US EPA's Principles for Ecological Restoration of Aquatic Resources and a New and Innovative Best Management Practice To Address Legacy Sediment Impairments

PA Legacy Sediment Workgroup *2009*

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What is ecological “restoration” ?

The National Research Council – 1992:

Restoration of Aquatic Resources

“Return of an ecosystem to a close approximation of its condition prior to disturbance.”

“The term restoration means the reestablishment of pre-disturbance aquatic functions and related physical, chemical and biological characteristics.”

Federal Agency Definitions for Wetland Tracking

“the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded wetland.”

http://www.epa.gov/owow/wetlands/restore/defs.html#Fed

Principles for the Ecological Restoration of Aquatic Resources (EPA841-F-00-003)

US Environmental Protection Agency
Washington, DC. 2000.

- The list of principles are based upon lessons learned from on-going and completed projects.
- The list of principles are thought to be critical to the success of a wide range of aquatic resource restoration projects.
- The principles are intended for use by a wide variety of people and organizations ranging from Federal, State, Tribal and local agencies to outdoor recreation or conservation groups.

http://www.epa.gov/owow/wetlands/restore/

Ecological Restoration Guiding Principles

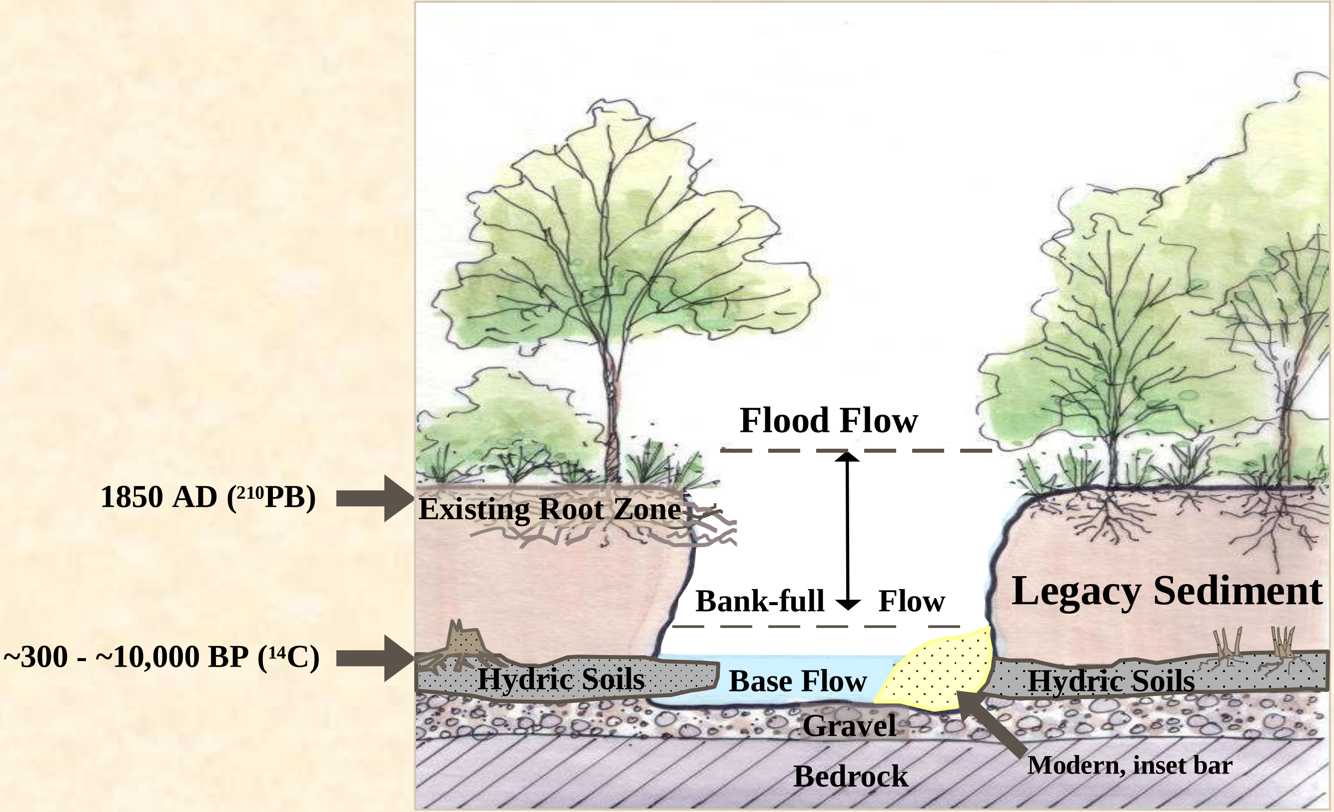
Address ongoing causes of degradation.

- Restoration efforts are likely to fail if the sources of degradation persist.
- It is essential to correctly identify the causes of degradation and eliminate or remediate them.

"… understanding the legacy sediment problem is the first step in proposing a fix."

Bay Journal, March, 2007. Alliance for the Chesapeake Bay.

Typical Existing Condition



- Legacy sediment stored in valley bottoms predominantly was established by the combined effect of increased sediment supply from uplands and sediment trapping behind ubiquitous dams in many Piedmont watersheds of the Mid Atlantic Region. (Walter and Merritts, 2008)
- Streambank erosion represents a significant sediment and nutrient source in watersheds where channels have incised through legacy sediment. (Walter, Merritts and Rahnis, 2007)
- New and innovative Best Management Practices are proposed to target the Typical Existing Conditions.

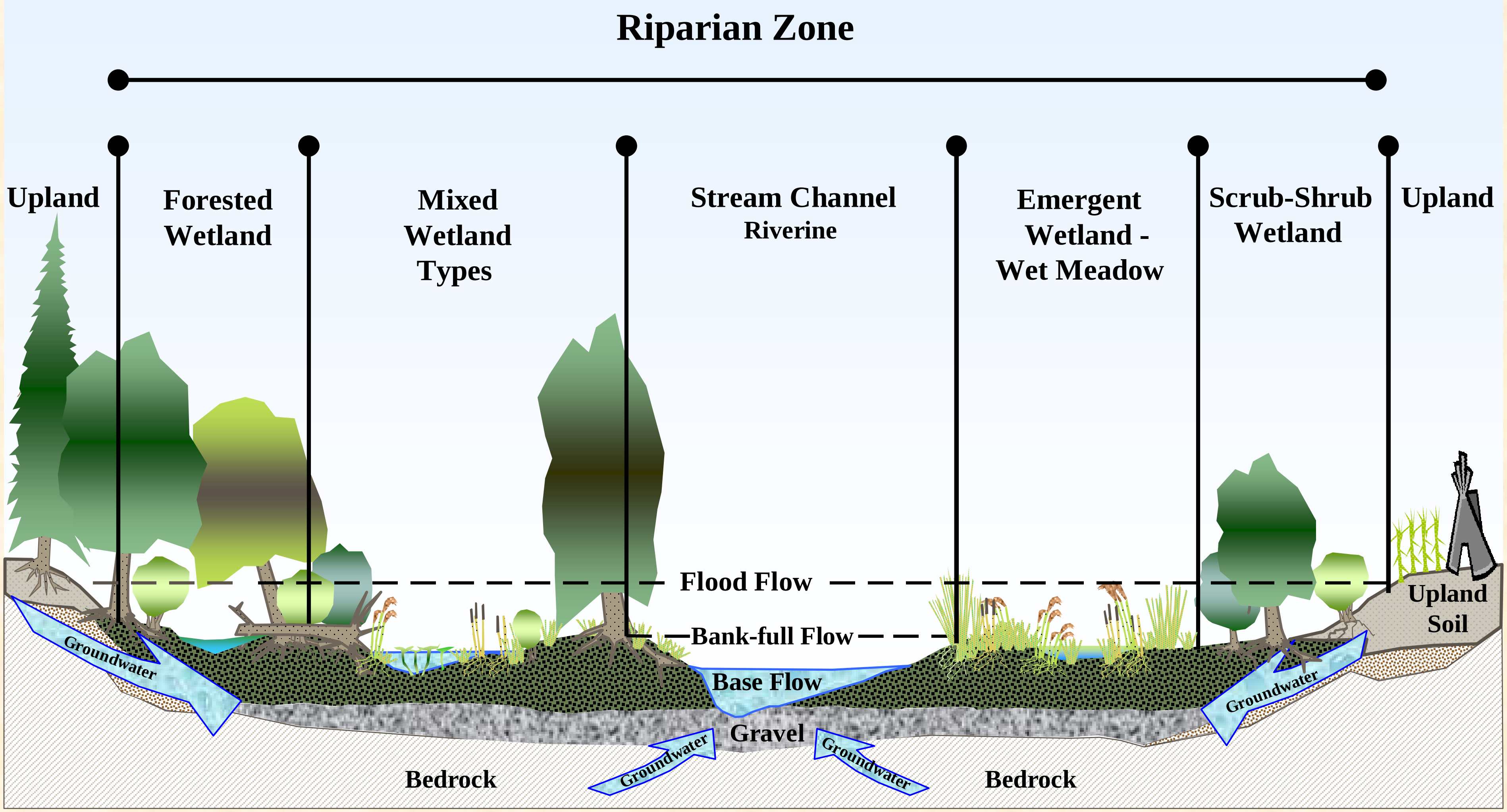
Ecological Restoration Guiding Principles

Understand the ***natural*** ***potential*** of the watershed

- Establishes restoration goals
- Dependant upon climate, geology, hydrology, anthropogenic (stormwater, sediment supply, etc.) and biological characteristics
- May be constrained by the extent and magnitude of watershed changes and restoration planning should take this into account

Natural Riparian Buffer Zones

Palustrine and Riverine Classifications (Cowardin, et. al. 1979)



Natural Potential

Ecological Restoration Guiding Principles

Restore Natural Structure

Physical Characteristics

- **Valley morphology**
- Channel alterations – relocation, incision, etc.
- Wetland fills
- **Essential to the success of other aspects like restoring natural plant communities, natural soil conditions, natural bio-geochemical processes, etc.**

Ecological Restoration Guiding Principles

Restore Natural Function.

Natural function and natural structure of aquatic resources are closely linked.

- For instance, re-establishing wetland elevations to restore the natural structure that drive beneficial functions
- Essential to the success of other project aspects like restoring natural bio-geochemical processes, natural flora and fauna that function in the context of a watershed's natural potential

Ecological Restoration Guiding Principles

Restore Ecological Integrity.

What is Ecological Integrity?

- A resilient and self-sustaining ecosystem able to accommodate stress and change while remaining stable relative to space, time, processes, and function
- Represented when key ecosystem processes are functioning properly
- Represented when plant and animal communities include native species indigenous to the region
- Restoration strives for the greatest progress toward ecological integrity by using designs that replicate or re-establish natural processes and floral/faunal communities that have sustained native ecosystems through time

Ecological Restoration Guiding Principles

Design for self-sustainability.

- Natural ecosystems are the epitome of self-sustainability
- Designs favor ecological integrity and enhance the ecosystems ability to adapt to changing boundary conditions in the watershed
- Ecological resilience

Anticipate future changes

- Watershed characteristics, particularly anthropogenic characteristics, are dynamic
- Ecological and societal changes can and should be factored into restoration design

Ecological Restoration Guiding Principles

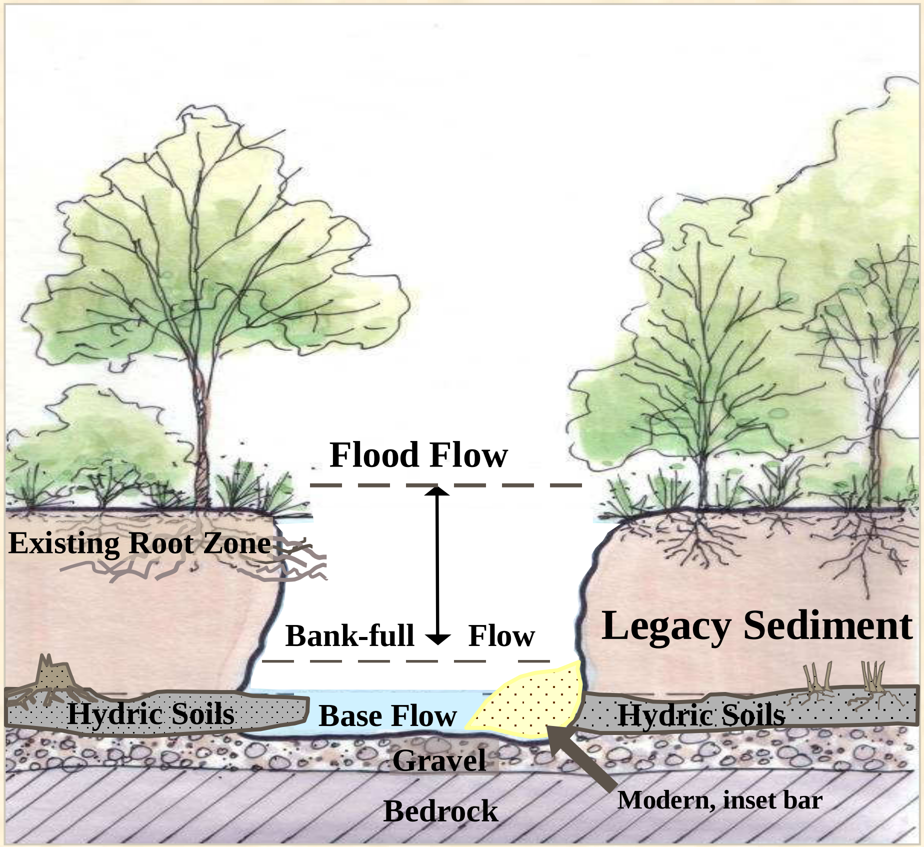
Involve the skills and insights of a multi-disciplinary team.

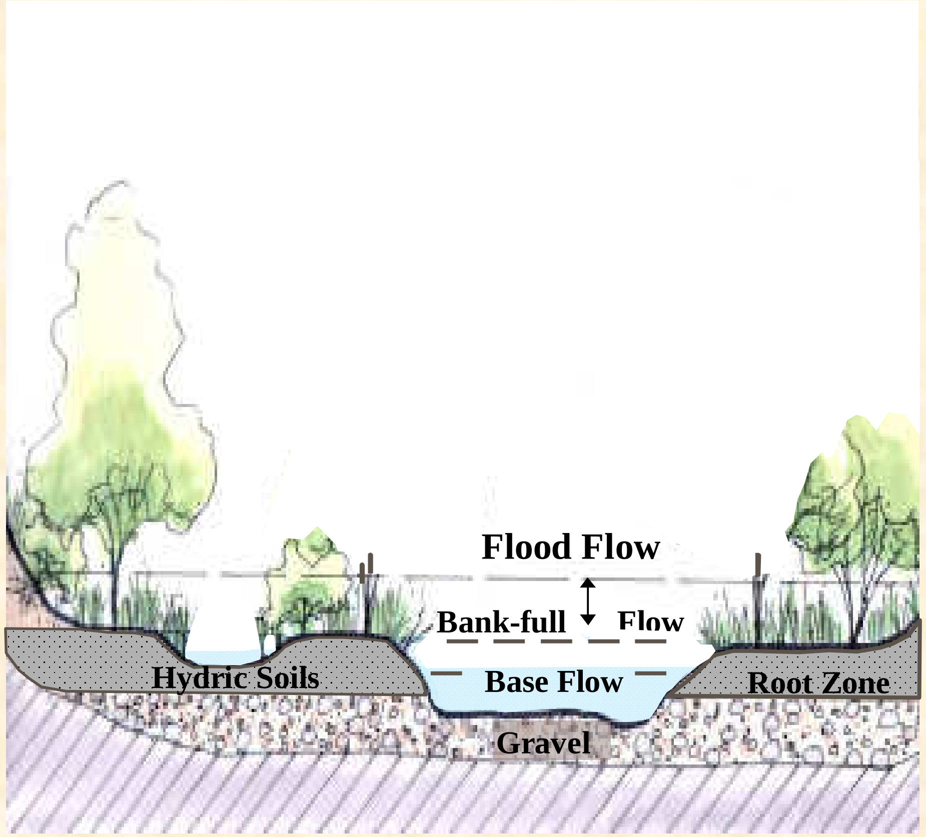
- Restoration can be a complex undertaking that integrates a wide range of disciplines
- Universities, government agencies, and private organizations may be able to provide useful information and expertise
- Complex projects require effective leadership to bring viewpoints, disciplines and styles together as a functional team

Natural Floodplain, Stream and Riparian Wetland Restoration Best Management Practice

Conceptual Design

Typical Existing Conditions ⇨ **Proposed Restoration**





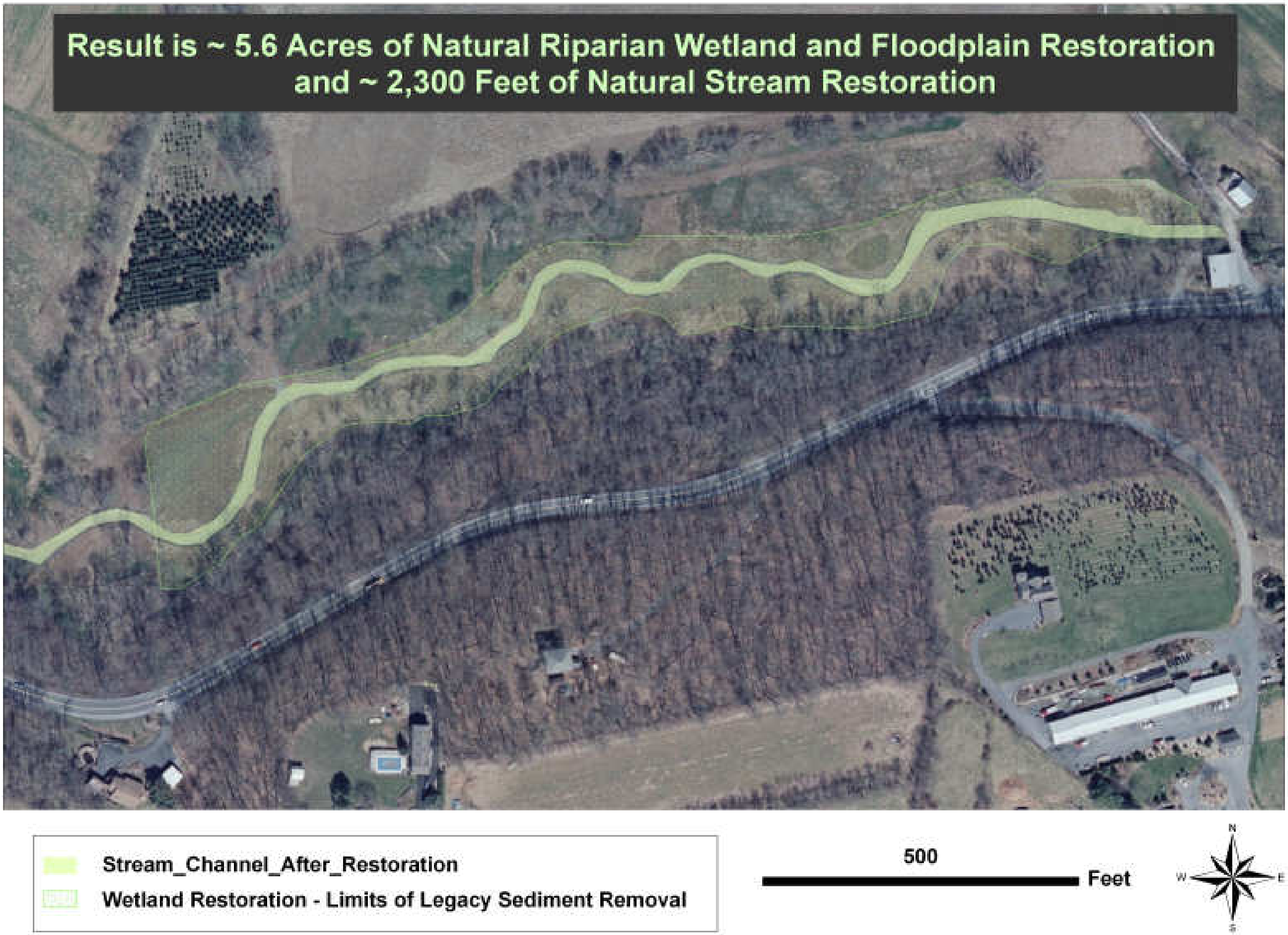
⇨ **Natural Condition**

Lititz Run Natural Floodplain, Stream and Riparian Wetland Resoration Project
"Banta Restoration Project" - Lancaster County, PA

2004

Photo Courtesy Landstudies, Inc.

Lititz Run Natural Floodplain, Stream and Riparian Wetland Restoration Project
"Banta Restoration Project" - Lancaster County, PA



Banta Restoration Site, Lititz Run – Lancaster Co.

Photo Courtesy Franklin & Marshall College

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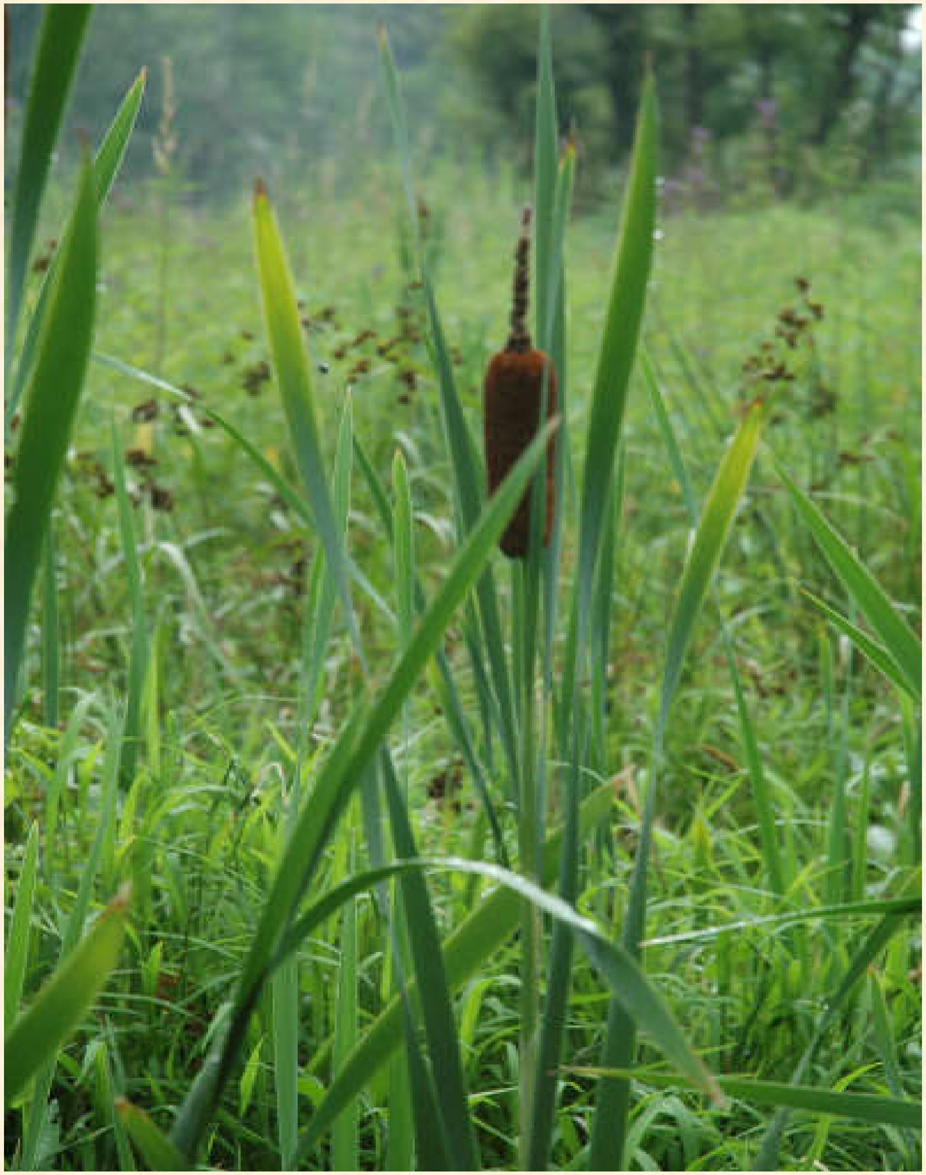


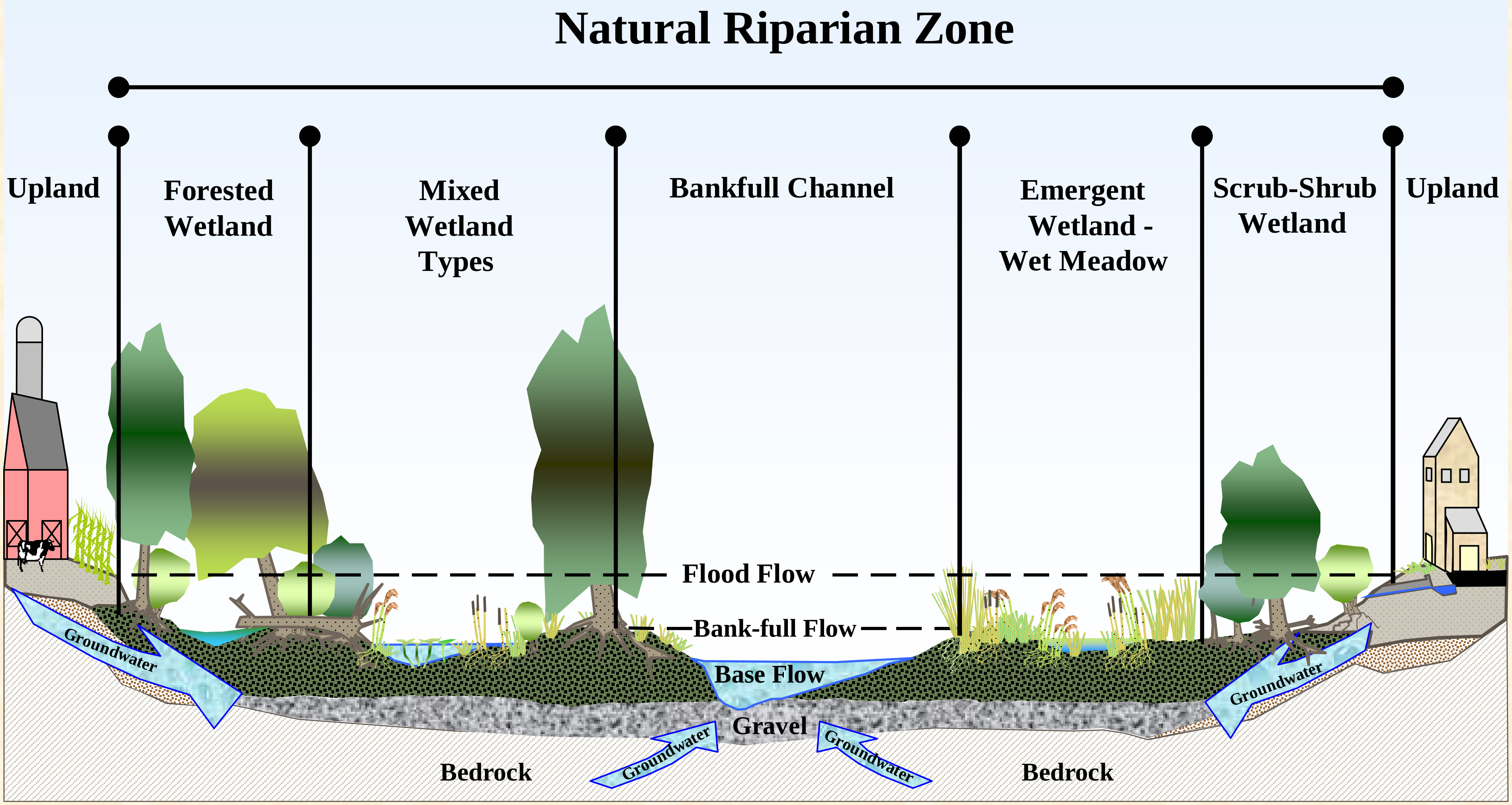
Photo Courtesy Franklin & Marshall College

Ecological Restoration Guiding Principles

Develop clear, achievable and measurable goals

- Low potential for success without clear goals
- Conceptual models with correctly identified problems and processes are essential to developing strategies
- Management alternatives should be chosen to achieve goals
- Good goals provide focus and increase project efficiency

Natural Floodplain, Stream and Riparian Wetland Restoration Best Management Practice Goal



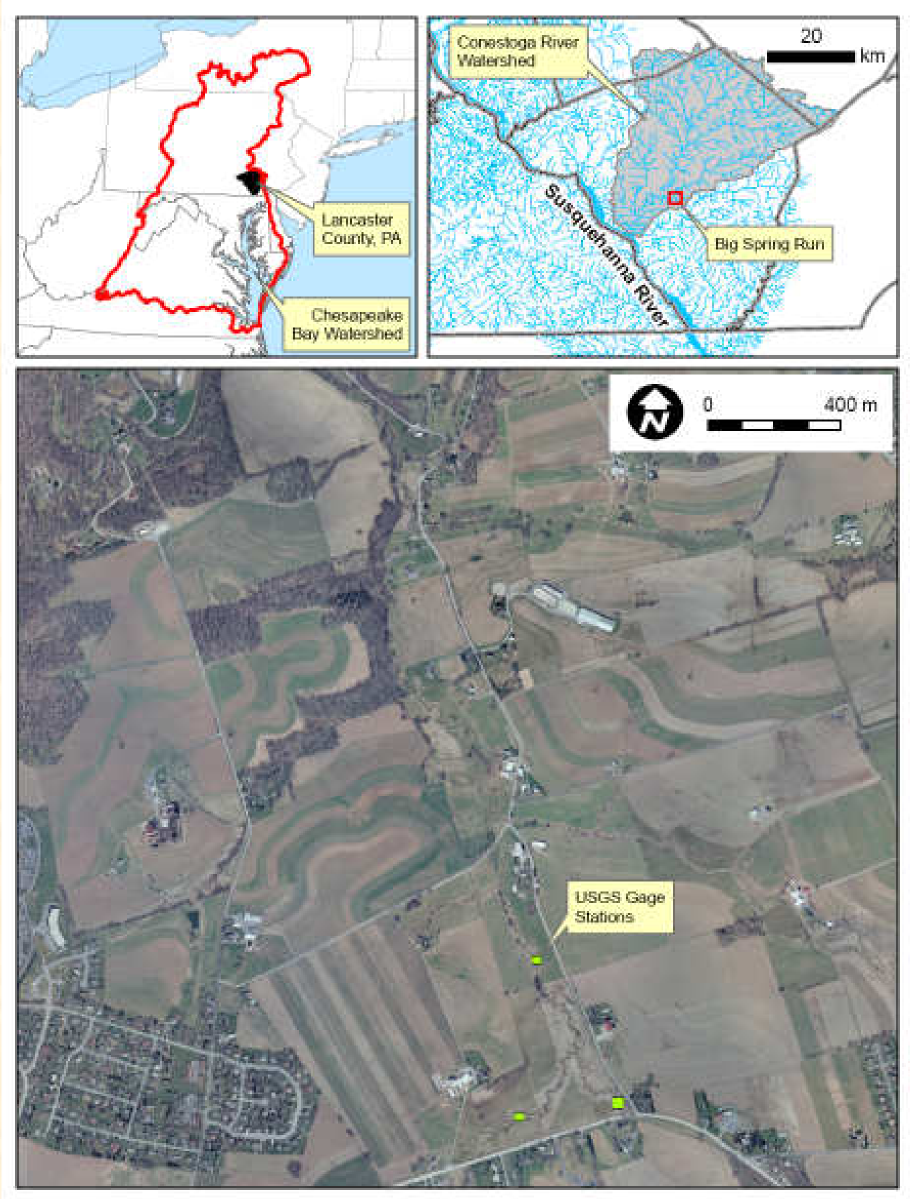
Natural Potential

Ecological Restoration Guiding Principles

Monitor and adapt where changes are necessary

- Monitoring before during and after is crucial for evaluating whether goals are achieved
- Post implementation monitoring can provide useful information for future restoration efforts
- Data gathered may be useful for model development and predicting results when scaling up in size

Big Spring Run Natural Floodplain, Stream and Riparian Wetland Restoration Project



USGS
science for a changing world

In cooperation with the
Pennsylvania Department of Environmental Protection

Effects of Streambank Fencing of Pasture Land on Benthic Macroinvertebrates and the Quality of Surface Water and Shallow Ground Water in the Big Spring Run Basin of Mill Creek Watershed, Lancaster County, Pennsylvania, 1993-2001

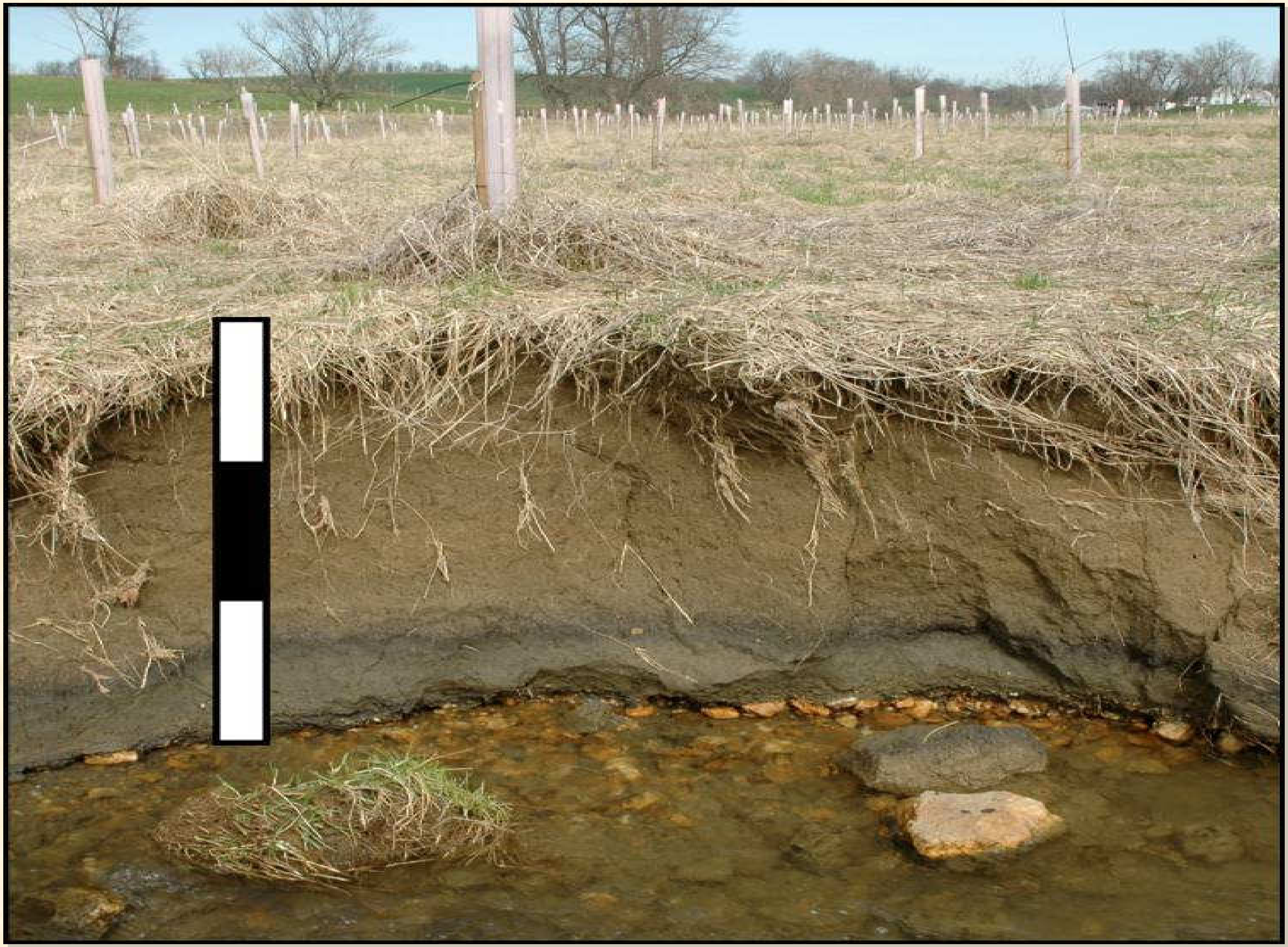
Scientific Investigations Report 2006-5141

By Daniel G. Galeone, Robin A. Brightbill, Dennis J. Low, and David L. O’Brien

Big Spring Run Natural Floodplain, Stream and Riparian Wetland Restoration Project

Courtesy Franklin & Marshall College

Big Spring Run - Type Section



Courtesy Franklin & Marshall College

Sediment, Nutrient, and Biological Monitoring and BMP Efficiencies - Big Spring Run, Lancaster County, PA

Robert Walter, Dorothy Merritts, Mike Rahnis, Karen Mertzman (F&M College)

Dan Galeone, Allen Gellis, and Mike Langland (USGS)

Paul Mayer, Ken Forshay (USEPA)

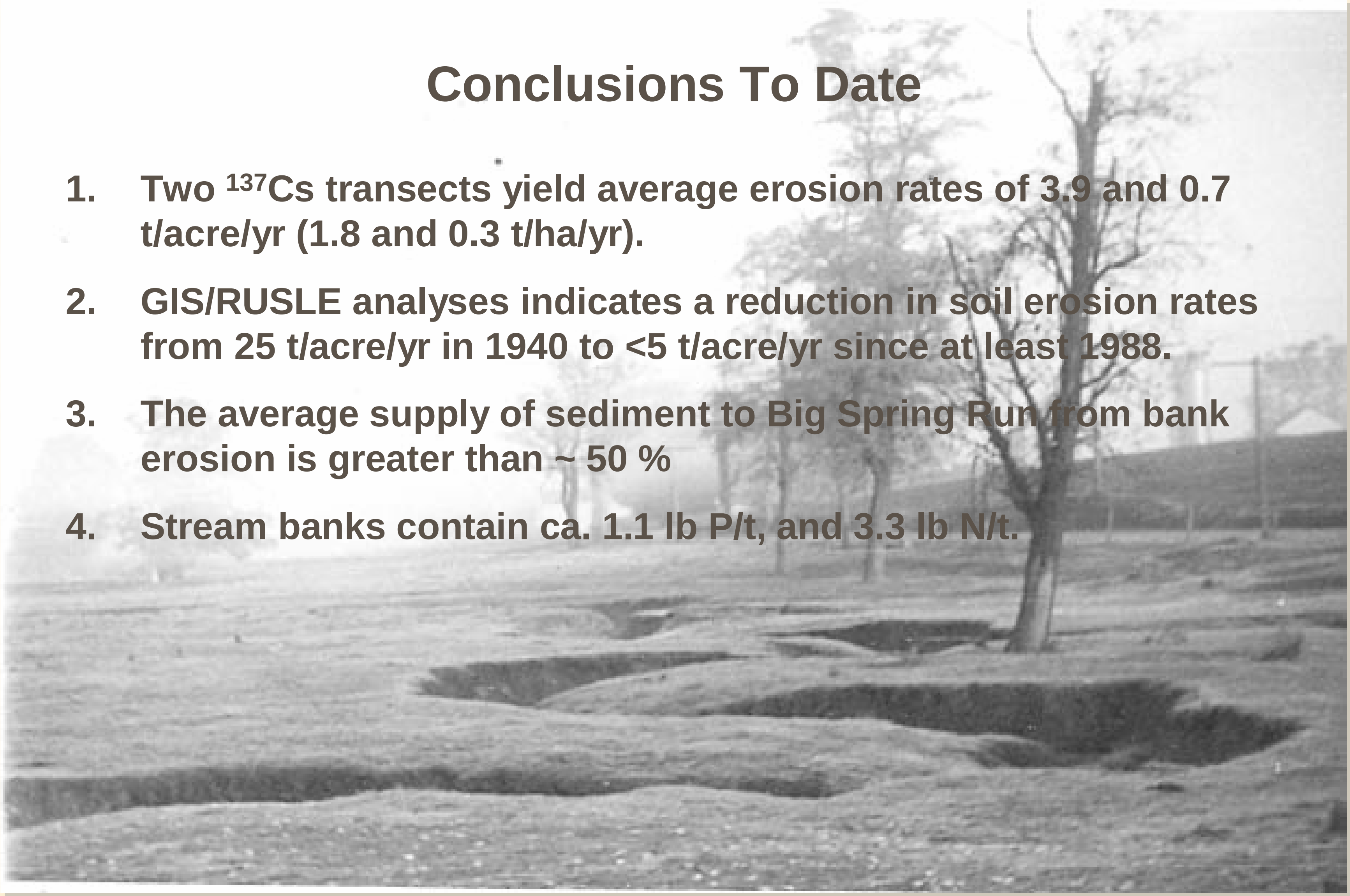
David Bowne (Elizabethtown College)

Big Spring Run ca. 1930

Courtesy Franklin & Marshall College

Conclusions To Date

1. Two ^{137}Cs transects yield average erosion rates of 3.9 and 0.7 t/acre/yr (1.8 and 0.3 t/ha/yr).
2. GIS/RUSLE analyses indicates a reduction in soil erosion rates from 25 t/acre/yr in 1940 to <5 t/acre/yr since at least 1988.
3. The average supply of sediment to Big Spring Run from bank erosion is greater than ~ 50 %
4. Stream banks contain ca. 1.1 lb P/t, and 3.3 lb N/t.



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