



# 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.**

Wetland Studies and Solutions, Inc.

5300 Wellington Branch Drive · Suite 100 · Gainesville · Virginia 20155

[www.wetlandstudies.com](http://www.wetlandstudies.com)



# 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.

- Mitigation Experience
  - Developed 17 mitigation bank sites
  - ± 900 acres of wetlands
  - 140,000 lf of stream



North Fork Wetland Mitigation Bank



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



Snakeden Branch – Reach 3

# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- Construction and Plantings
- Technical Review, Monitoring, and Maintenance
- Summary
- Questions

# AGENDA

- **Mitigation Banking and Why Reston?**
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- Construction and Plantings
- Technical Review, Monitoring, and Maintenance
- Summary
- Questions

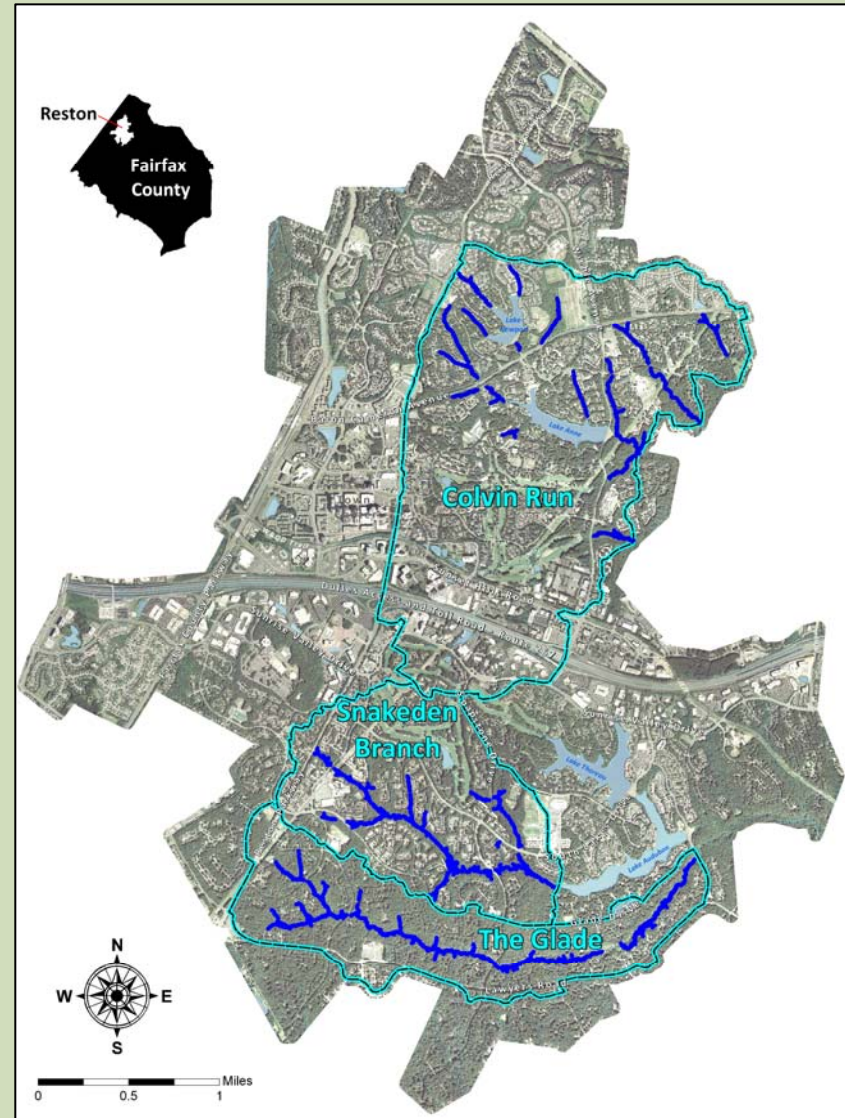
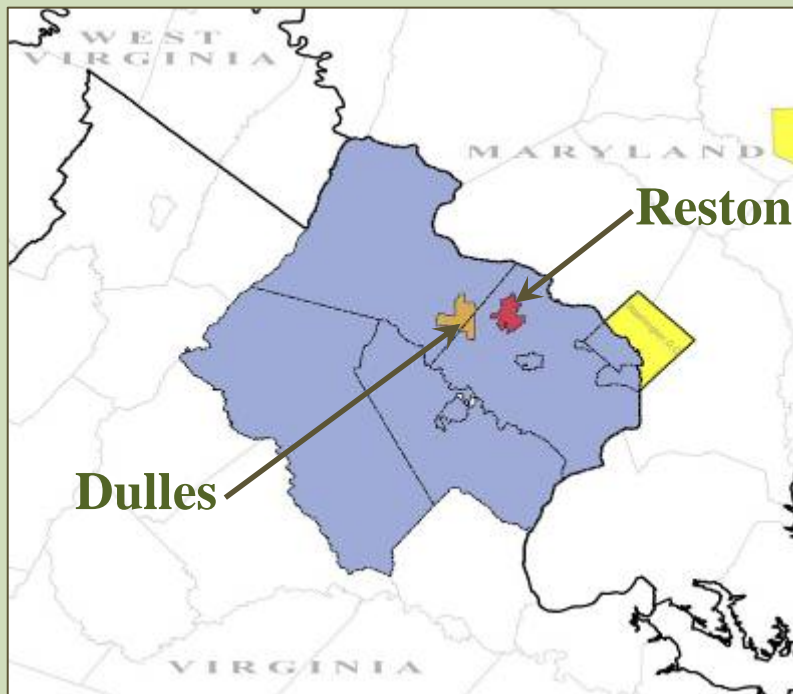
# WHY A STREAM BANK IN RESTON?

- Community members are actively involved in protecting local natural resources
  - They recognized the degraded state of the streams
  - Watershed Subcommittee of the Citizen's Advisory Committee for the Environment and Ecology published 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?

- 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)

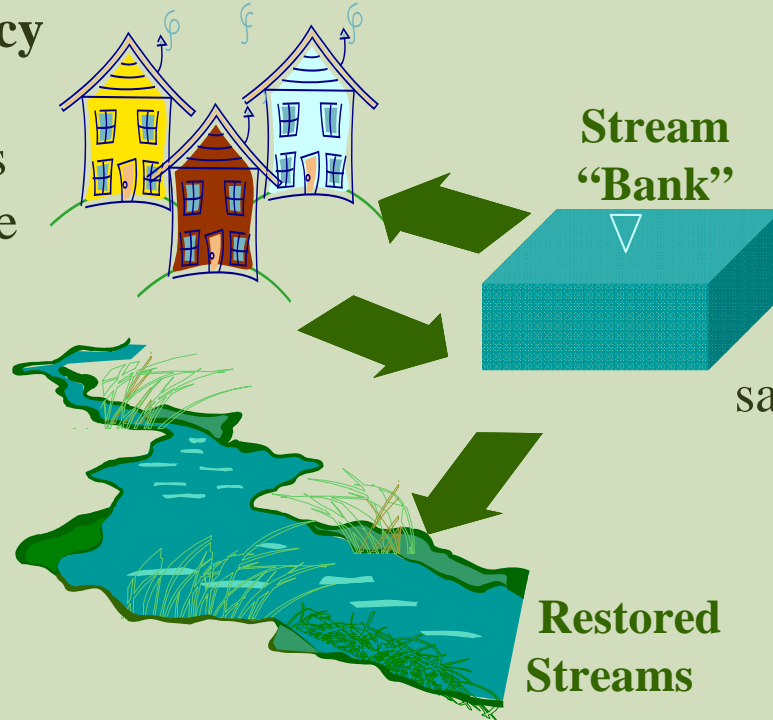


# WHAT IS MITIGATION BANKING ?

## 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.

**Public Works /  
Landowner**



**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.

# 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)
- VA State Law HB-2464 Approved: Defines “*Natural Channel Design Concepts*” in Code of Virginia.

### July 2005:

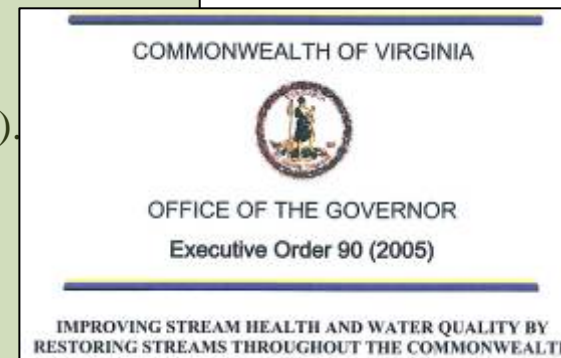
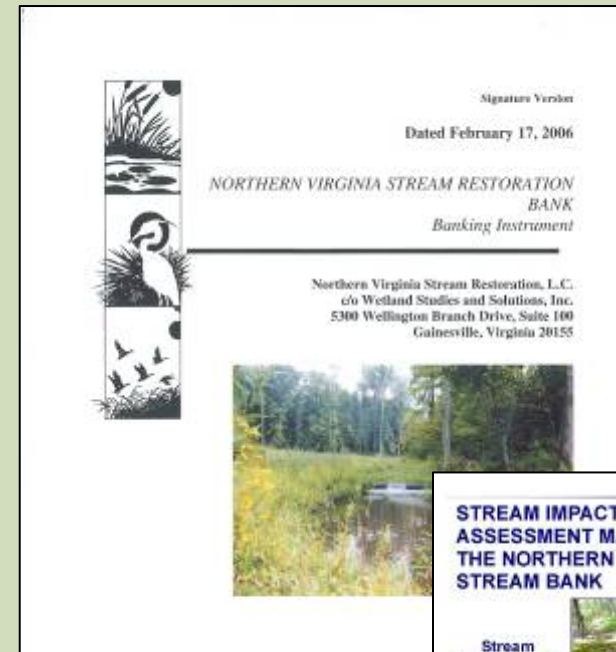
- Executive Order 90 Issued – “*Improving Stream Health and Water Quality by Restoring Streams Throughout the Commonwealth*”

### February 2006:

- DEQ & COE sign MBI for Phase I (~14 miles).
- Phase II approximately 15 additional miles.

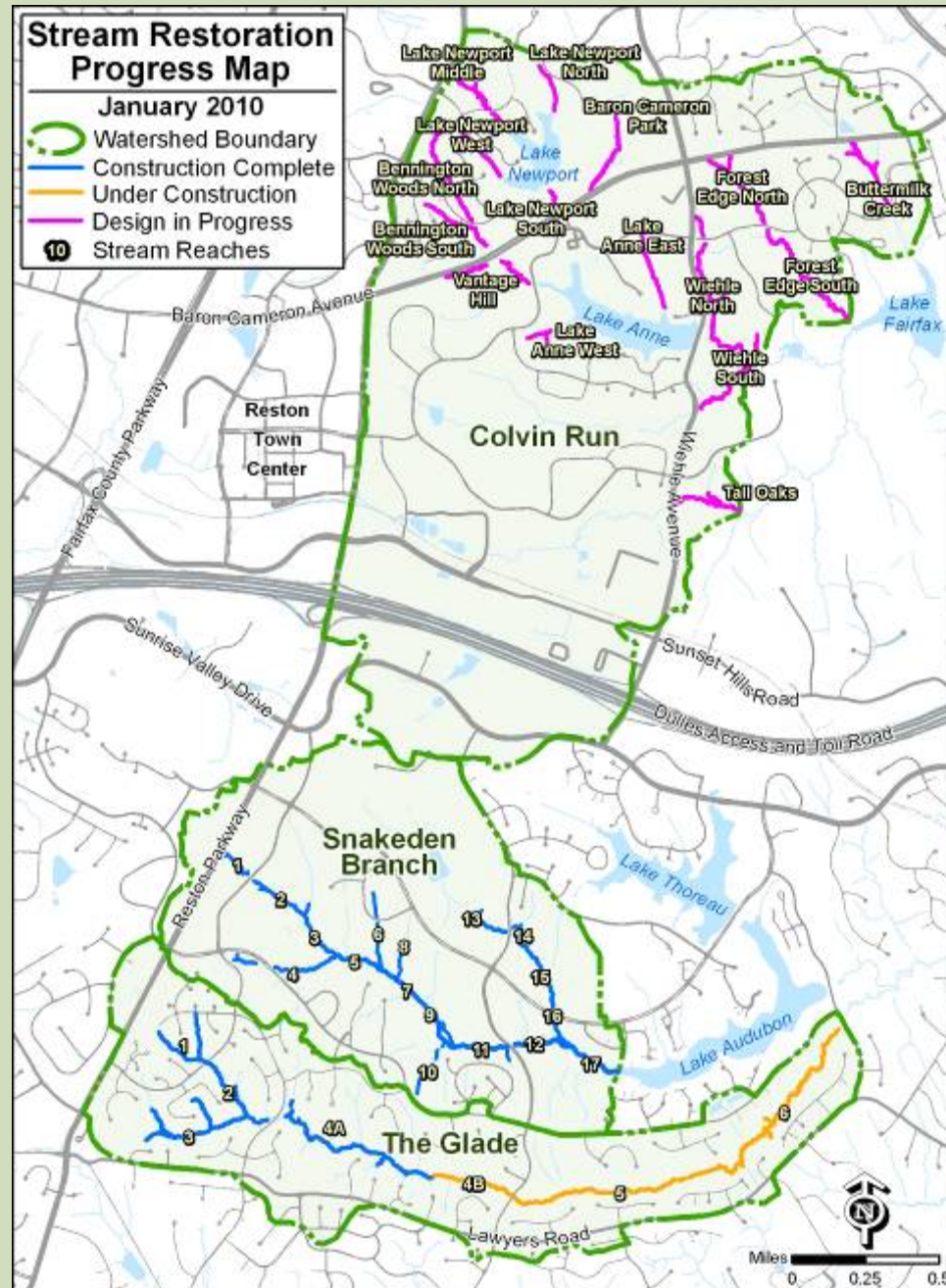
### June 2006:

- Concept Plan Approved by DEQ & COE



# RESTORATION PROGRESS

- Since February 2008, over 30,000 lf of restoration completed
  - Snakeden
  - The Glade, Reaches 1-4A
  - Portion of The Glade, Reach 4B



# RESTORATION PROGRESS – REACH 13



Pre-Construction  
(March 2008)

Post-Construction  
(October 2009)



# RESTORATION PROGRESS – REACH 4A



Pre-Construction  
(September 2009)

Post-Construction  
(November 2009)



# RESTORATION PROGRESS – REACH 4A



Pre-Construction  
(September 2009)

Post-Construction  
(November 2009)



# RESTORATION PROGRESS – TRIBUTARY TO REACH 4A



Pre-Construction  
(September 2009)

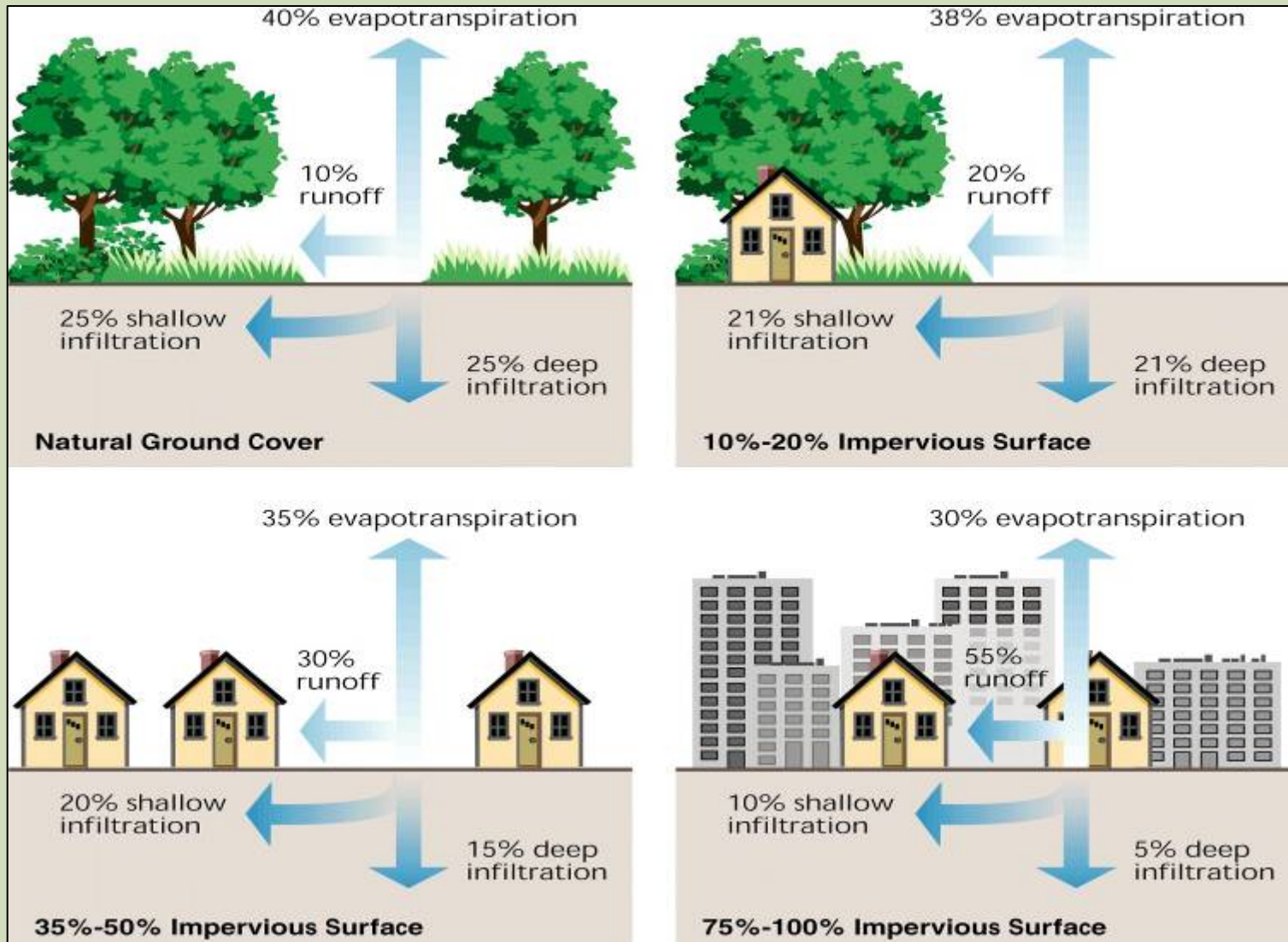
Post-Construction  
(December 2009)



# AGENDA

- Mitigation Banking and Why Reston?
- **The Urban Watershed Problem and Solutions**
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- Construction and Plantings
- Technical Review, Monitoring, and Maintenance
- Summary
- Questions

# THE URBAN WATERSHED PROBLEM



Source: The Federal Interagency Stream Restoration Working Group



# THE URBAN WATERSHED PROBLEM IN RESTON



1954 - Northeast Reston



1988 - Northeast Reston

# THE URBAN WATERSHED PROBLEM IN RESTON



1954 – Lake Anne Area

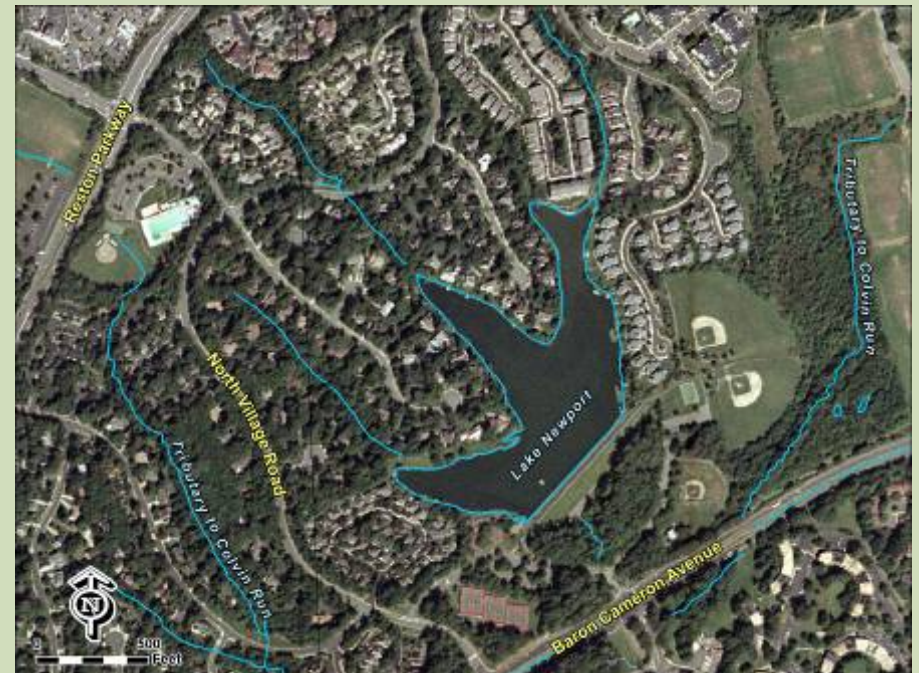


1988 – Lake Anne Area

# THE URBAN WATERSHED PROBLEM IN RESTON



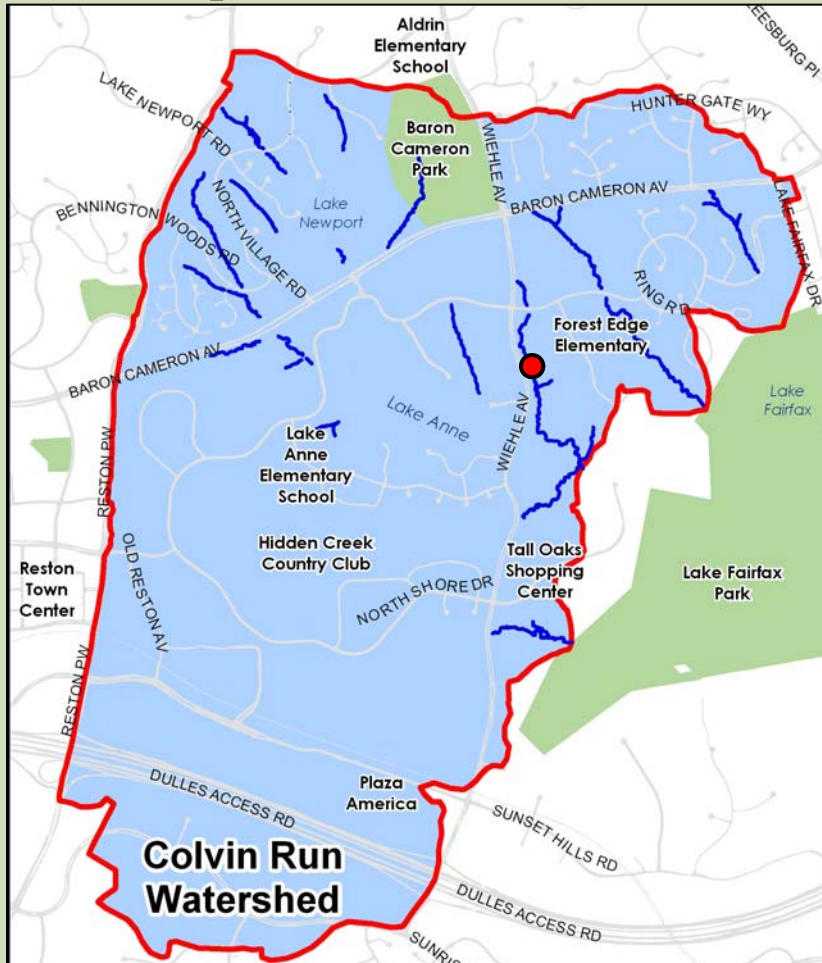
1954 – Lake Newport Area



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*



Green roof at WSSI



Pervious concrete  
at WSSI

Pervious pavers  
at WSSI

GravelPave2 infiltrating during a large rain storm 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



Conventional dry pond in Fairfax County



Green roof at WSSI



Water quality swale at WSSI

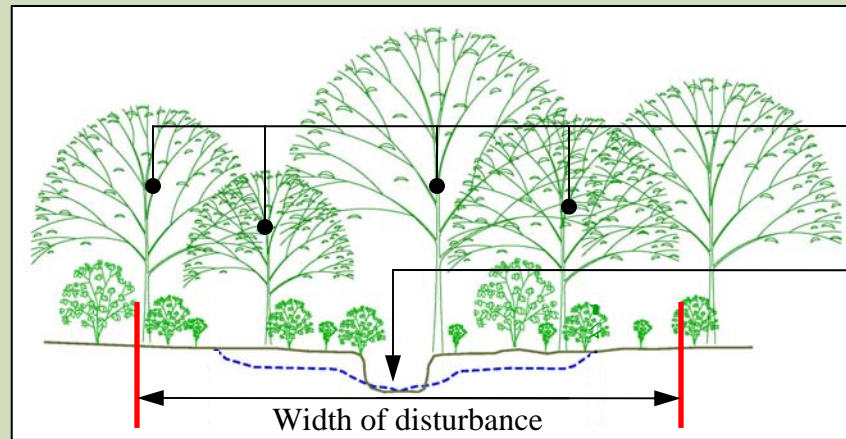


Rain Garden at WSSI

# CORRECTING THE PROBLEM

Option 3: Restore streams to handle these flowrates

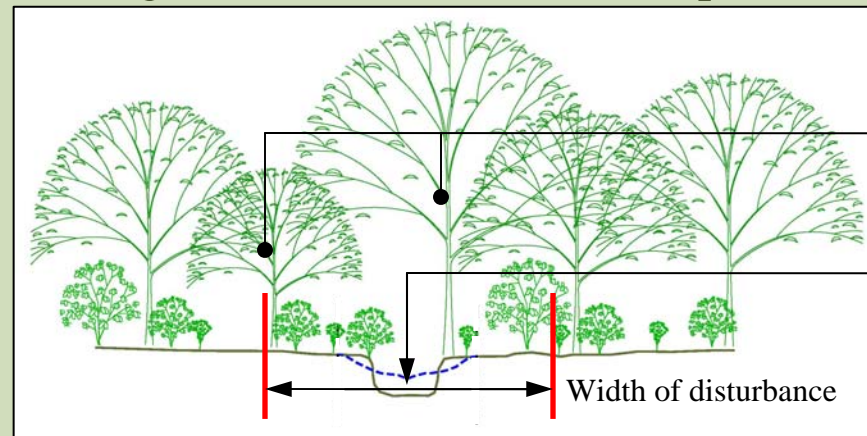
Lowering the floodplain results in a larger project area



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

# 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



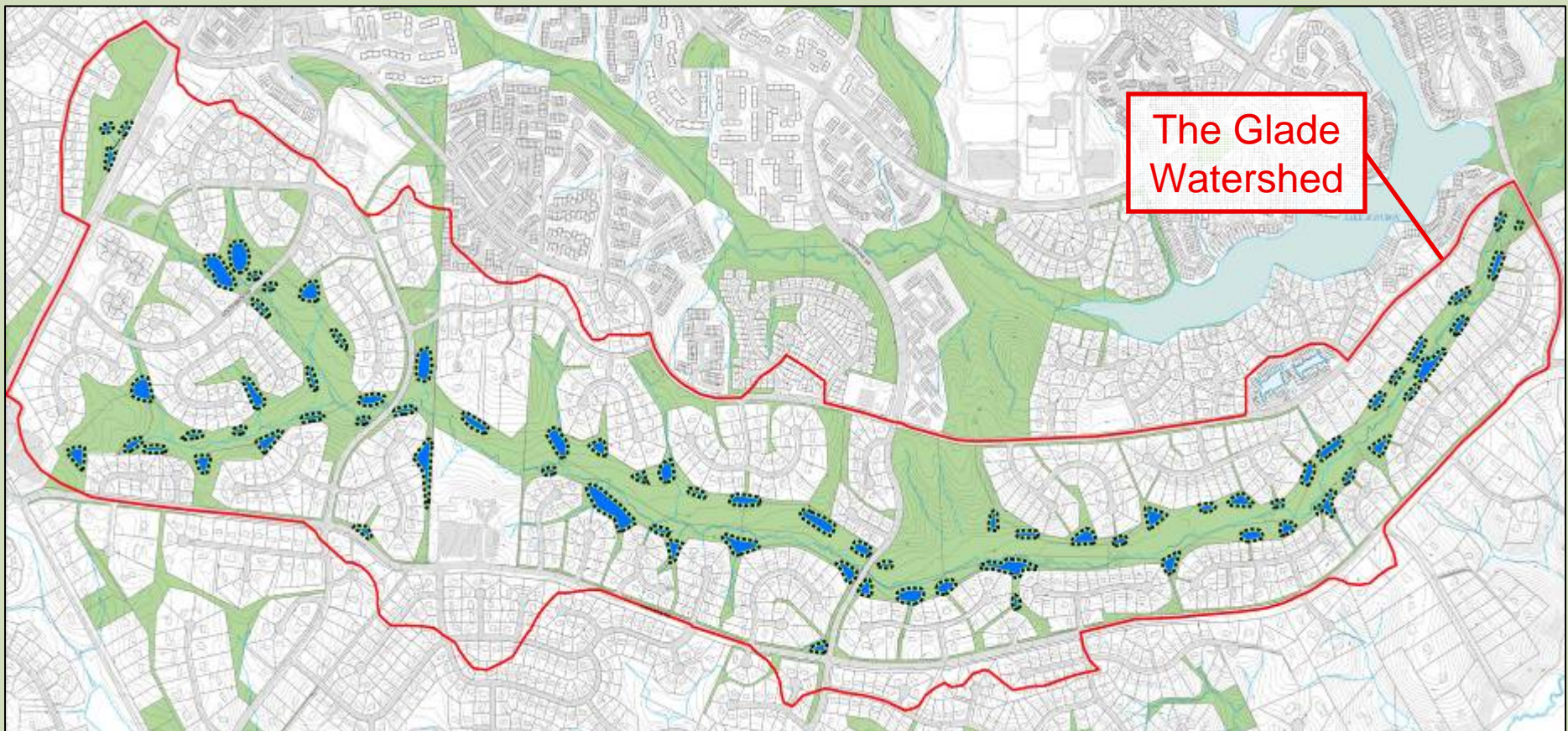
Dry Ponds in Fairfax County

# CORRECTING THE PROBLEM

## CONVENTIONAL STORMWATER SCENARIO

### **Results** (The Glade)

- 75 ponds
- 29.3 acres disturbance from grading



# 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



Rain Garden at Mike Rolband's House

# 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



Stream relocation - 1999

**UVA Research Park – Charlottesville, VA**



After planting - 1999



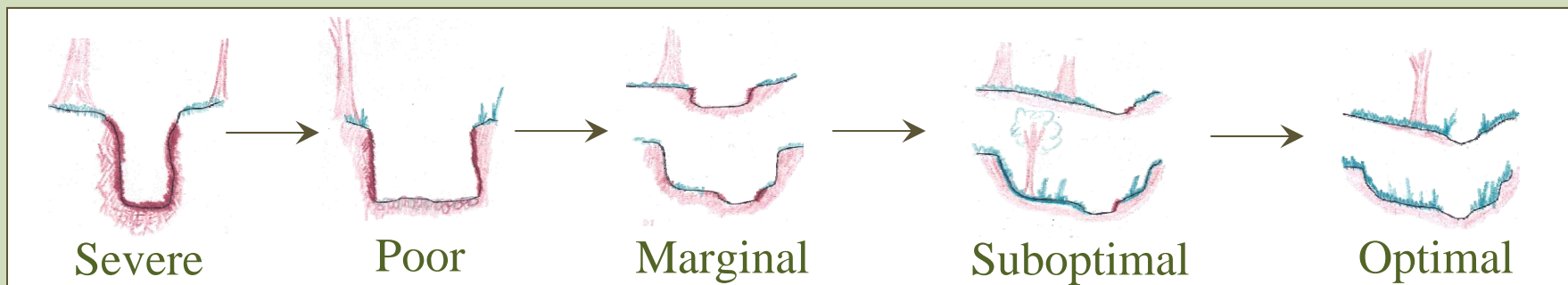
2007

# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- **Urban Stream Restoration Methodology**
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- Construction and Plantings
- Technical Review, Monitoring, and Maintenance
- Summary
- Questions

# DESIGN METHODOLOGY FOR URBAN STREAMS - NATURAL CHANNEL EVOLUTION -

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



South Lakes High School

Severe  
Channel Condition

Optimal  
Channel Condition



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



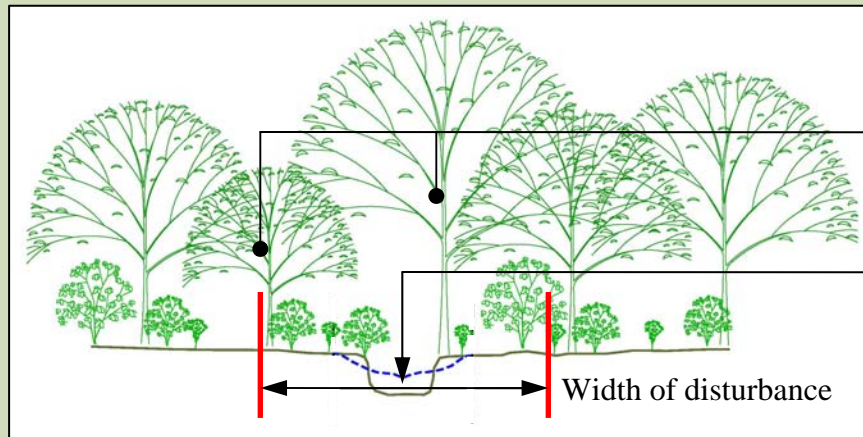
Snakeden Branch – Reach 3 (after 16 months)



McLean Place (after 4.5 yrs)

# RESTORATION APPROACHES

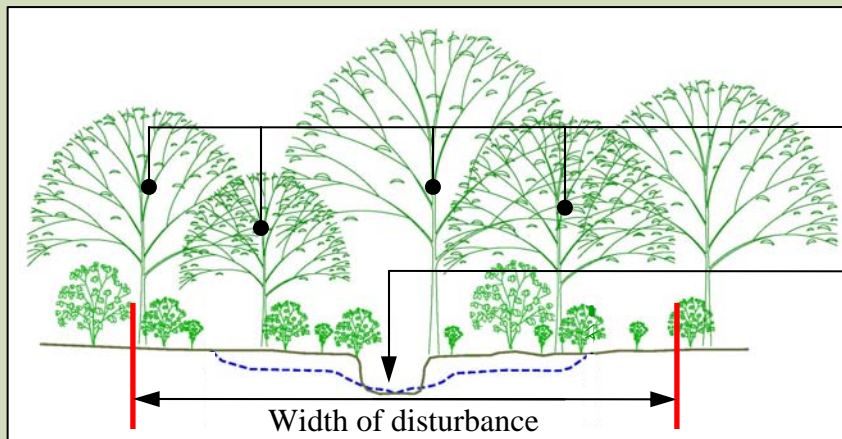
**Priority 1 Restoration** - Raise stream to reconnect with the floodplain.



Snakeden Branch Reach 2 – Priority 1 Restoration

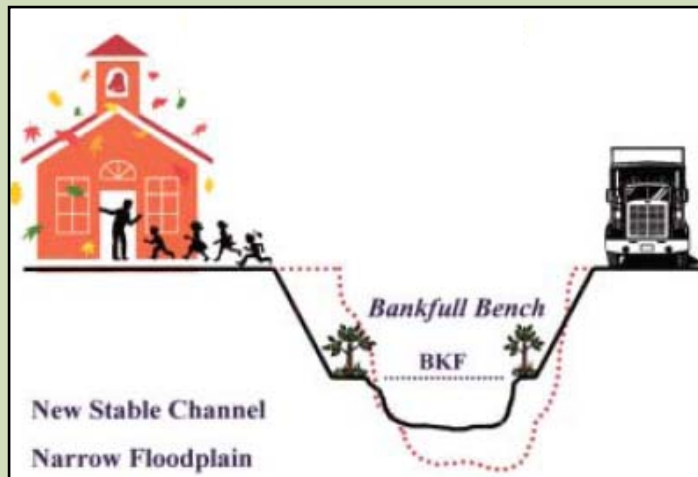
# RESTORATION APPROACHES

**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

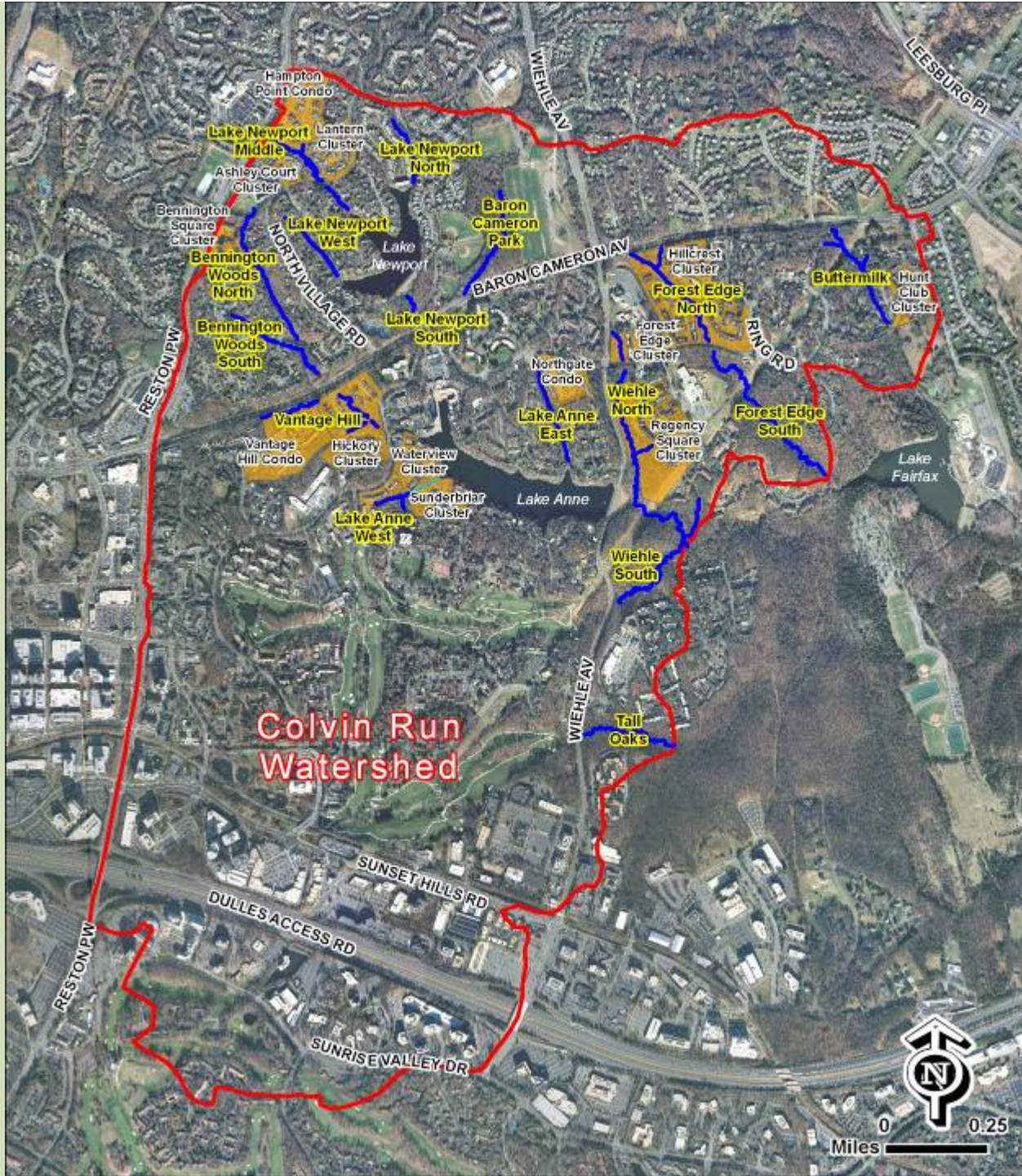


Snakeden Branch Reach 2  
(2003, by others) –  
Long-term stability not  
achieved using this approach.

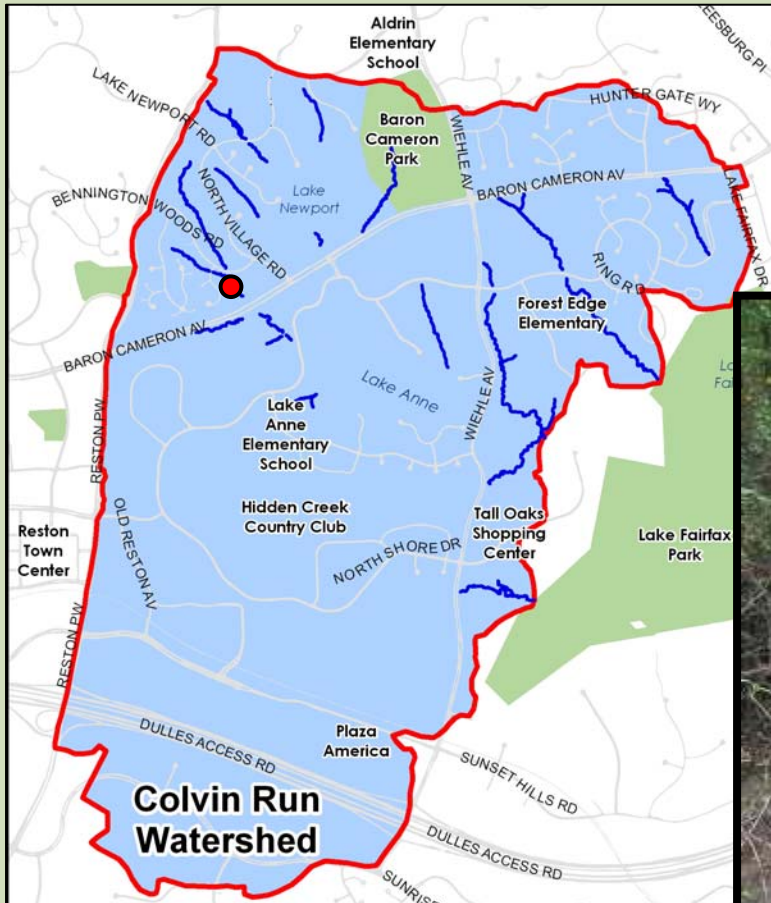


# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- **Colvin Run Watershed – Existing Conditions**
- Data Collection and Design
- Construction and Plantings
- Technical Review, Monitoring, and Maintenance
- Summary
- Questions



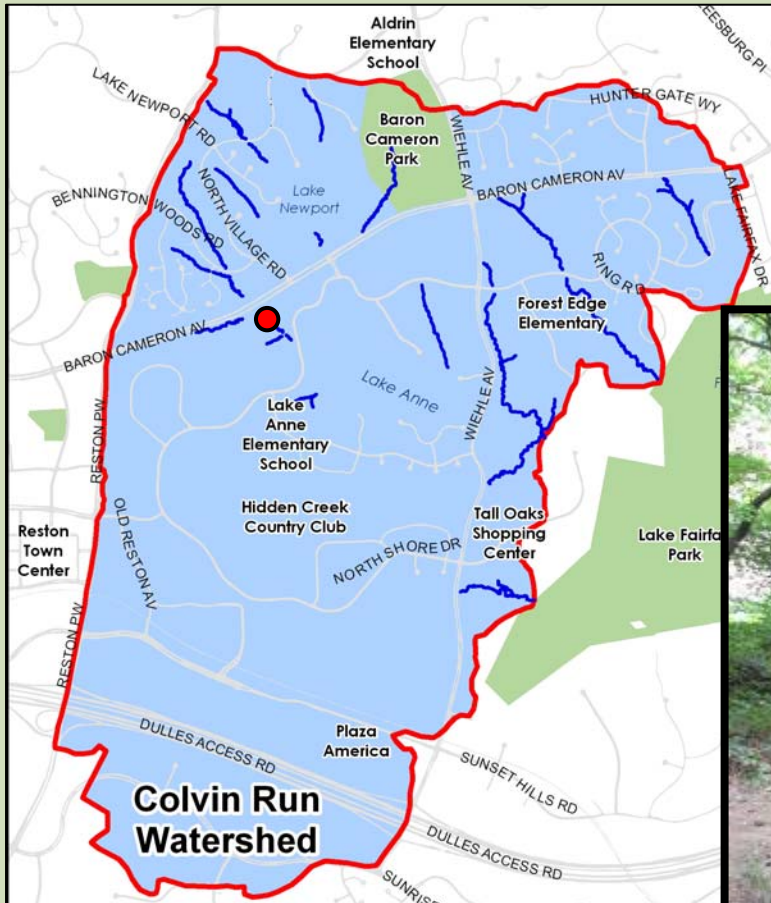
# EXISTING CONDITIONS IN COLVIN RUN



Bennington Woods South



# EXISTING CONDITIONS IN COLVIN RUN

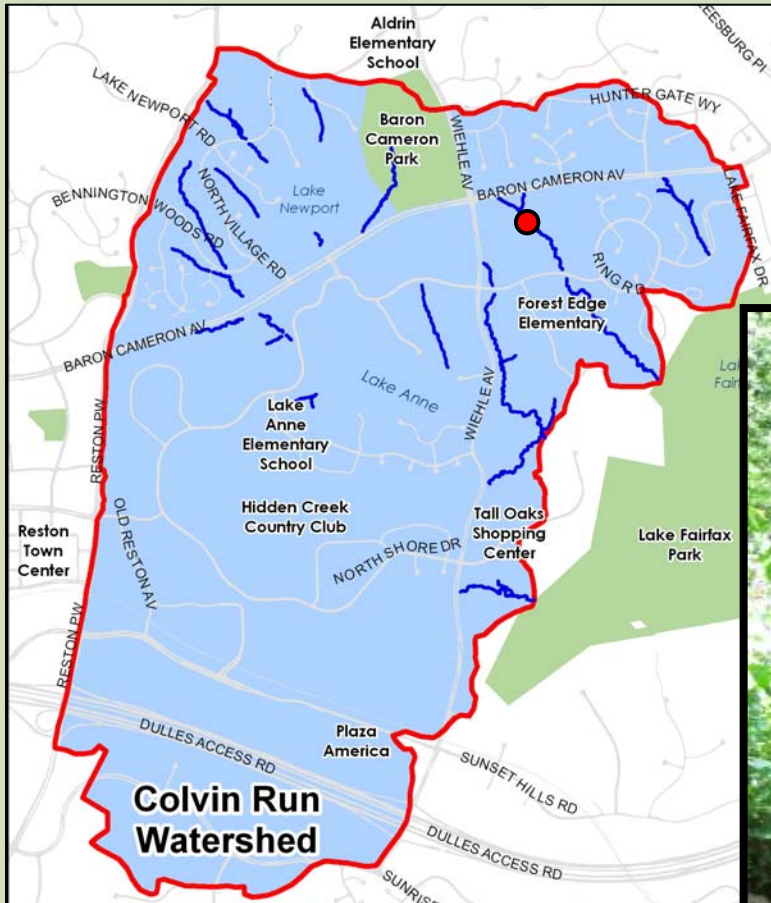


Vantage Hill



Exposed Manhole

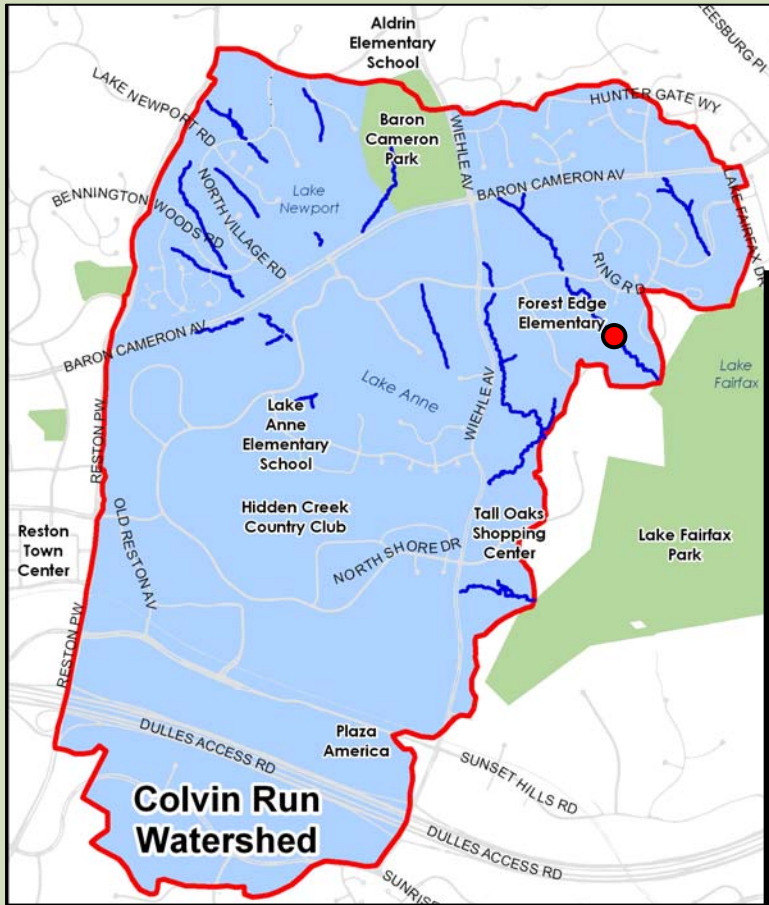
# EXISTING CONDITIONS IN COLVIN RUN



Forest Edge North



# EXISTING CONDITIONS IN COLVIN RUN

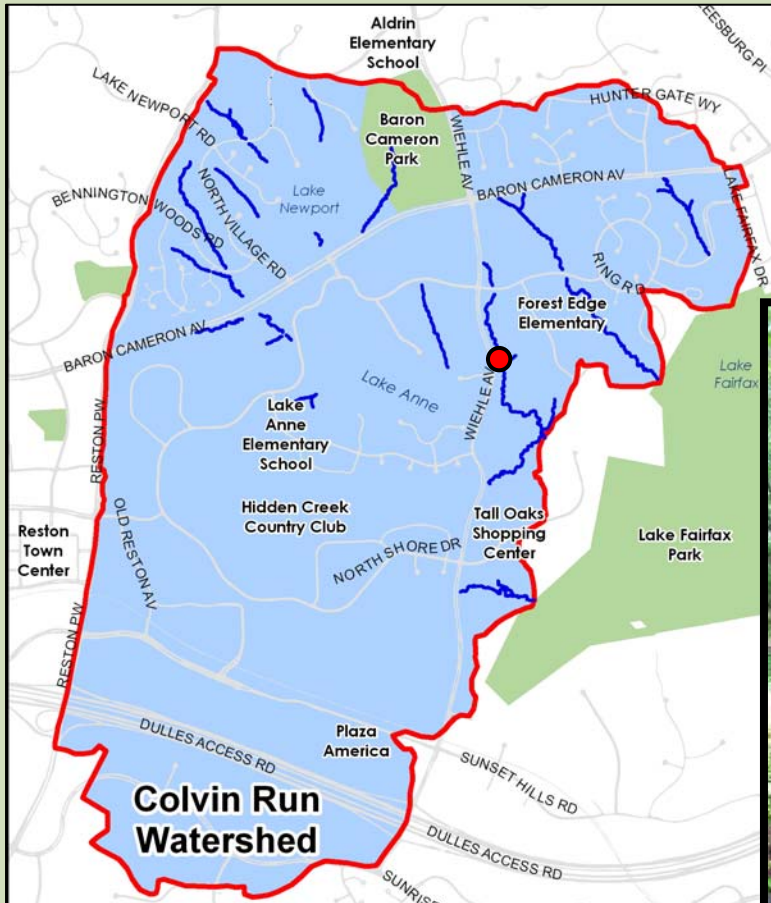


Forest Edge South



Exposed utility and manhole

# EXISTING CONDITIONS IN COLVIN RUN



Wiehle North

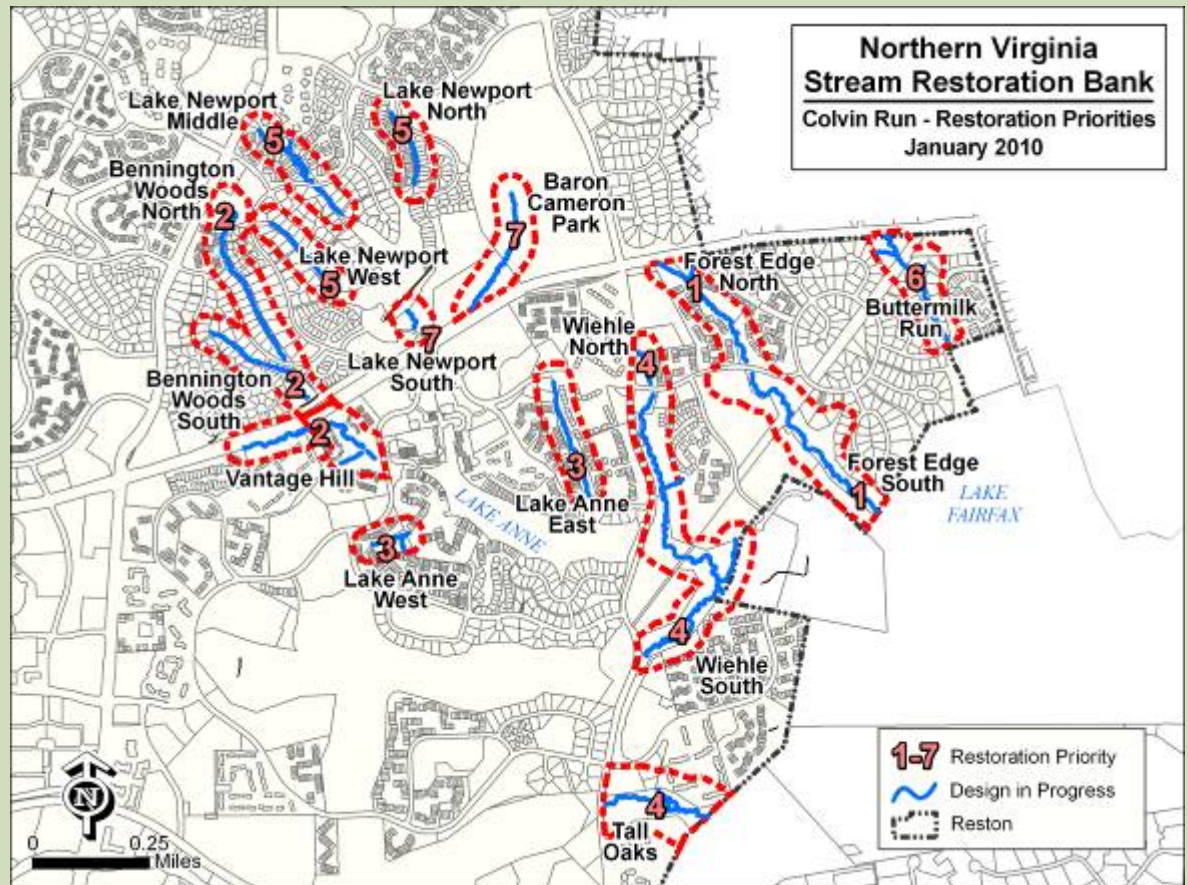


Exposed utility

# COLVIN RUN RESTORATION PRIORITIES

## Priority Reach Name and Adjacent Clusters

- 1 { Forest Edge (North, South)
  - Hillcrest Cluster
  - Forest Edge Cluster
  
- 2 { Vantage Hill
  - Hickory Cluster
  - Vantage Hill Condo
- Bennington Woods (North, South)
  - Bennington Square Cluster
  
- 3 { Lake Anne (East, West)
  - Waterview Cluster
  - Sunderbriar Cluster
  - Northgate Condo
  
- 4 { Wiehle (North, South)
  - Forest Edge Cluster
  - Regency Square Cluster
- Tall Oaks
  
- 5 { Lake Newport (North, Middle, West)
  - Hampton Point Condo
  - Ashley Court Cluster
  - Lantern Cluster
  
- 6 { Buttermilk
  - Hunt Club Cluster
  
- 7 { Baron Cameron
  - Lake Newport (South)

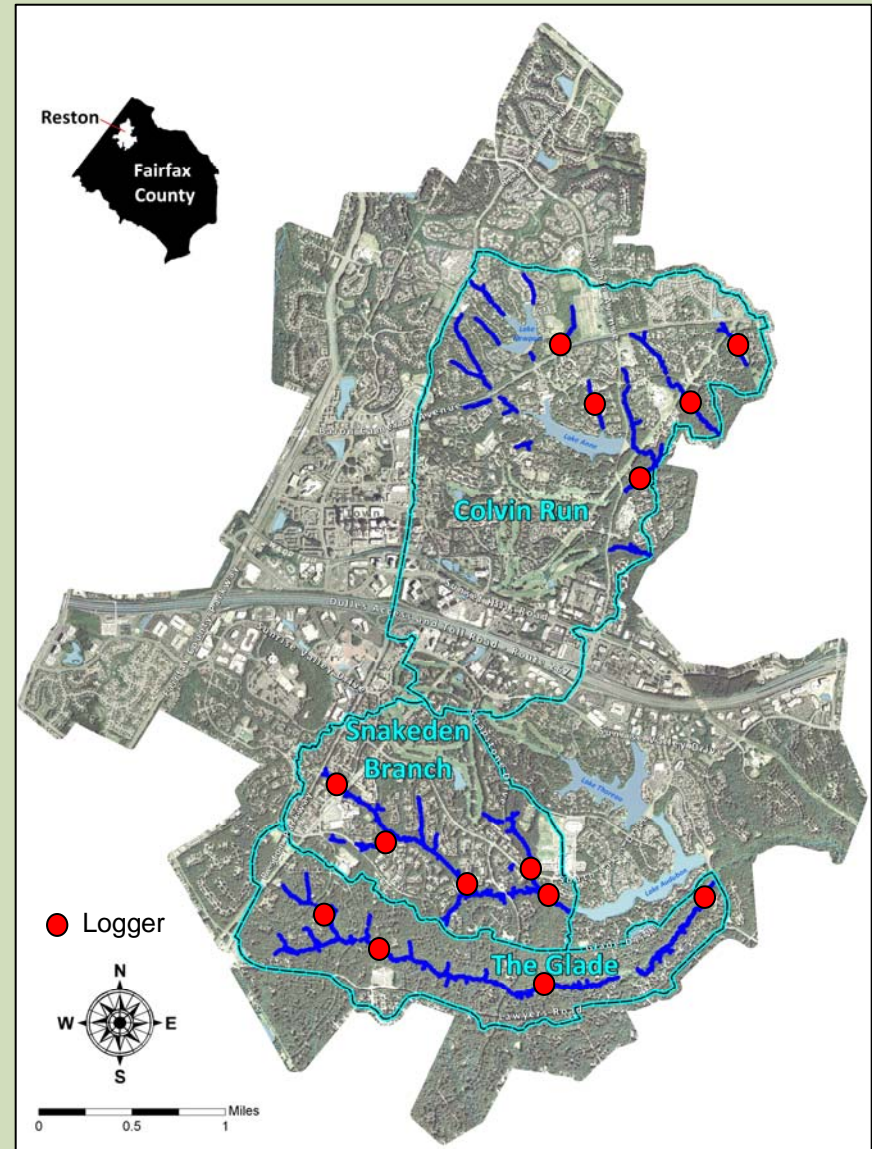


# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- **Data Collection and Design**
- Construction and Plantings
- Technical Review, Monitoring, and Maintenance
- Summary
- Questions

# DATA COLLECTION

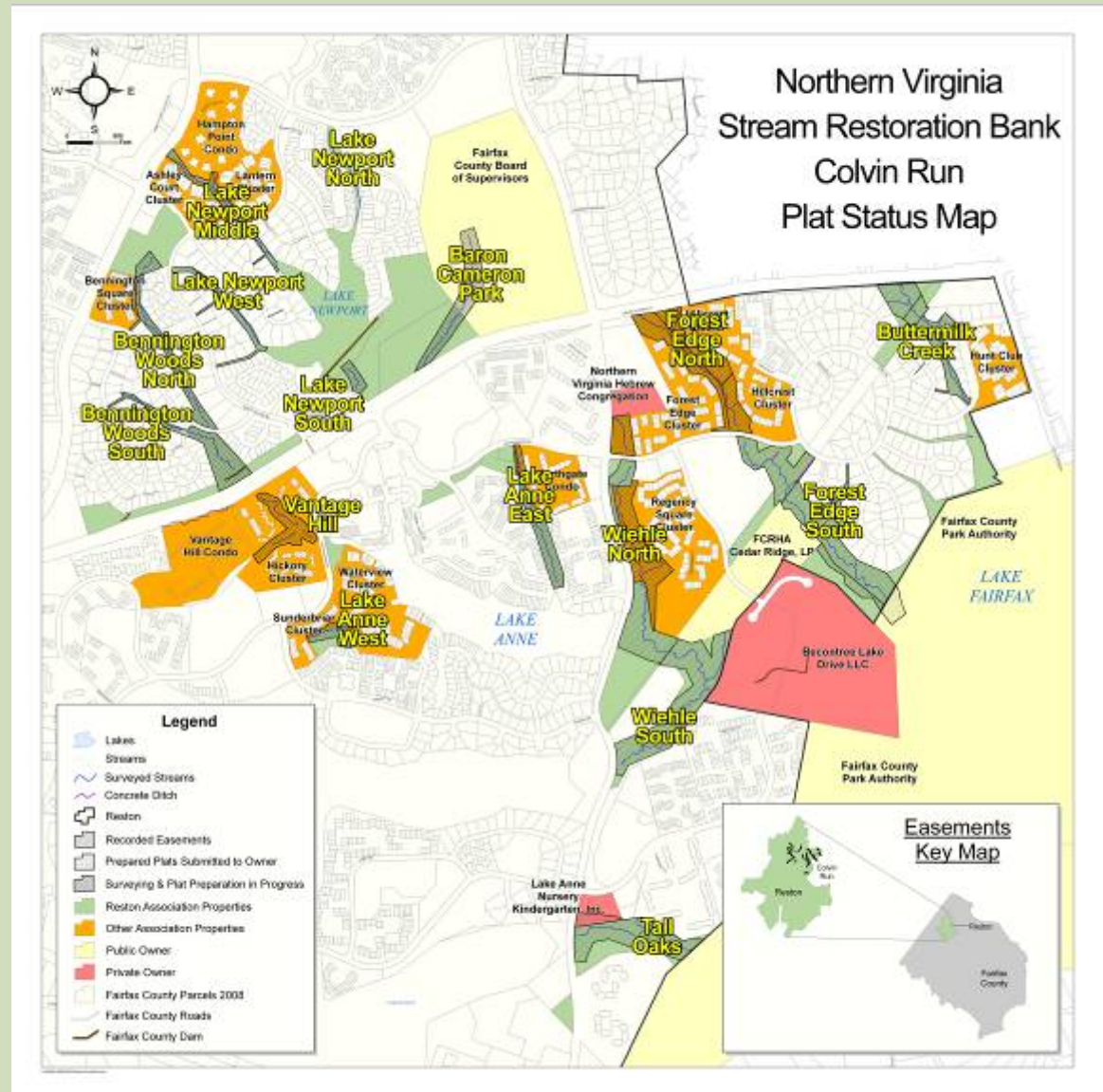
- Obtained aerial photography and topography of Phase I watersheds.
- Investigated stream valleys for potential archeological sites.
- Survey located & tagged nearly 35,000 trees ( $\geq 4''$  dbh) *so far!*
- Surveyed channel profile and cross-sections.
- Performed geomorphic analyses.
- Performed wetland 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-yr of monitoring and maintenance.
2. *Restoration Easement*: to protect the stream and buffer in perpetuity.



# 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.

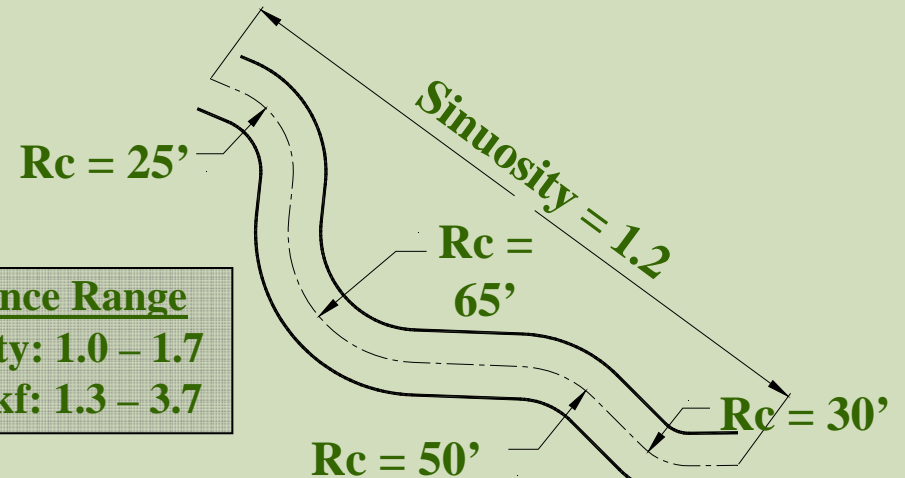
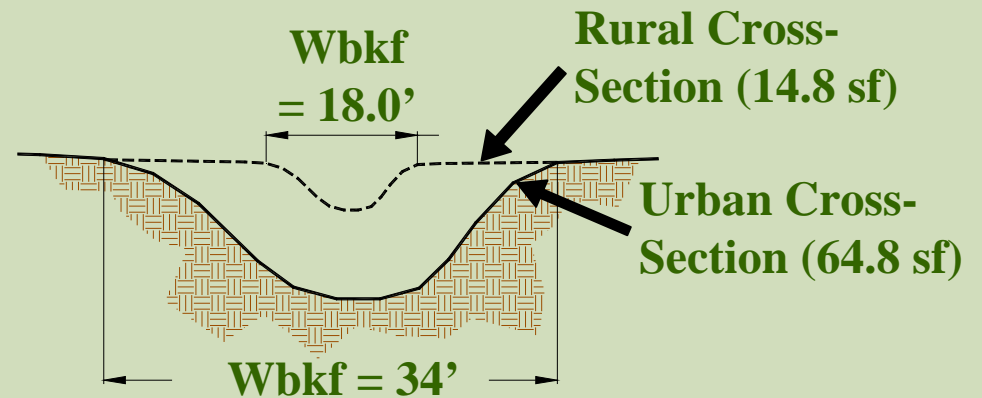


Apply Bankfull Width to reference ranges of sinuosity and meander radii.

(Continued)



### Snakeden at Soapstone Drive



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

# 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.



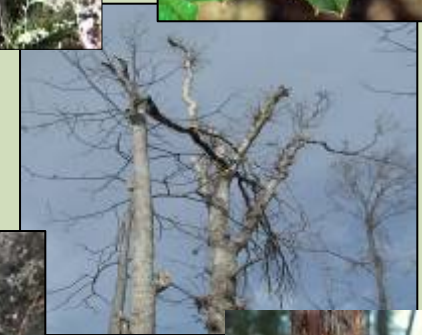
**Also, determine access** - preferably by existing trails and sewers to minimize impacts.

# STREAM RESTORATION DESIGN & MINIMIZING TREE IMPACTS

## TREE IMPACT CONSIDERATIONS

### Ecological / Habitat Value

- Size / Diameter
- Higher - Climax species: Oaks, Hickory, Holly (*most 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.*)

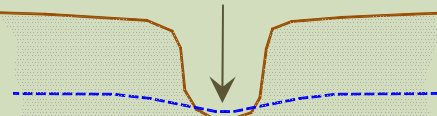
### Proposed Condition

- 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

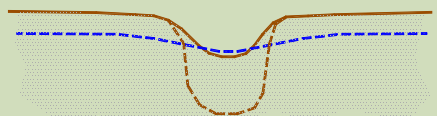


## Incised stream



**Lower water table**

## Restored (raised) stream



**Higher water table**

## 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.

# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- **Construction and Plantings**
- Technical Review, Monitoring, and Maintenance
- Summary
- Questions

# CONSTRUCTION – THE GLADE REACH 4A



Pre-Construction (August 2009)



Construction (October 2009)

# CONSTRUCTION – THE GLADE REACH 4A

Construction  
(October 2009)



Pre-Construction  
(September 2009)



# CONSTRUCTION – THE GLADE REACH 4A



Pre-Construction  
(August 2009)

Construction  
(October 2009)



# SNAKEDEN REACH 1



# SNAKEDEN REACH 2



# SNAKEDEN REACH 2



# SNAKEDEN REACH 3



# THE GLADE REACH 1



# 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.)



<b>EXAMPLE</b>	{	<b>Glade, Reach 1 (1939 lf) - 2,371 Trees, 3,296 Shrubs</b>
<b>TOTAL</b>		<b>Glade, Reach 2 (1901 lf) - 2,215 Trees, 3,013 Shrubs</b>
<b>PLANTINGS:</b>		<b>Glade, Reach 3 (3576 lf) - 4,168 Trees, 6,077 Shrubs</b>

- **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.



Eastern Redbud

# 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!

# GREATER 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



Cottontail Rabbit



Red-shouldered Hawk



Orchard Oriole

# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- Construction and Plantings
- **Technical Review, Monitoring, and Maintenance**
- Summary
- Questions

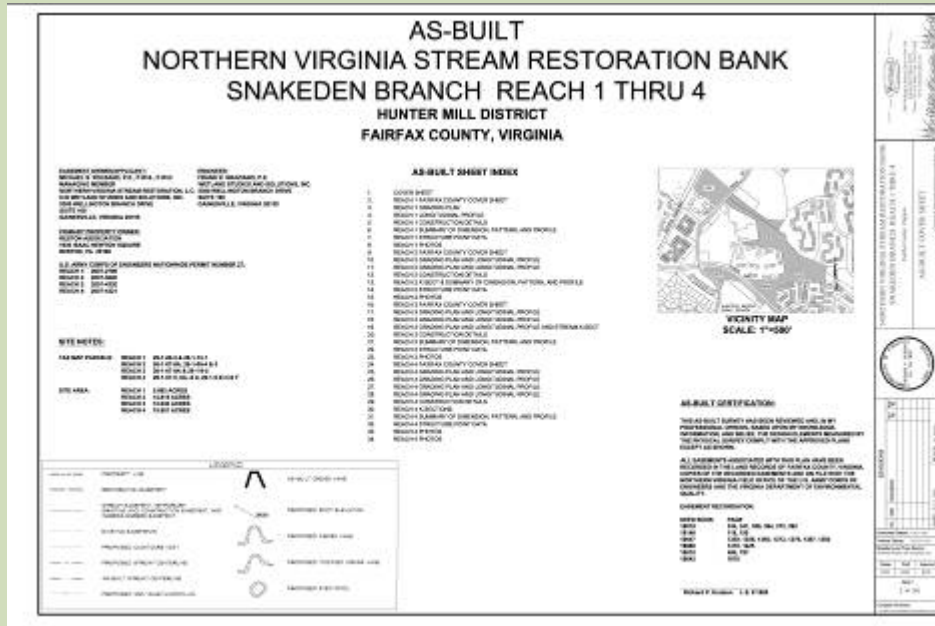
# TECHNICAL REVIEW

- **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

## *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.

# TROPICAL STORM HANNA (9/06/08)

*100-YR EVENT (6.22" IN 9 HOURS)*



# TROPICAL STORM HANNA

*2 - DAYS LATER*



# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- Construction and Plantings
- Technical Review, Monitoring, and Maintenance
- **Summary**
- Questions

# 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.



# AGENDA

- Mitigation Banking and Why Reston?
- The Urban Watershed Problem and Solutions
- Urban Stream Restoration Methodology
- Colvin Run Watershed – Existing Conditions
- Data Collection and Design
- Construction and Plantings
- Monitoring, Maintenance, and Technical Review
- Summary
- Questions



<http://reston.wetlandstudies.com>

QUESTIONS?