrading).
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 6 months)  McLean Place (after 4.5 yrs)
CONSTRUCTION – REACH 2

Pre-Construction

Construction

Post Construction

4 Months After Construction
CONSTRUCTION – REACH 2

Pre-Construction

Wall

Post Construction

5 Months After Construction

© Wetland Studies and Solutions, Inc.
CONSTRUCTION – REACH 3

Pre-Construction

Construction

Post Construction

5 Months After Construction
Snakeden Bridges – Reach 3
CONSTRUCTION – REACH 12

Pre-Construction - 2004

Construction

Pre-Construction - 2008

Days After Construction

Existing Manhole

Existing Manhole

Existing Manhole

Existing Manhole

©
TROPICAL STORM HANNA (9/06/08)

100-YR EVENT (6.22” IN 9 HOURS)
Tropical Storm Hanna

2 - Days Later

High Water Mark
**Monitoring and Maintenance**

10-year monitoring program

- Streambed surveys
- Structure surveys
- Vegetation surveys
- Biological Surveys
- As-built for Reaches 1-4 has been approved.

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

How is it funded?

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.
## Sizes of Streams

Vary by % I.C. and D.A.

### Bankfull Width (ft)

**Snakeden Branch (38%, 863 ac)**

<table>
<thead>
<tr>
<th>Reach</th>
<th>Width (ft)</th>
<th>Locator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14</td>
<td>Top of Snakeden</td>
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<tr>
<td>2</td>
<td>16 - 17.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>17.5 - 22.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>14 - 18</td>
<td>Deepwood Cluster Trib</td>
</tr>
<tr>
<td>5</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>Tribs to Snakeden</td>
</tr>
<tr>
<td>6A</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6B</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>8A</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>6 - 8.5</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>32</td>
<td>Above Soapstone Dr</td>
</tr>
<tr>
<td>12</td>
<td>34</td>
<td>Below Soapstone Dr</td>
</tr>
<tr>
<td>13</td>
<td>20</td>
<td>South Lakes Trib</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>22</td>
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<tr>
<td>16</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>36</td>
<td>Above Lake Audubon</td>
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**The Glade (15%, 780 ac)**

<table>
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<tr>
<th>Reach</th>
<th>Width (ft)</th>
<th>Locator</th>
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<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>Steeplechase to Colts Neck</td>
</tr>
<tr>
<td>1A</td>
<td>8.5</td>
<td>Trib to Reach 1</td>
</tr>
<tr>
<td>2</td>
<td>13 - 18</td>
<td>Colts Neck to Steeplechase</td>
</tr>
<tr>
<td>3</td>
<td>6 - 11</td>
<td>Joins Reach 2 at Steeplechase</td>
</tr>
<tr>
<td>4A</td>
<td>16 - 19</td>
<td>Below Steeplechase</td>
</tr>
</tbody>
</table>
Stream Restoration Design & Minimizing Tree Impacts

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)

Reference Range
Sinuosity: 1.0 – 1.7
Rc/Wbkf: 1.3 – 3.7

Wbkf = 18'
Rc = 25'

Wbkf = 12.5'
Rc = 25'

Rural Cross-Section (8.3sf)

Urban Cross-Section (14.1sf)

Glade at Steeplechase Drive

Sinuosity = 1.2

Rc = 65'

Rc = 30'

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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.

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, timber products

• 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.
Wetland Restoration Area Plantings

- Seed mix includes 6 grass, 21 forb, 5 shrub and 5 tree species
- Plantings include 8 tree and 10 shrub species
- Riparian Forest: 640 trees/shrubs per acre
- Streamside:
  - 1 gallon container 3’ O.C.
  - live stake/tubling 1’ O.C.
- Increased sunlight on forest floor
- Edge effect established
Greater Wildlife Species Richness

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

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

- All species benefit from the “edge effect”

- Restored stream allows detrital input to be processed, thus increasing stream health and function
**Improved Aquatic Habitat Value**

- 1,423 linear feet of Sycolin Creek were restored - summer and fall of 2007.

- Long-term biological stream monitoring - habitat and benthic macroinvertebrates.

- 2008 Results - stream habitat and the benthic macroinvertebrates have improved since restoration - attributed to the establishment of riparian vegetation, the stability of the bioengineered banks, and improved geomorphology.

![Mayfly Larvae](image)

![Figure 1: Comparison of Habitat Assessment Scores for Pre-construction and Year 1 (post-construction)](image)
## Tree Summary

### The Glade Watershed

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Reston Association Area</td>
<td>208.4</td>
<td>acres</td>
</tr>
<tr>
<td>Church Easement Area</td>
<td>9.06</td>
<td>acres</td>
</tr>
<tr>
<td>Total Area</td>
<td>217.5</td>
<td>acres</td>
</tr>
<tr>
<td>Estimated Number of Trees (based on total area tree density)</td>
<td>25,259</td>
<td>trees</td>
</tr>
<tr>
<td>Acres in Tree Survey</td>
<td>82.4</td>
<td>acres</td>
</tr>
<tr>
<td>Number of Trees</td>
<td>9,573</td>
<td>trees</td>
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<tr>
<td>Tree Density</td>
<td>116</td>
<td>trees/acre</td>
</tr>
<tr>
<td>Limits of Clearing 1-3, 4A (LOC)</td>
<td>17.19</td>
<td>acres</td>
</tr>
<tr>
<td>Total Trees Within LOC</td>
<td>1,848</td>
<td>trees</td>
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### Snakeden Watershed

<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Reston Association Area</td>
<td>117.1</td>
<td>acres</td>
</tr>
<tr>
<td>Cluster Easement Area</td>
<td>52.6</td>
<td>acres</td>
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<tr>
<td>Total Area</td>
<td>169.72</td>
<td>acres</td>
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<tr>
<td>Estimated Number of Trees (based on total area tree density)</td>
<td>28,876</td>
<td>trees</td>
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<tr>
<td>Acres in Tree Survey</td>
<td>63.8</td>
<td>acres</td>
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<tr>
<td>Number of Trees</td>
<td>10,852</td>
<td>trees</td>
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<tr>
<td>Tree Density</td>
<td>170</td>
<td>trees/acre</td>
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<tr>
<td>Limits of Clearing</td>
<td>28.9</td>
<td>acres</td>
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<tr>
<td>Total Trees Within LOC</td>
<td>3,264</td>
<td>trees</td>
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### Snakeden Post Construction Results

<table>
<thead>
<tr>
<th>Reach</th>
<th>Area (Ac.)</th>
<th>Trees</th>
<th>Density (trees/ac.)</th>
<th>Number of Trees Taken</th>
<th>% of Trees Taken</th>
</tr>
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<tbody>
<tr>
<td>6A</td>
<td>0.47</td>
<td>71</td>
<td>150</td>
<td>43</td>
<td>61%</td>
</tr>
<tr>
<td>8A</td>
<td>0.48</td>
<td>78</td>
<td>161</td>
<td>19</td>
<td>24%</td>
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<tr>
<td>Totals</td>
<td>0.96</td>
<td>149</td>
<td>155</td>
<td>62</td>
<td>42%</td>
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</table>
THE GLADE - PROPOSED LIMITS OF CLEARING REACHES 1-4A AND TRIBUTARIES
Old Horse Arena
Existing Conditions

Upstream Inlet

Downstream Outlet

Wetland Studies and Solutions, Inc.
OLD HORSE ARENA
EXISTING CONDITIONS

Looking Downstream

Looking Toward Steeplechase Drive

33" Culvert
**Old Horse Arena - Option #1**

**Existing Conditions**
- 135 LF culvert with poorly draining fill

**Option #1**
- Maintain 2 flat areas
- Daylight stream with a 3-ft bench at 15:1 slope
- From bench up to existing grade slope ranges from 4:1 up to 10:1

Culvert will be removed.
**Old Horse Arena - Option #2**

**Existing Conditions**
- 135 LF culvert with poorly draining fill

**Option #2**
- Tie-in upstream & downstream restoration with existing culvert

Culvert remains in-place.
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.
Questions ?