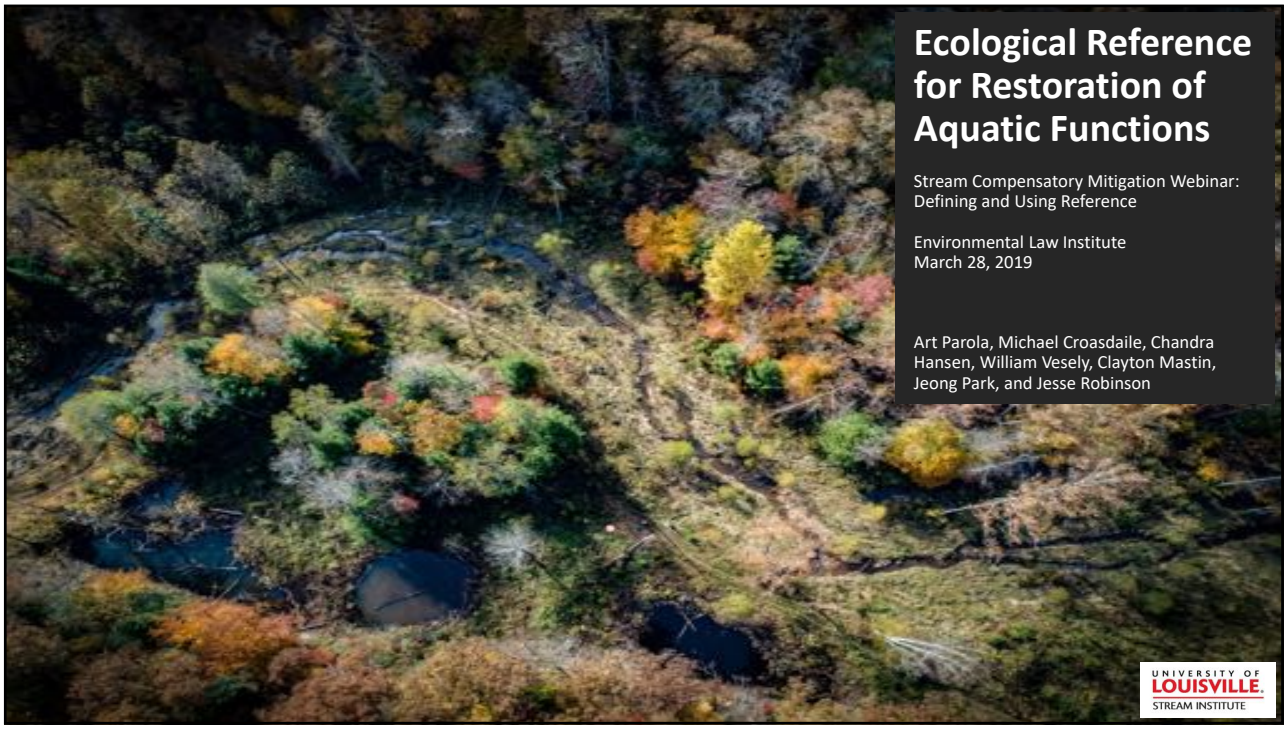
Ecological Reference for Restoration of Aquatic Functions
Stream Compensatory Mitigation Webinar: Defining and Using Reference
Environmental Law Institute
March 28, 2019
Art Parola, Michael Croasdaile, Chandra Hansen, William Vesely, Clayton Mastin, Jeong Park, and Jesse Robinson
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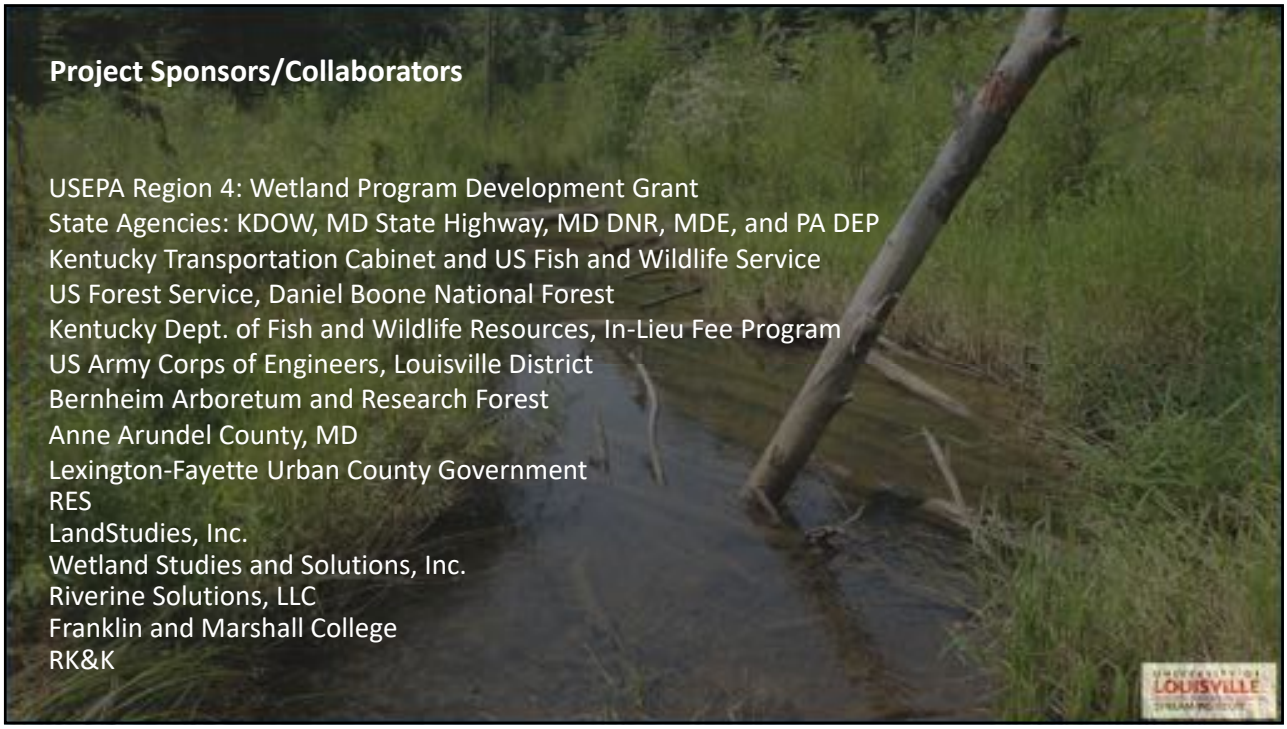
Project Sponsors/Collaborators
USEPA Region 4: Wetland Program Development Grant
State Agencies: KDOW, MD State Highway, MD DNR, MDE, and PA DEP
Kentucky Transportation Cabinet and US Fish and Wildlife Service
US Forest Service, Daniel Boone National Forest
Kentucky Dept. of Fish and Wildlife Resources, In-Lieu Fee Program
US Army Corps of Engineers, Louisville District
Bernheim Arboretum and Research Forest
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Construction Contractors/Collaborators

Advanced Enterprises, Richmond, Kentucky

Ridgewater, Lexington, Kentucky
EcoGro, Lexington, Kentucky

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Purpose of Ecological References: Assessment of Existing Conditions

What functions were lost or diminished?

Reference: Pre-settlement functions

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Purpose of Ecological References: Functional Reference for Design Objectives

Design objectives to restore functions

Reference: Pre-settlement functions

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Purpose of Ecological References: Success Criteria and Performance Standards

Restored stream-wetland functions

Reference: Pre-settlement functions

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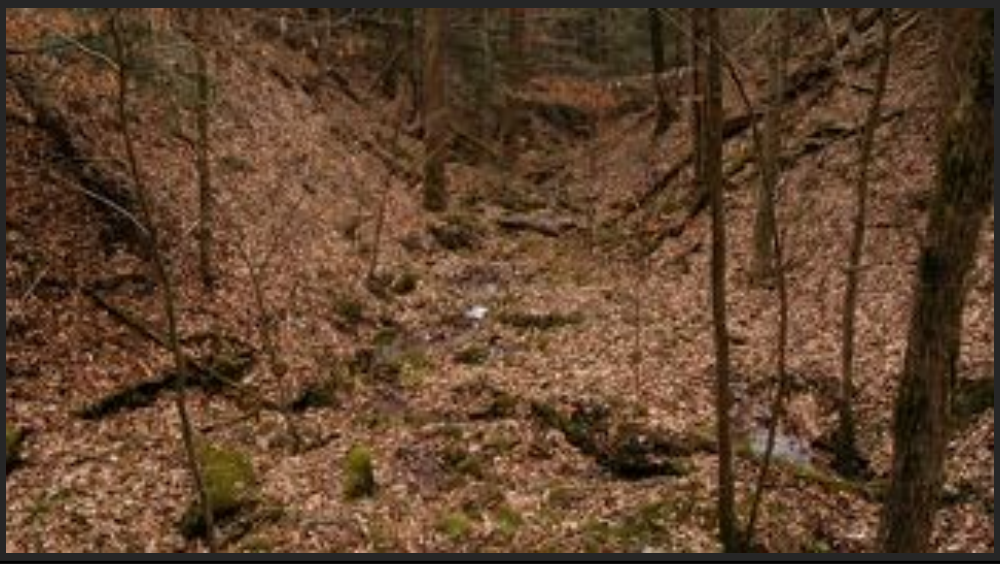
Ecological Reference: Least Disturbed Sites



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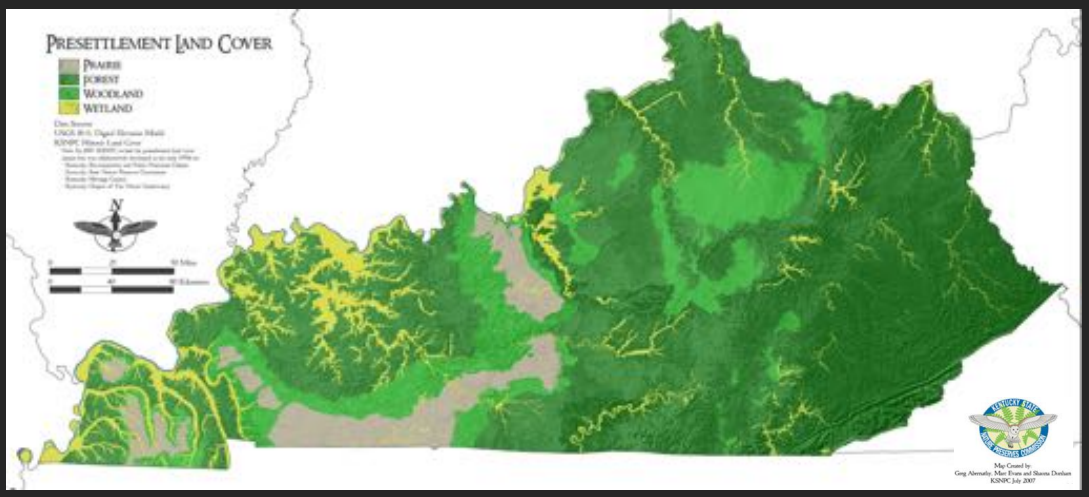
Pre-Settlement Kentucky



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Historical Mapping

Note: Not pre-settlement maps

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Pre-Beaver-Removal

Stream-Wetland-Beaver Complex

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Stratigraphy of Valley Materials

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Stratigraphy of Valley Materials

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Stratigraphy of Valley Materials—Beaver Gnawed Wood

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Test Pits

Profile valley material
Determine bedrock elevation
Evaluate groundwater conditions

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First Cut Wood on Floodplain of Major River

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Historical Floodplain—Highly Retentive Systems

- Bank height
- Floodplain connectivity
- Channel connectivity to groundwater
- Tree root access to groundwater
- Infrequent substrate movement

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Existing Conditions—Export and Transport System

Bank height

Floodplain connectivity

Channel connectivity to groundwater

Legacy Sediments

Tree root access to groundwater

Frequent substrate movement

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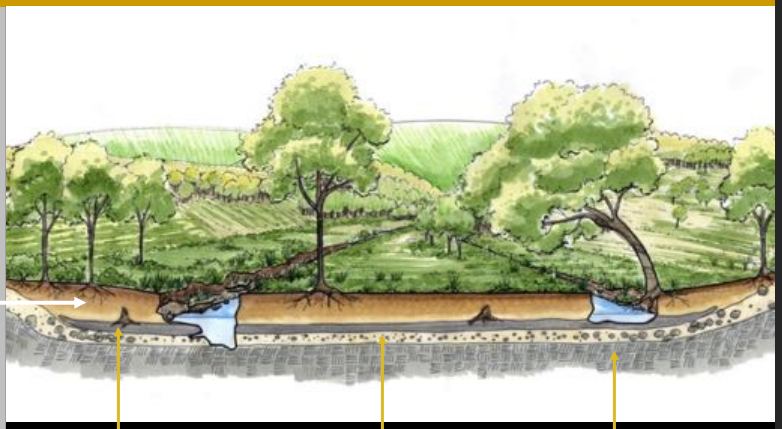

Historical Floodplain Soils

Cobble/Gravel Bed

Bedrock

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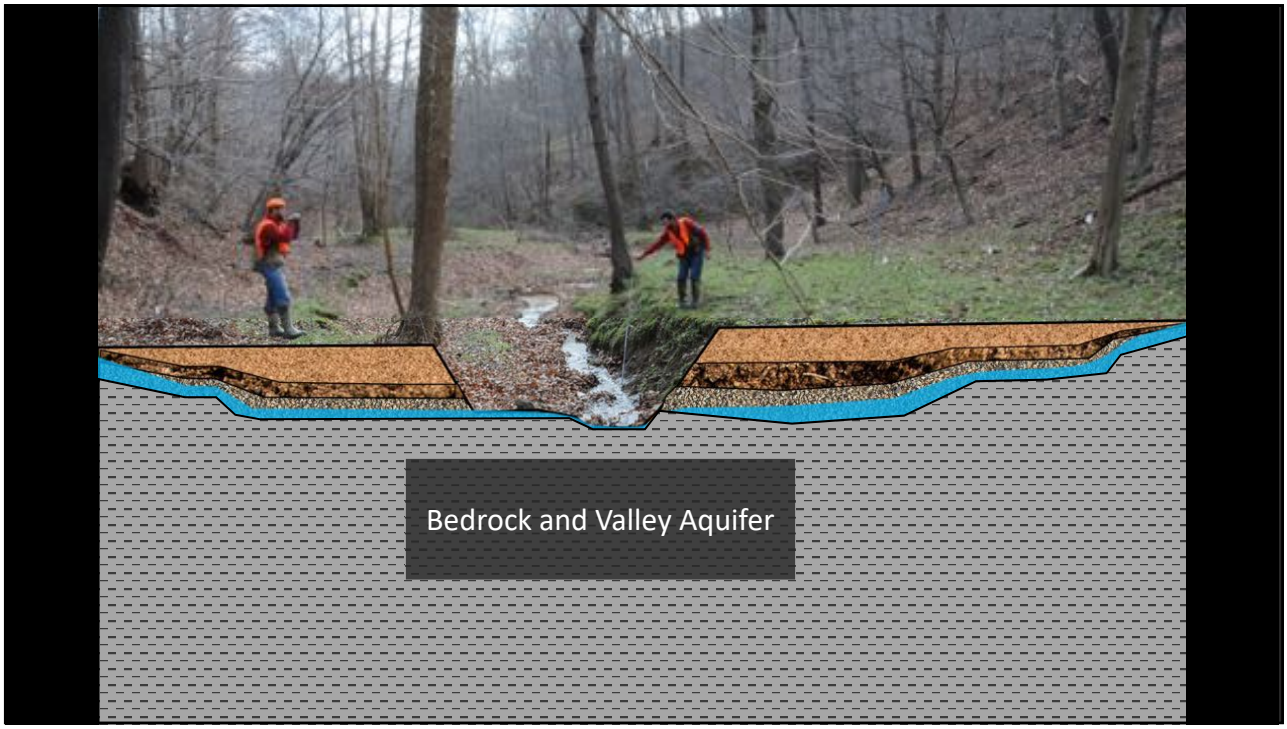

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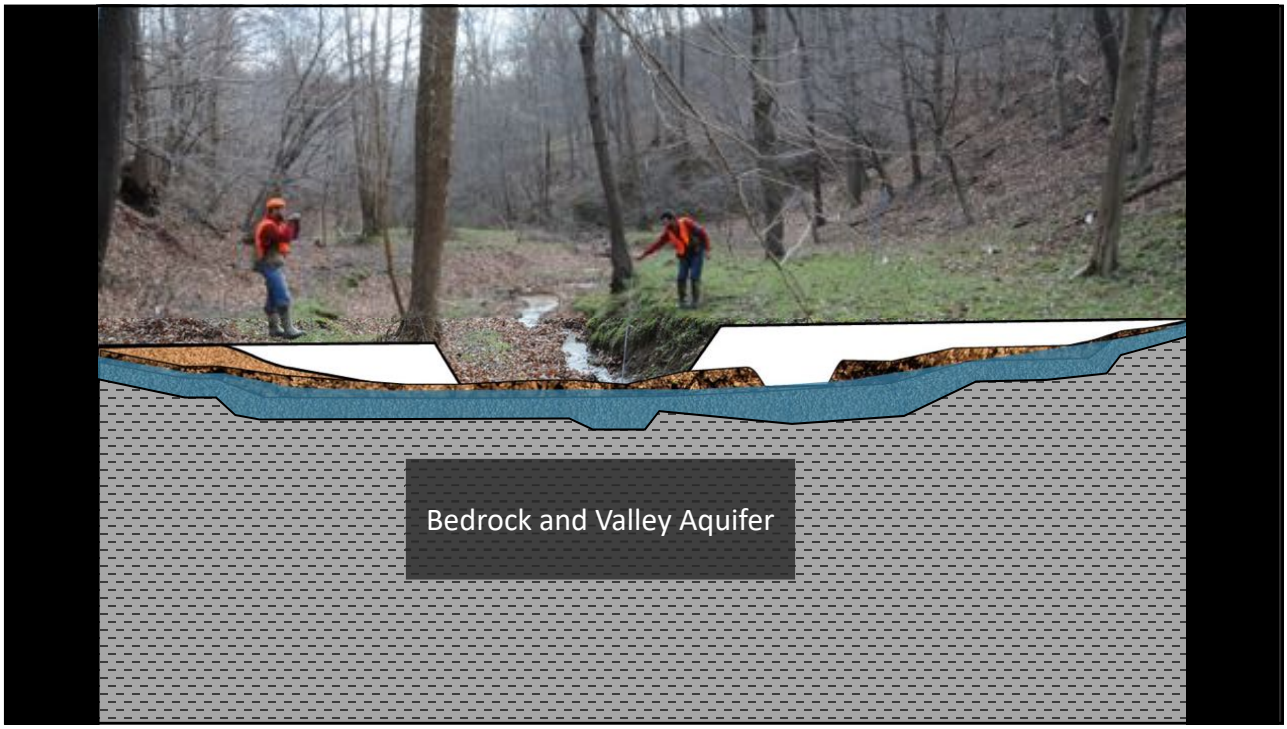

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Channel and Floodplain

Refence for channel geometry—measurement of channels on site or in low sediment transport systems in the region

Analytical relations—radius of curvature to channel width

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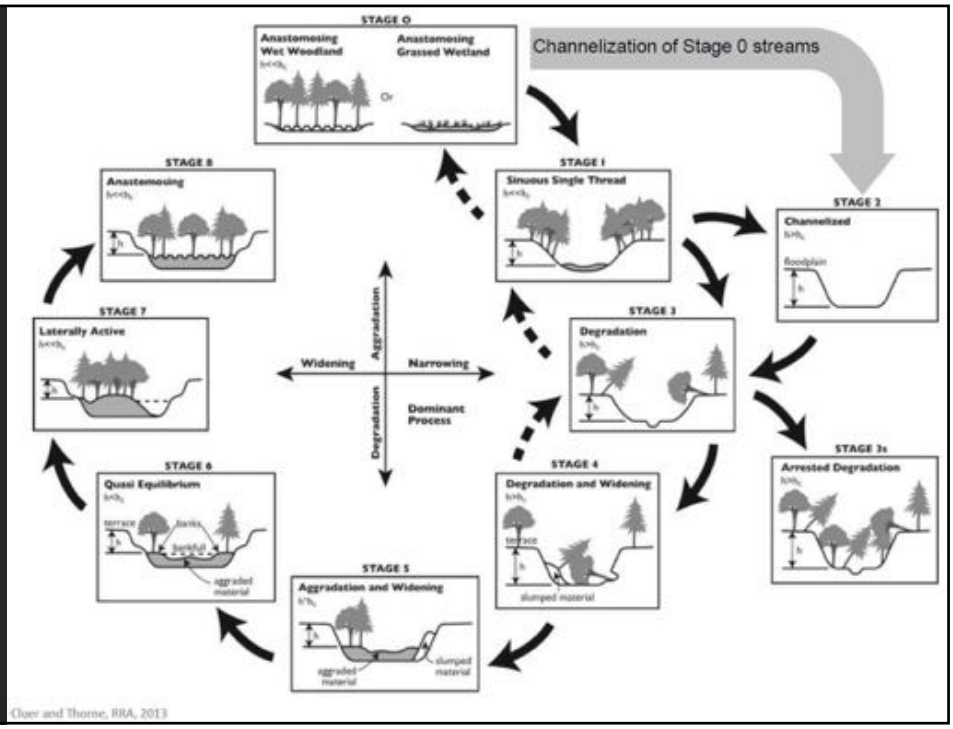
Channel Evolution Model



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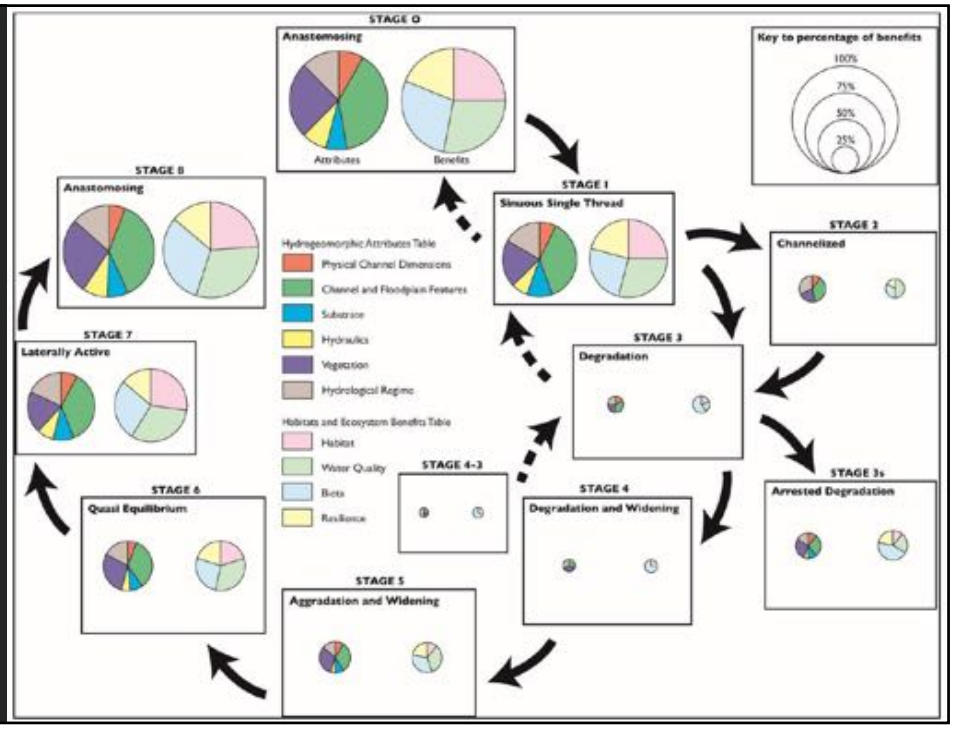
Ecological Benefits



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Pre-Beaver-Removal

Stream-Wetland-Beaver Complex

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Some Important Functions of Pre-Settlement Stream-Wetland Complexes

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Develop References Based on All Relevant Available Information

- Consider regional historical information for stream/valley characteristics and impacts.
- Use valley stratigraphy to inform the ecological reference.
- Focus on historic reference physical functions
- Consider the effect of the loss of beaver.

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Some Concluding Thoughts

- Do not let observations of our current least disturbed reference sites limit what can be.
- We may be able to restore much of the functionality of pre-settlement aquatic ecosystems especially in small watersheds
- Develop valley-specific ecosystem references based on valley stratigraphy.
- Beaver were probably a major morphological, hydrological, and ecological factor of many 2nd through at least 4rd order streams.
- Beaver complexes would not have been mature forested valley bottoms.

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