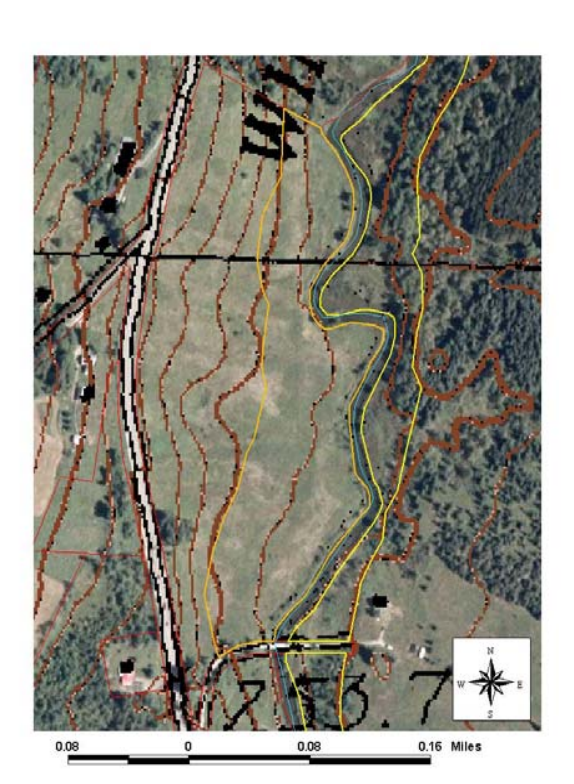
River Corridor Easement Program

- Vermont River Management Program
- Conservation Organizations
  - Vermont Land Trust
  - Vermont River Conservancy



Shayne Jaquith
River Restoration Scientist
Vermont DEC
River Management Program
(802) 241-4456
Shayne.jaquith@state.vt.us

Agency of Natural Resources

Department of Environmental Conservation

Water Quality Division

River Management Program

Vermont River Management Program

- State Floodplain Management, NFIP
- Stream Alterations Permitting
- Fluvial Erosion Hazard Management
- River Assessment, Restoration and Protection

70+ years of observing river behavior and interactions with private and public investments.

Understanding River Behavior

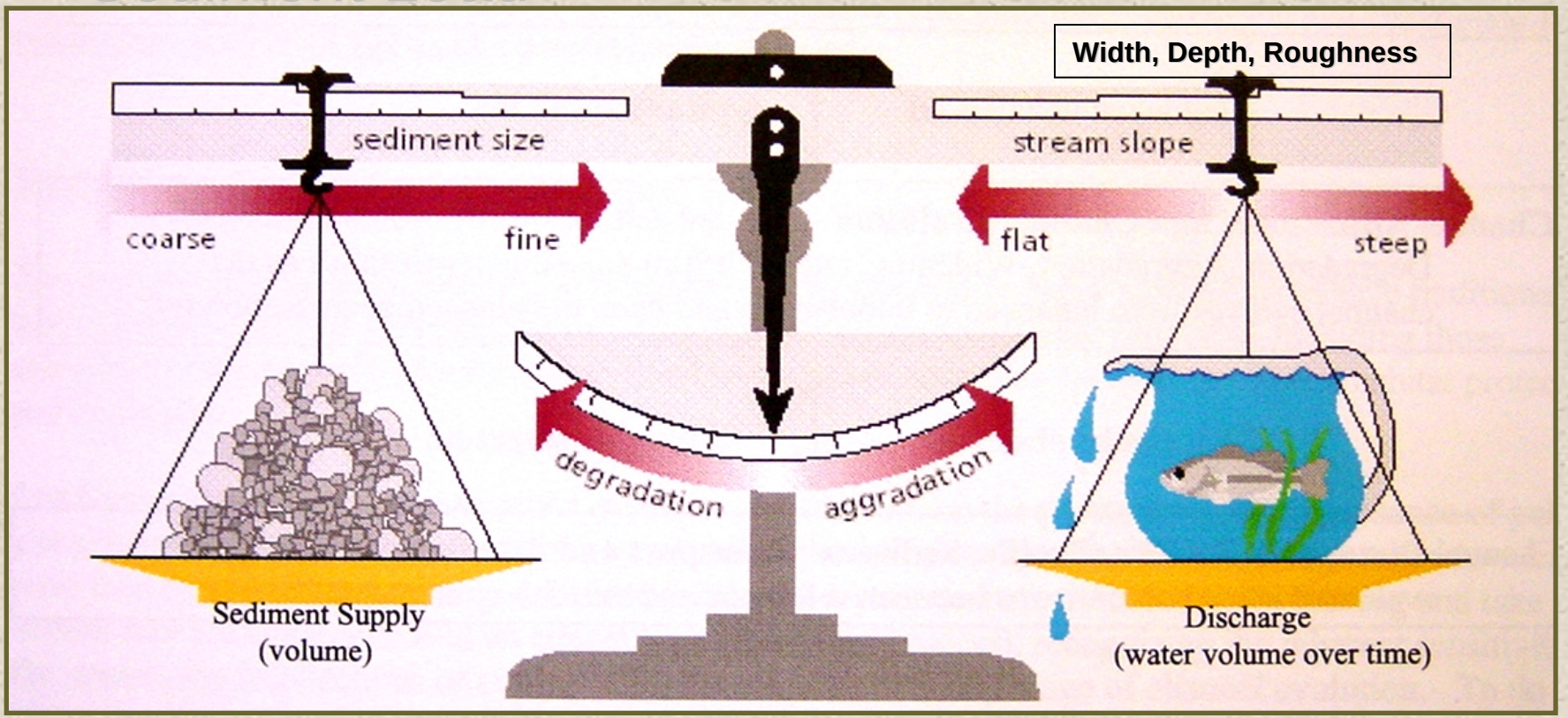
Fluvial Geomorphology:

The study of landforms created by flowing water

Self Maintaining Long Term Channel Stability/Equilibrium

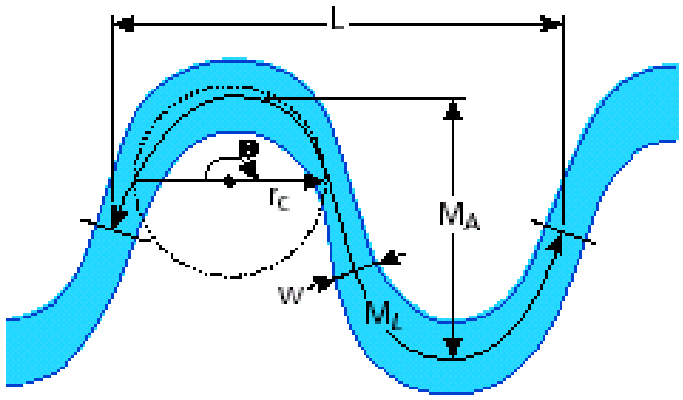
Sediment Load

Transport Capacity



Lane (1955)

Planform and Slope



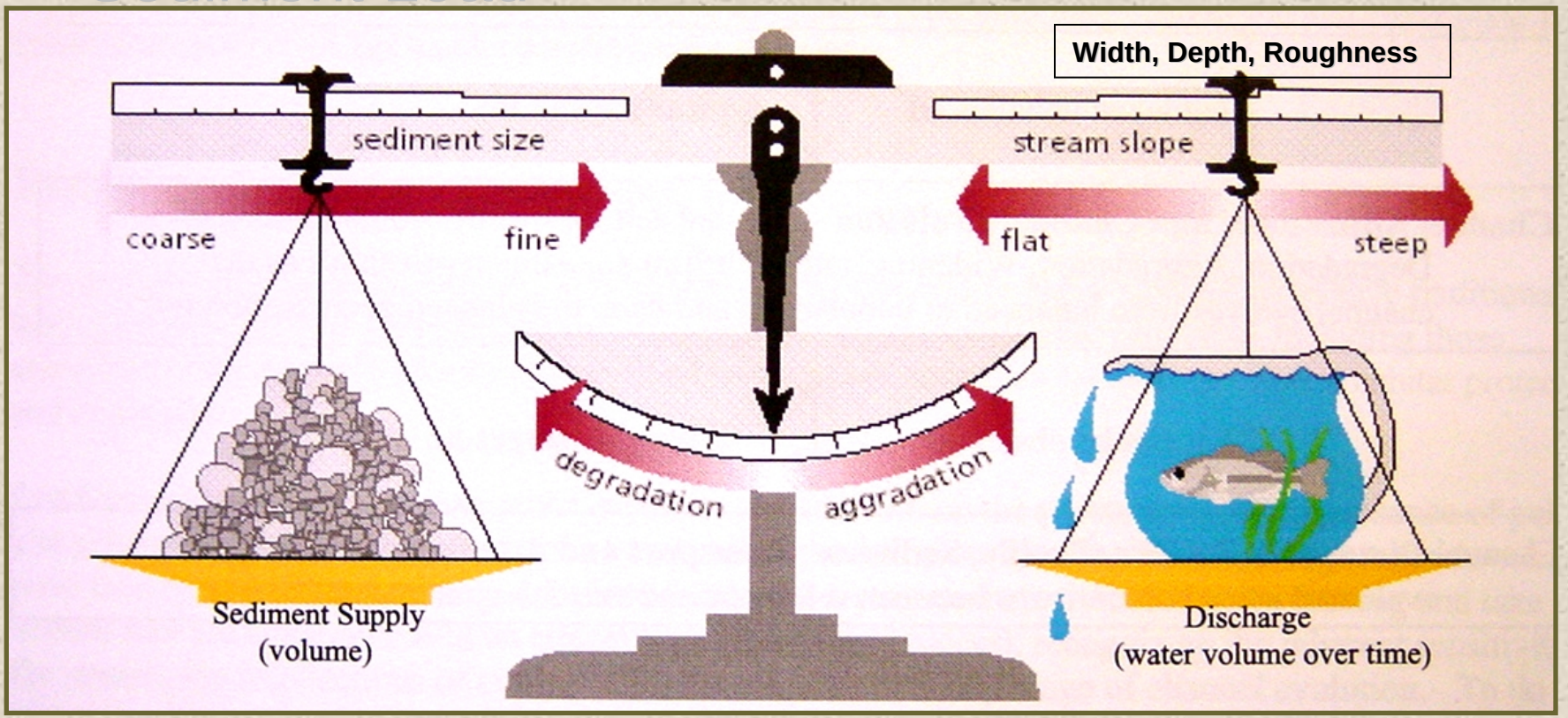
L meander wavelength
M_L meander arc length
w average width at bankfull discharge
M_A meander amplitude
r_c radius of curvature
θ arc angle

Figure 7.21: Meander geometry variables.
Adapted from Williams 1986.

Channel Equilibrium

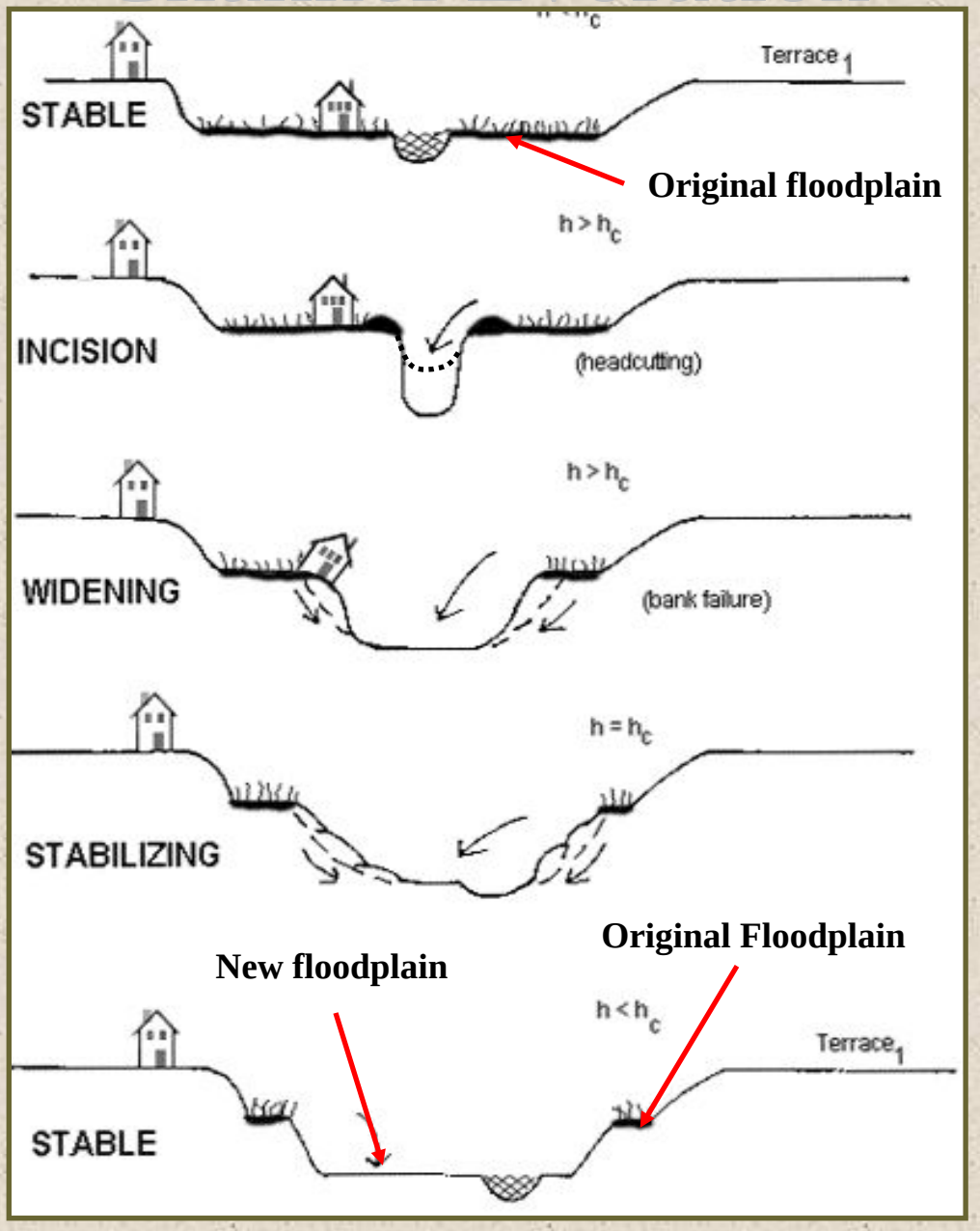
Sediment Load

Transport Capacity



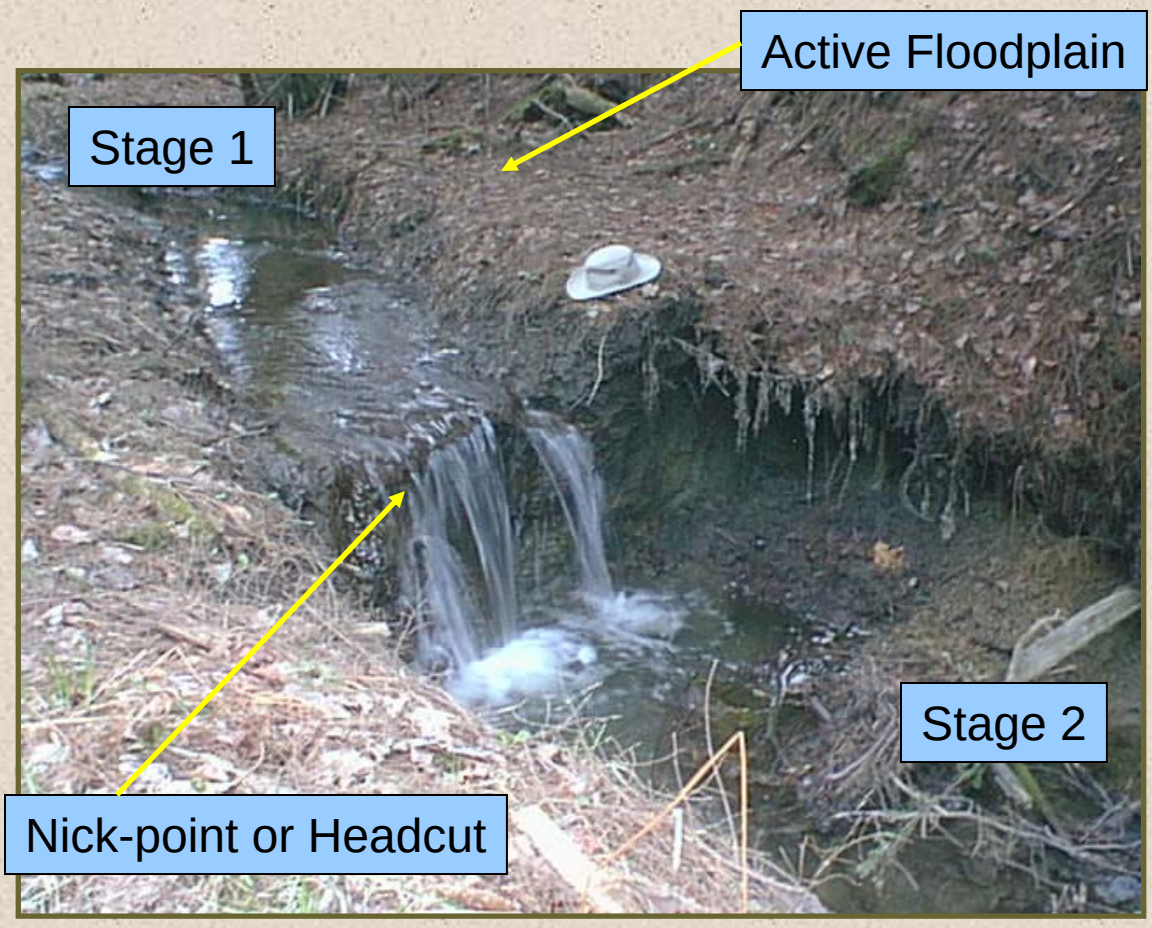
Lane (1955)

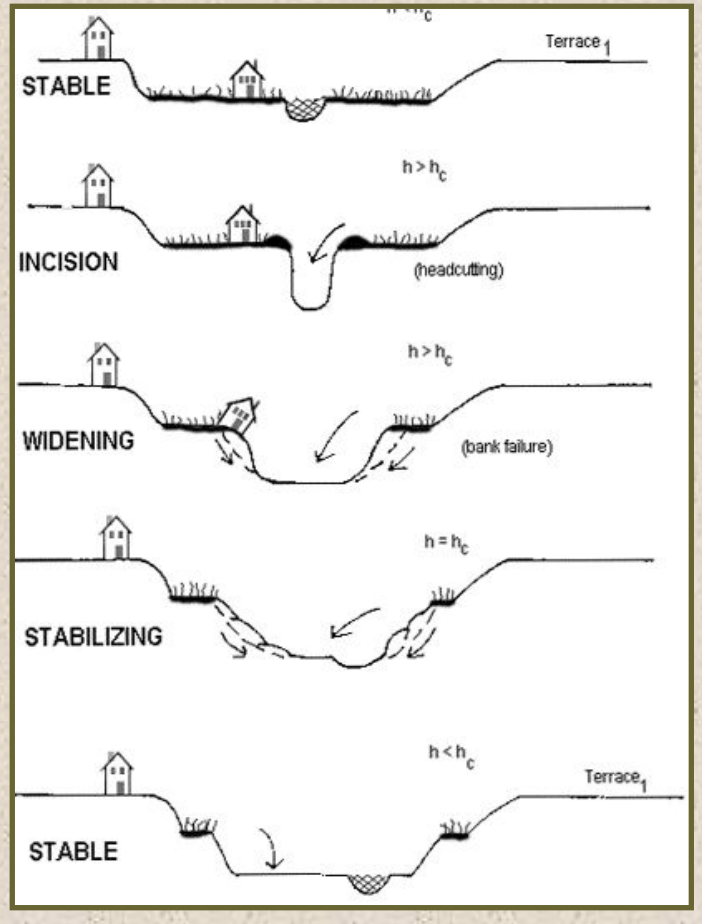
Channel Evolution



Schumm Channel Evolution Model

Stages 1 and 2: Equilibrium to Incision

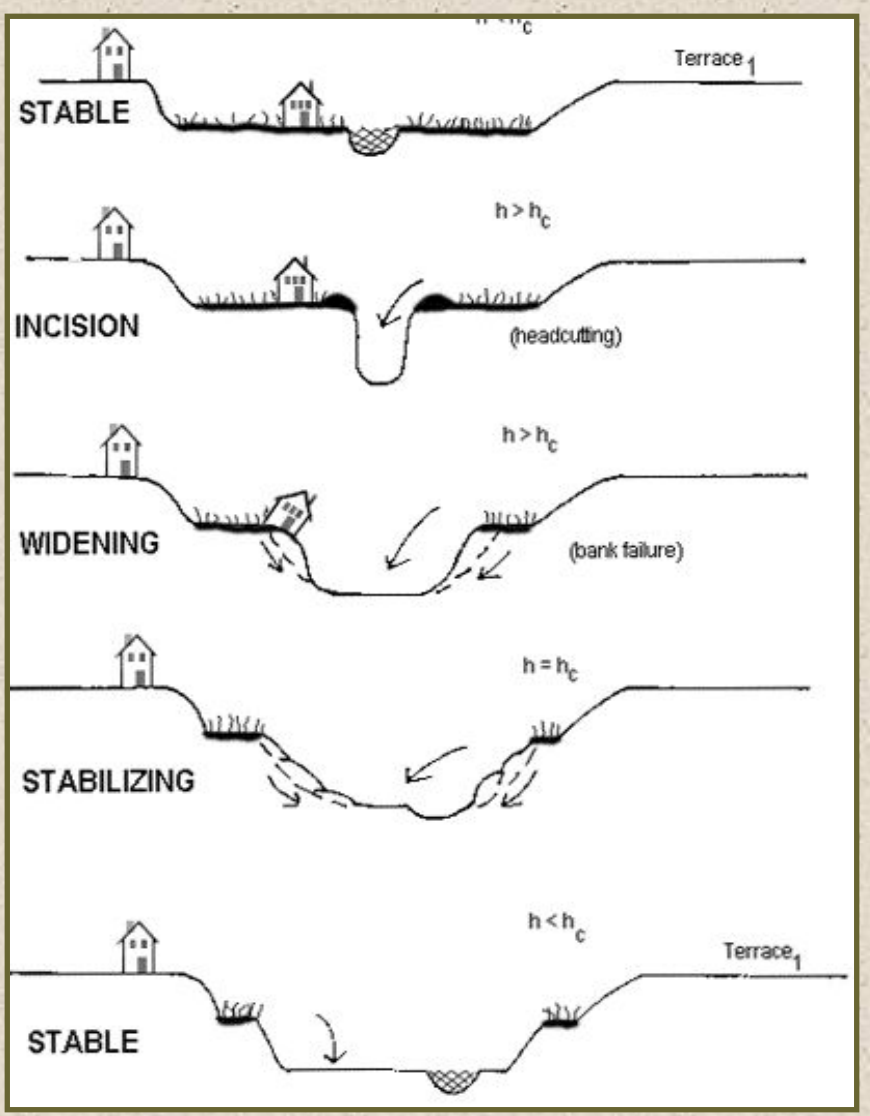




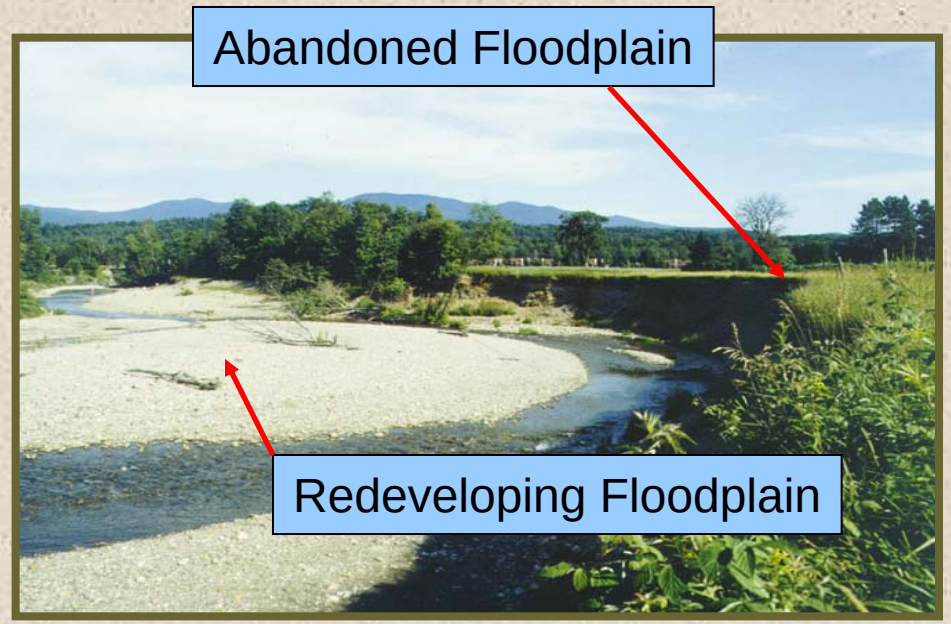
Stage 3: Widening

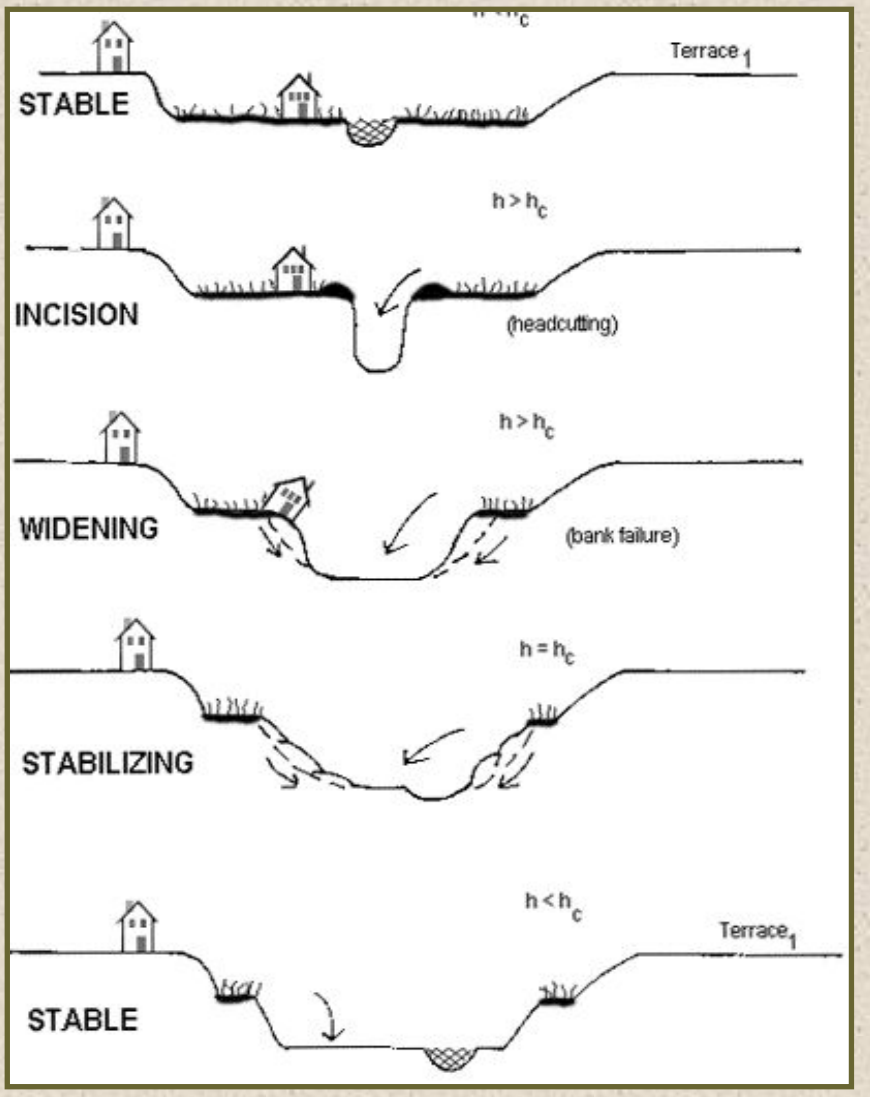
Abandoned Floodplain

Failing Banks



Stage 4: Continued widening and floodplain development

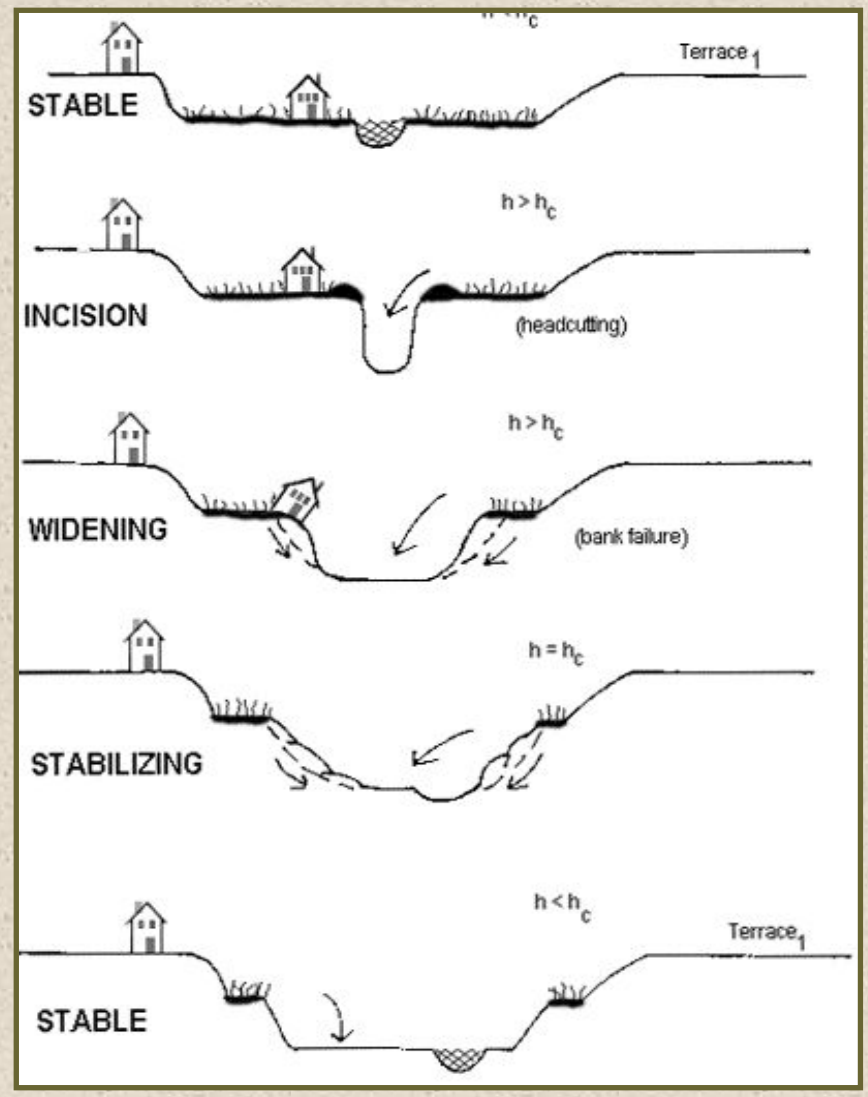




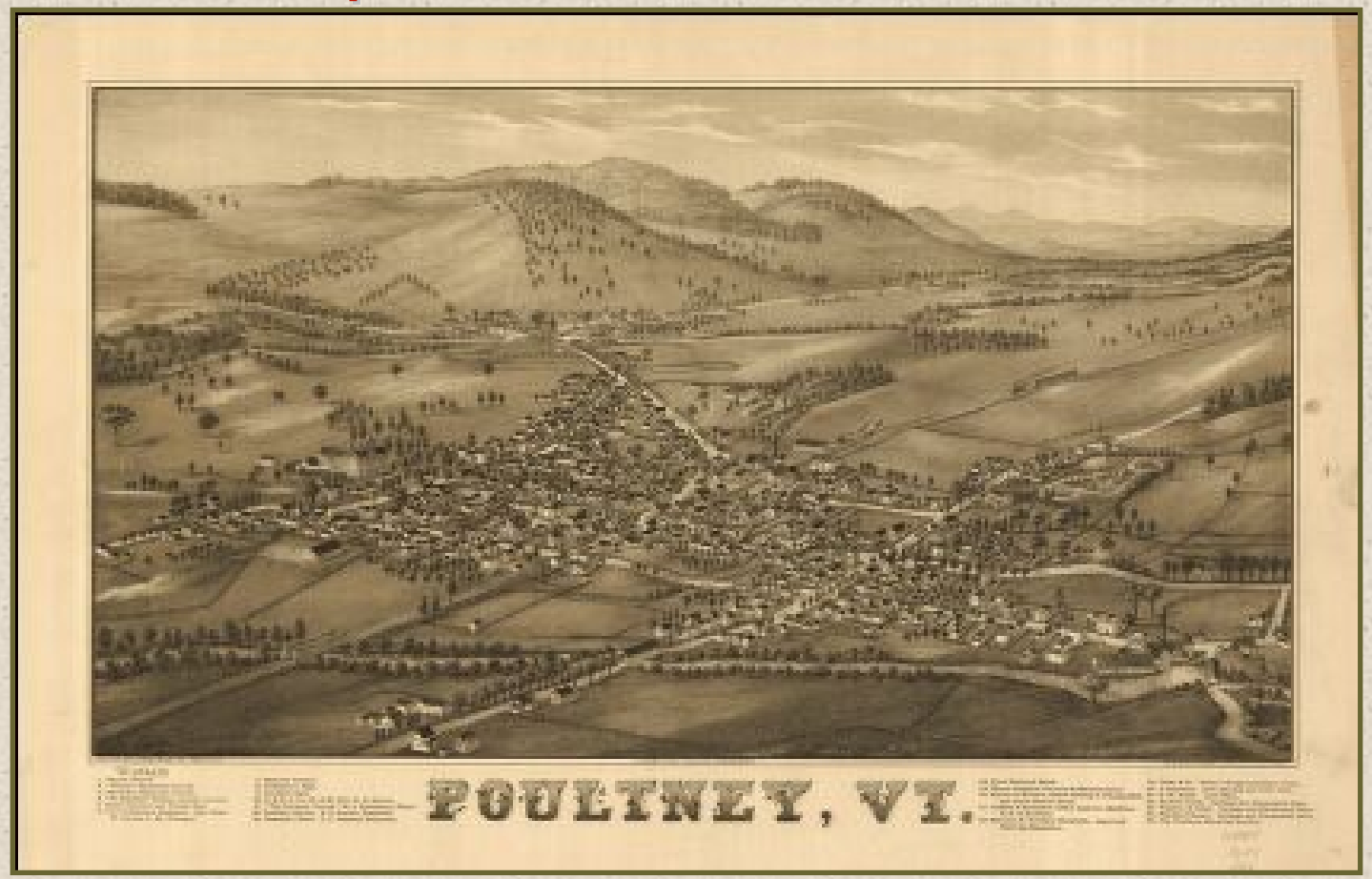
Stage 5: Return to Equilibrium

Abandoned Floodplain

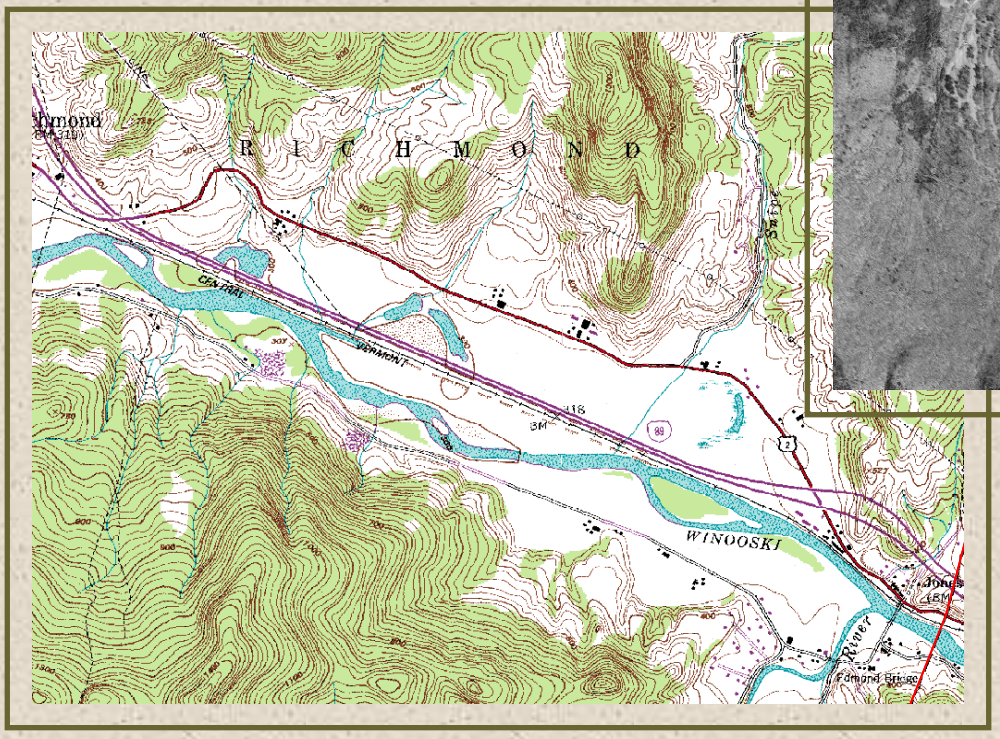
Redeveloped Floodplain



Throughout Vermont changes in land cover and land use have resulted in dramatic changes to average annual flow and sediment inputs.



Channel **planform** and **slope** have been significantly altered to accommodate transportation infrastructure agriculture and other land uses.



Post flood recovery works have altered channel dimension and boundary condition.

Timescale of Geomorphic Response (relaxation period)

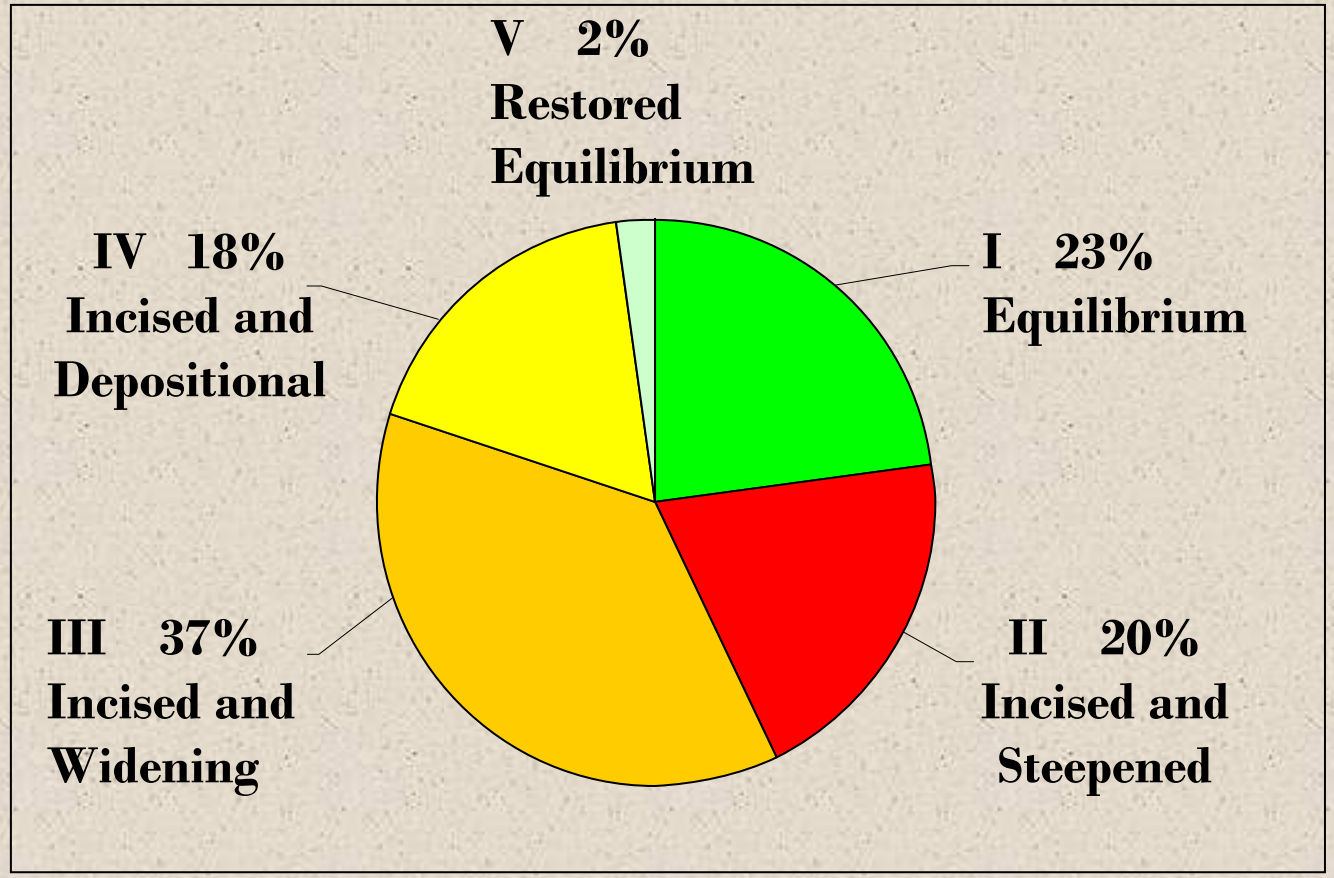
Micro-scale changes (bedforms): 1-10 yrs.

Meso-scale changes (cross section dimensions) 10-100 yrs.

Macro-scale changes (meander geometry and floodplain) 100+ yrs.

Rivers today are likely still adjusting to changes going back to the 1800's deforestation

Approx. 900 Miles Assessed



River Corridor Easements

Within the river corridor, the sale or donation of certain land use rights (Channel Management Rights) to a conservation organization (VLT or VRC).

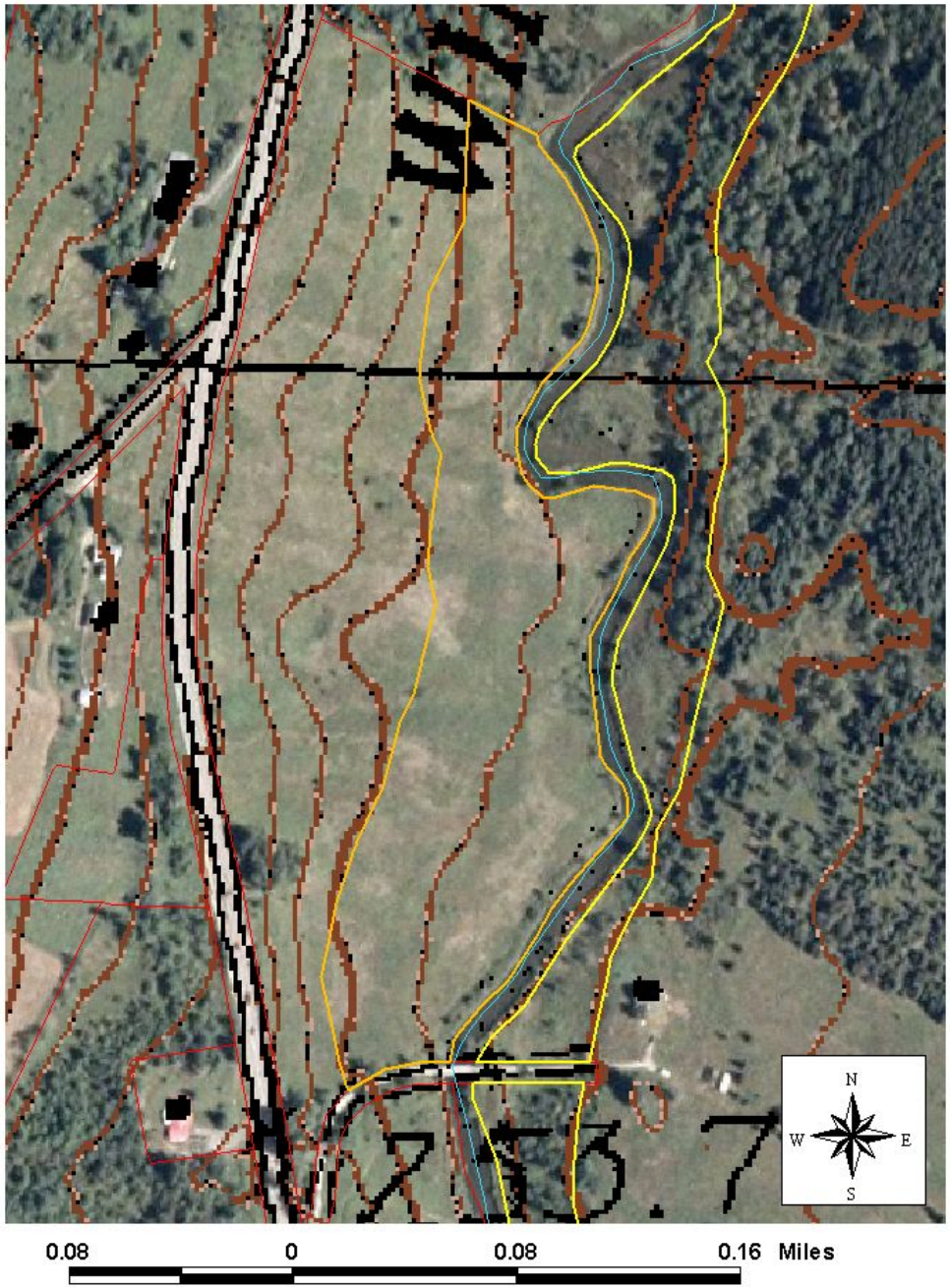
River Corridor Easement

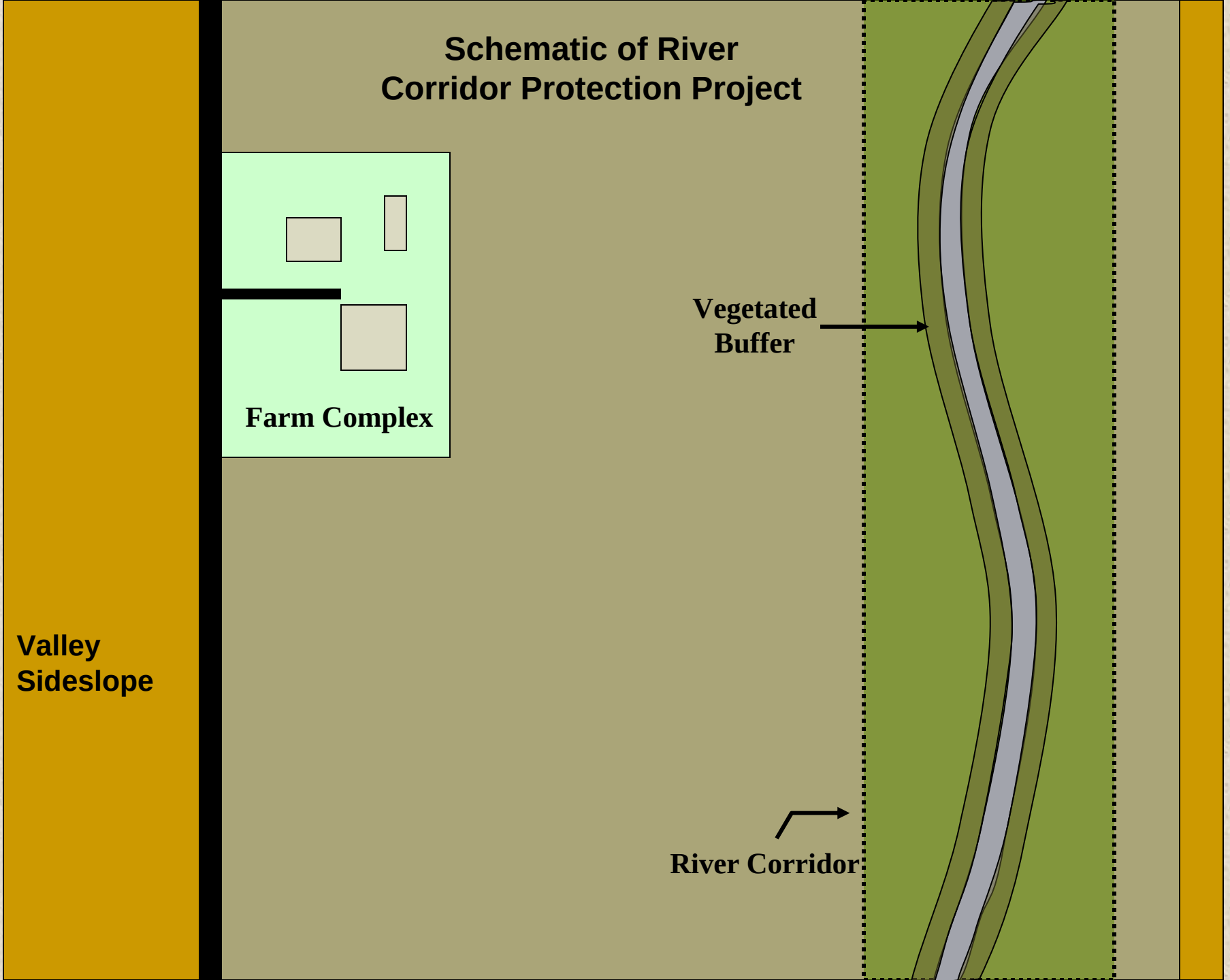
Purpose

To allow the river to re-establish a stable slope and meander pattern and its access to floodplains.

Anticipated Results

- reduced erosion rates,
- improved water quality,
- improved aquatic and wildlife habitats


N
W
E
S
0.08
0
0.08
0.16
Miles


Schematic of River
Corridor Protection Project
Farm Complex
Vegetated
Buffer
Valley
Sideslope
River Corridor

Channel Management Rights (what you give up)

- No manipulation of the natural watercourses, wetlands or other water bodies.

- The management of beaver dams in accordance with BMPs is permitted to prevent or mitigate flooding and property damage outside of the river corridor.

- No filling or excavation that would change the topography of the land, except in connection with activities for agriculture or silviculture.

Channel Management Rights (What you give up)

- No new permanent structures or improvements other than fences and at-grade fords of streams, both for agricultural purposes only.

- A floating buffer consisting of native vegetation a minimum of fifty feet (50’) as it may move from time-to-time.

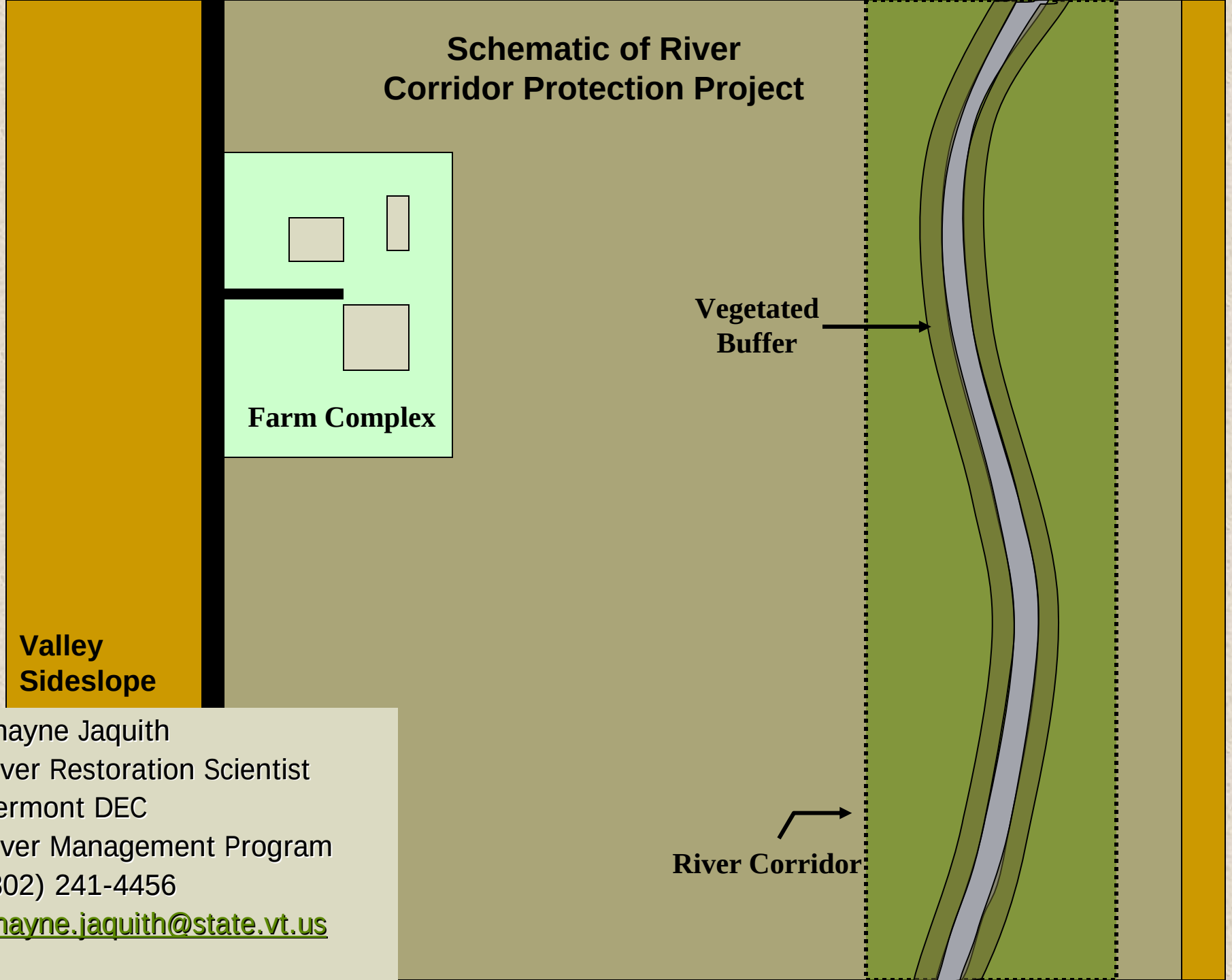
- No timber cutting shall occur within the buffer except that, if necessary to maintain the Protected Property’s eligibility for enrollment in the State of Vermont’s Use Value Program.

Channel Management Rights (What you keep)

The grantor may conduct agriculture, silviculture, or non-commercial recreational activity in the River Corridor.

Following a flood event the landowner may remove wood and other non-earthen debris from the stream channel and Protected Property if necessary to prevent damage to life, or to property outside the Protected Property, or to enable the resumption of previously conducted agricultural, silvicultural or non-commercial recreational activity within the corridor.

Schematic of River Corridor Protection Project



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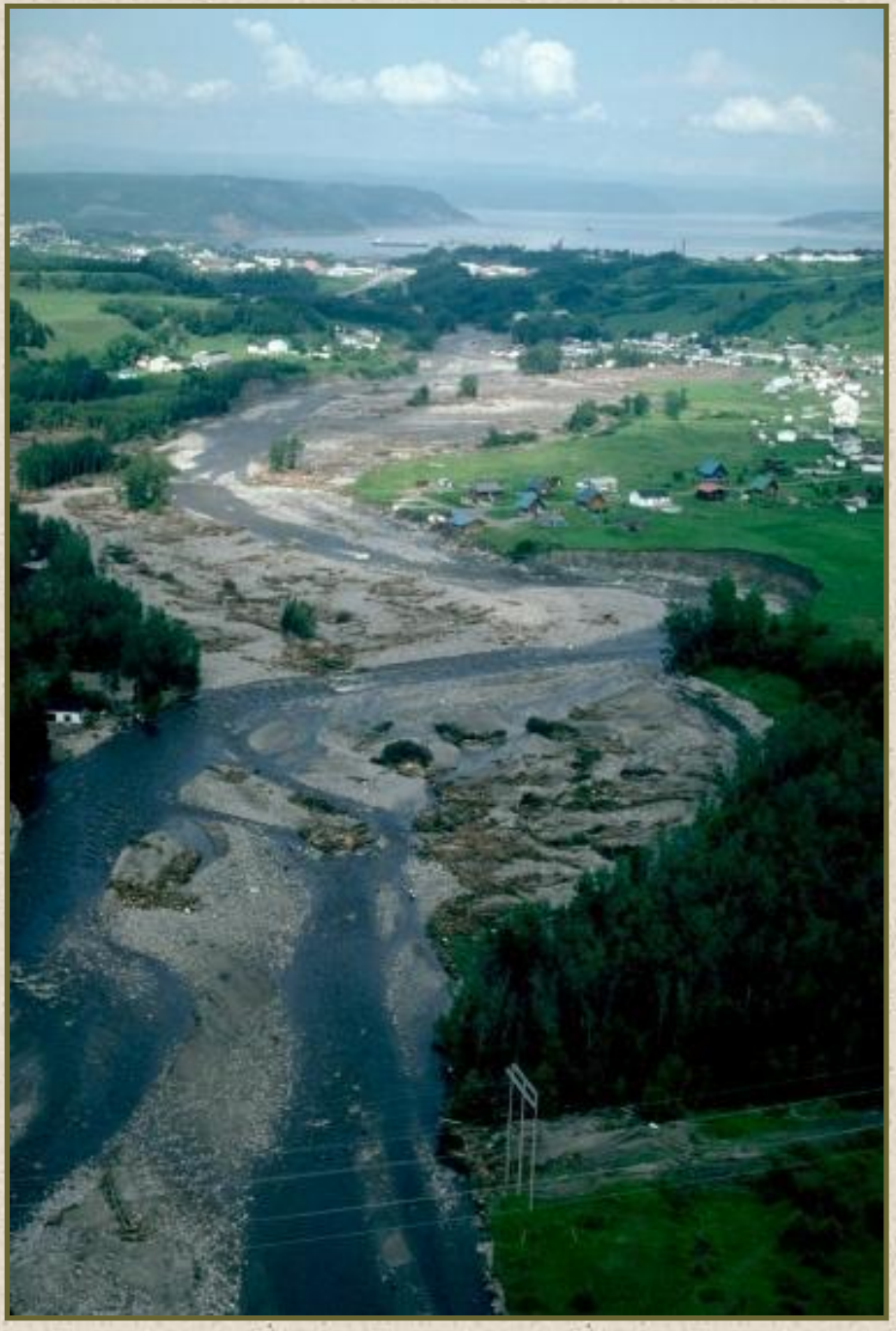

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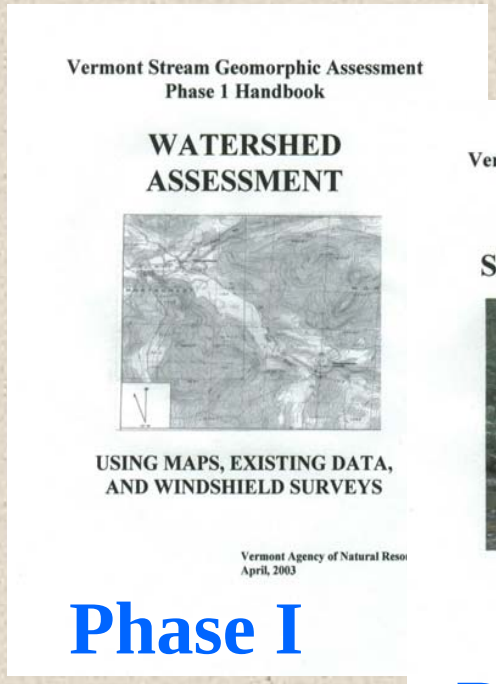
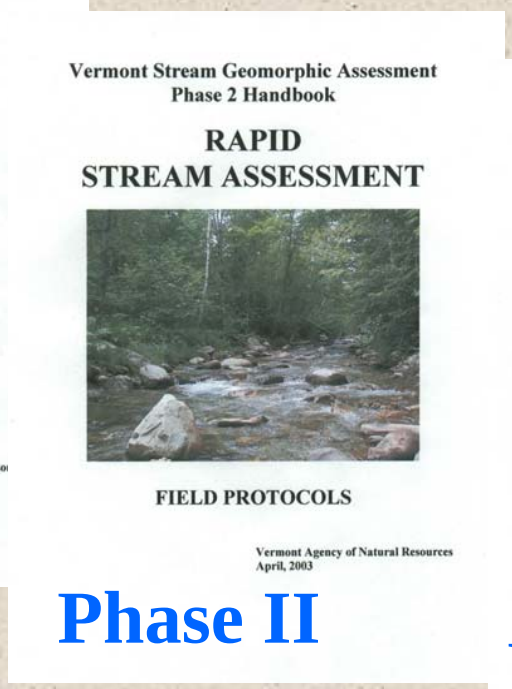
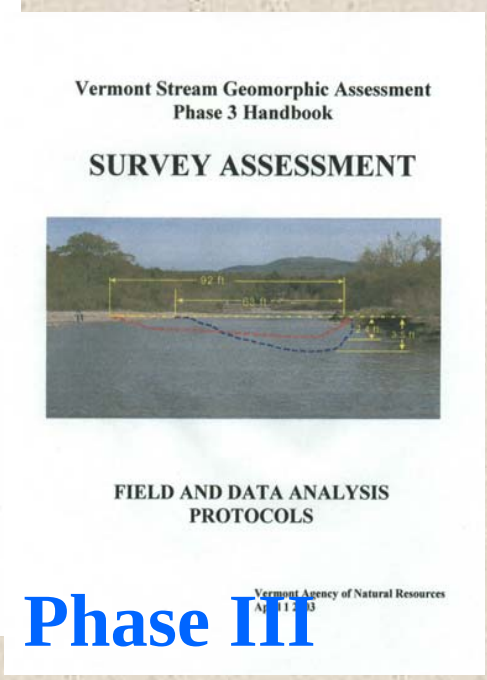
Geomorphic Assessment to Understand Stream Type, Sensitivity and Ongoing Adjustments



Remote Sensing



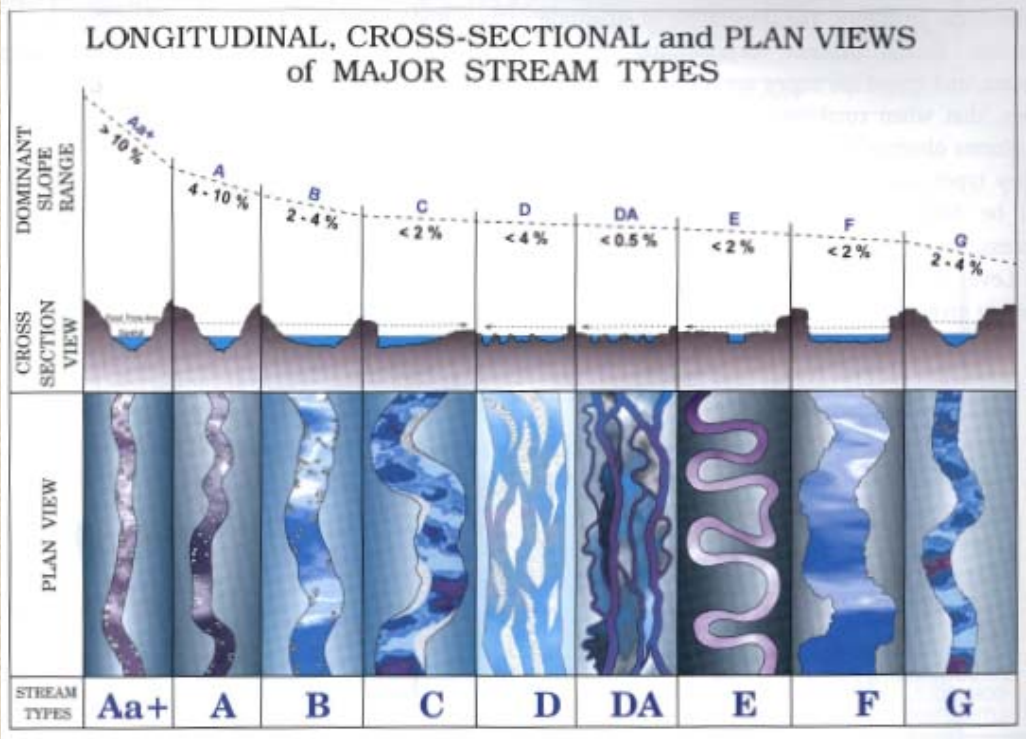
Qualitative & Rapid Field Assessment



Quantitative Field Surveys

Stream Typing to establish accurate expectations of process

Classification systems have been developed to define the most probable channel form for various valley settings

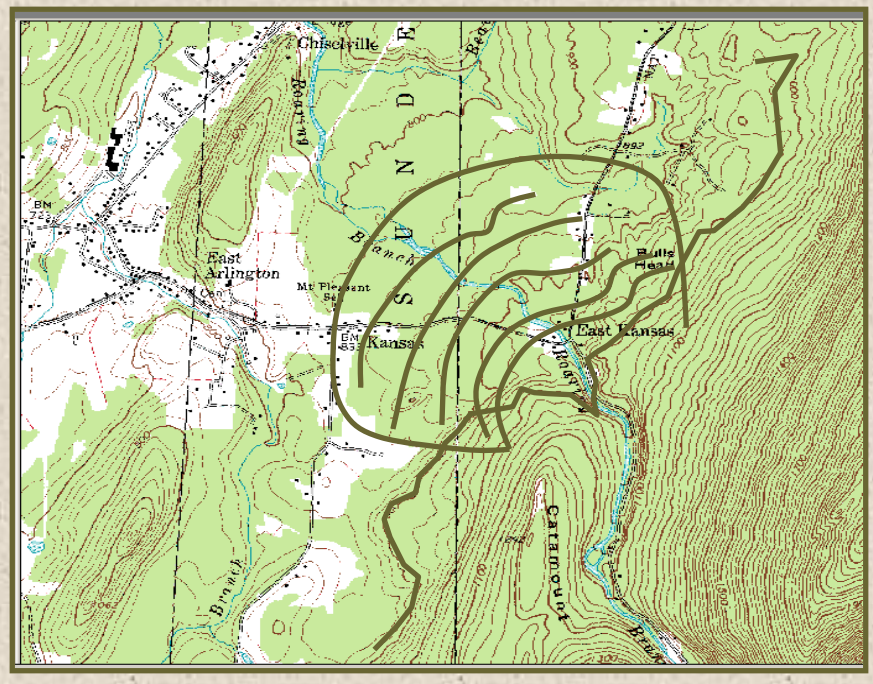


Rosgen (1996)

The Impact of Various Landforms

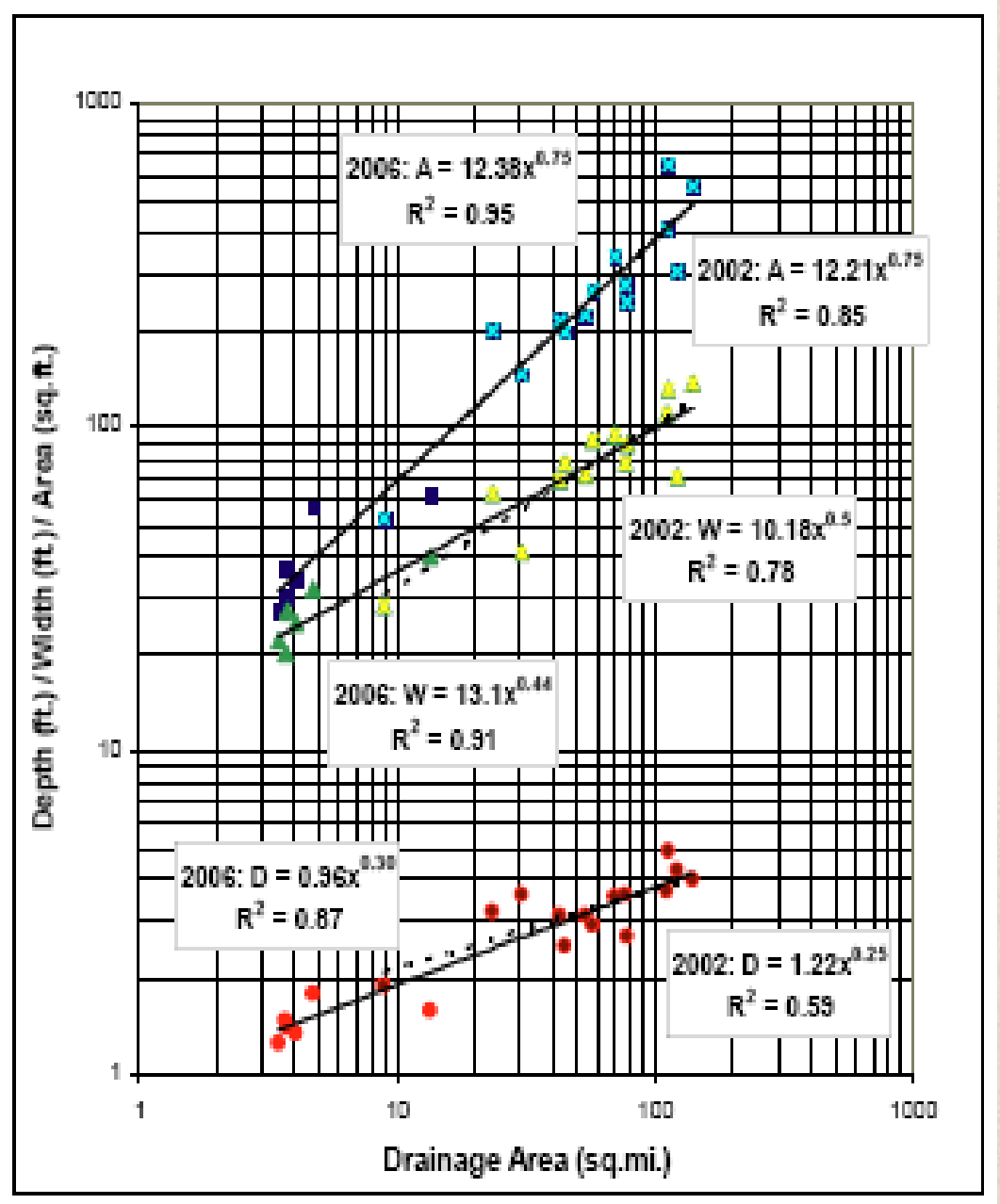
- Sediment naturally deposits at locations of significant decrease in valley slope.
- These highly depositional zones may form “alluvial fans”.

Figure 1.1 A small alluvial fan deposited from a steep tributary due to a change in slope.



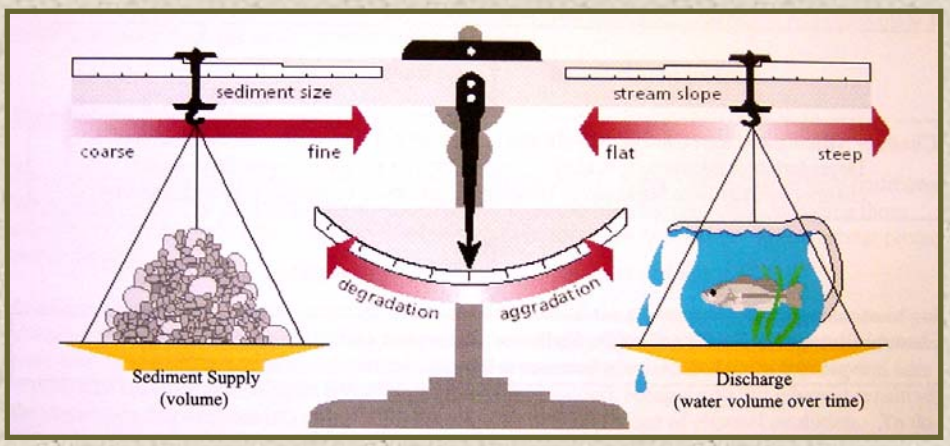
Hydraulic Geometry Curves

for understanding the stable condition

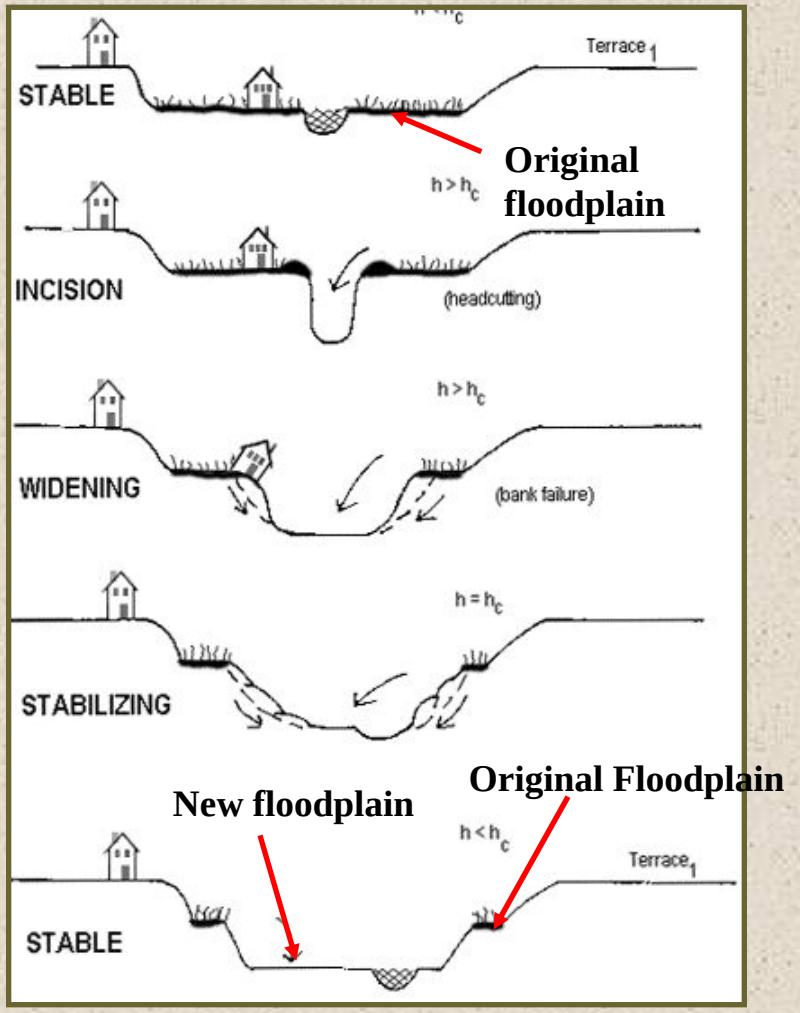


http://www.anr.state.vt.us/dec/waterq/rivers.htm

Channel Evolution

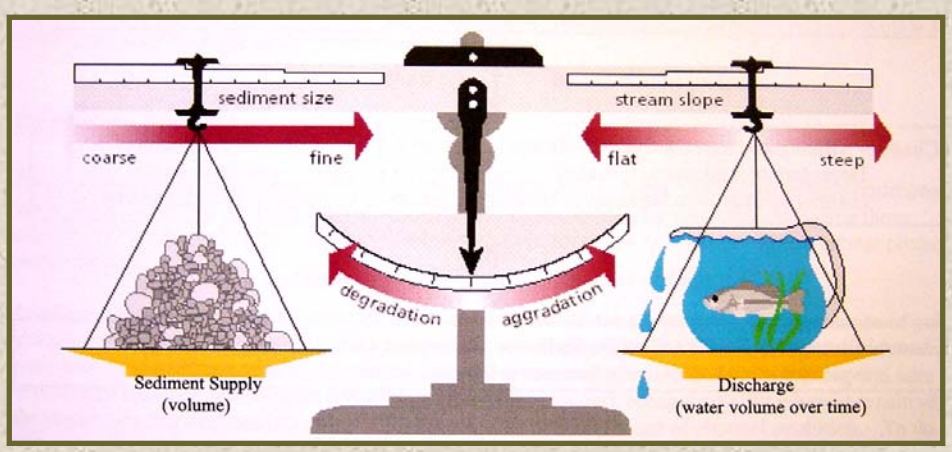


- Caused by changes to:
- Flow regime
- Sediment regime
- Slope
- Cross section
- Boundary condition
- Channel Roughness



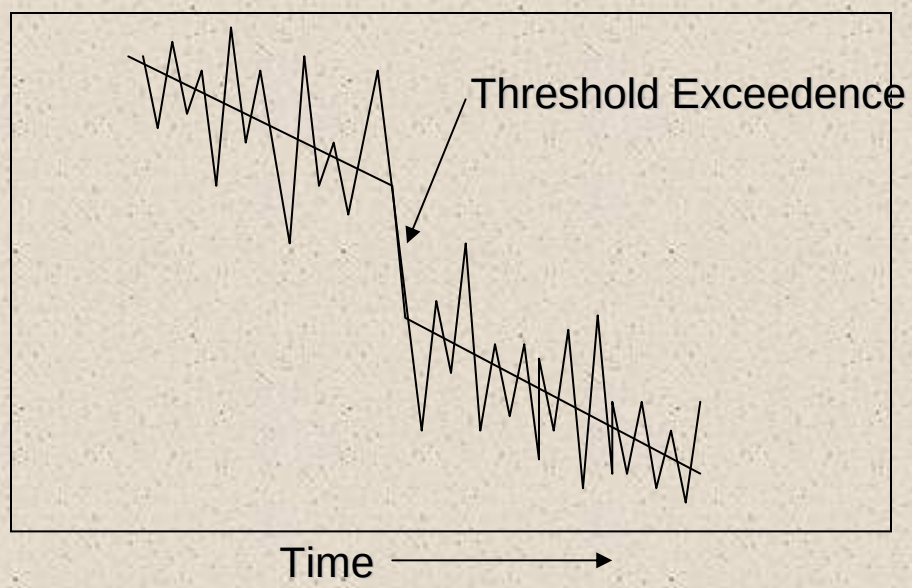
Channel Evolution

The sequence of adjustments processes that a channel goes through when changes to controlling factors exceed a “geomorphic threshold”.



Controlling Factors

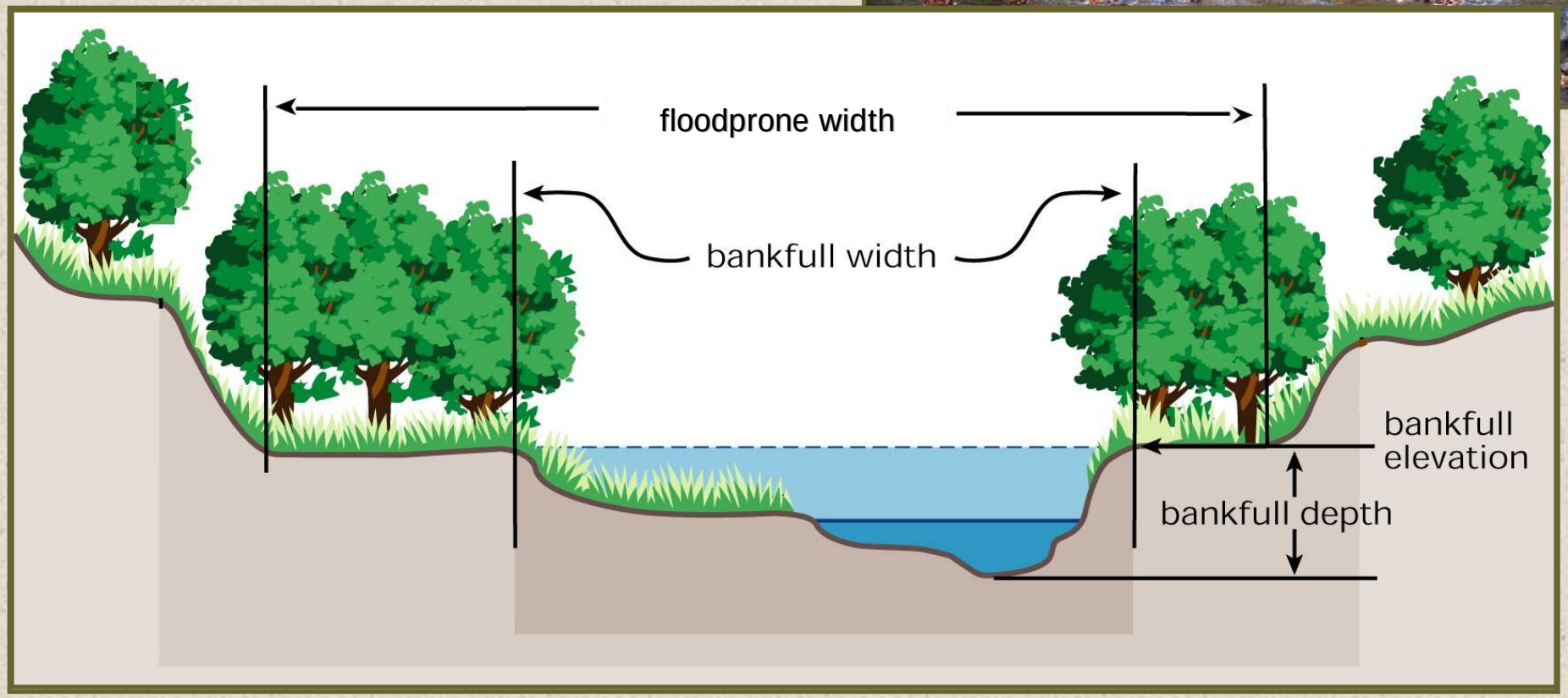
- Flow regime
- Sediment regime
- Slope
- Cross section
- Boundary condition
- Channel Roughness



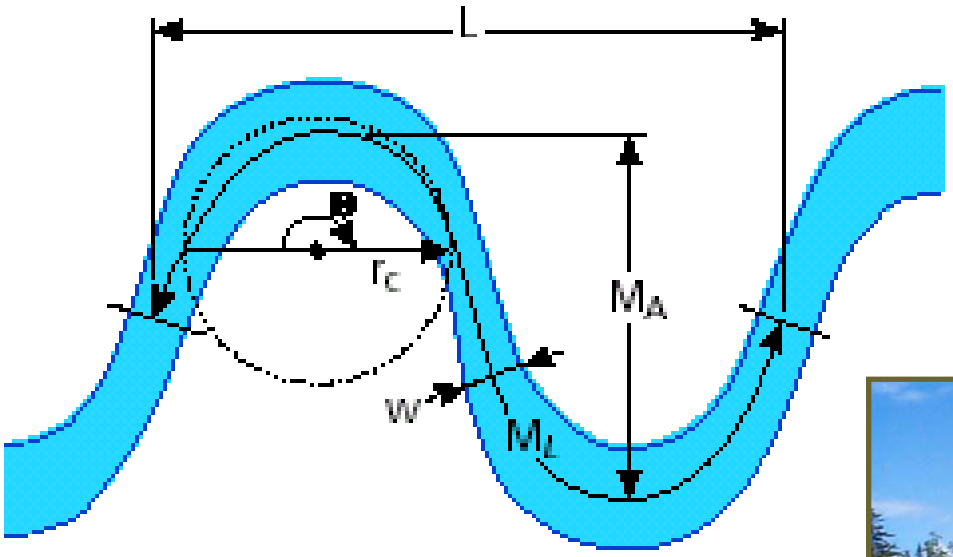
Most Probable Form and Self Maintenance

Given consistent inputs (average annual precipitation and sediment input), every river has a single most probable form toward which it is constantly working (Leopold, 1994).

Most Probable Dimensions



Channel Planform Geometry



L meander wavelength
M_L meander arc length
w average width at bankfull discharge
M_A meander amplitude
r_c radius of curvature
θ arc angle

Figure 7.21: Meander geometry variables.
Adapted from Williams 1986.

River Corridor Protection Area

The River Corridor shall be managed under a Management Plan which shall be developed and subsequently amended from time-to-time by (or with approval from) the DEC in consultation with (the AAFM,) the Grantors and Grantees. The Management Plan shall include provisions for:

- the right of the (grantee,) DEC, or its designees, to conduct stream and channel management activities within the corridor including, but not limited to: installing, maintaining, repairing, or removing structural elements or improvements including, but not limited to, bank revetments, levees, or fill encroachments; adjusting bank height or otherwise manipulating the water courses.

- the right of the (grantee,) DEC, or its designees, to establish and maintain a 50-foot vegetative buffer; and

- a process assuring that no management activity shall be undertaken by the (grantee or) DEC without adequate notice to the Grantors and due regard to the impact of such management activity on the Grantors' use of the river corridor otherwise permitted under this Grant, particularly agricultural use; so that Grantors' capital investments in the corridor are reasonably considered.

River Corridor Protection Area

The Grantees and the DEC shall have a right of reasonable ingress and egress on and over the Protected Property to and from the river corridor for inspection, administration, management, and enforcement.

The DEC, with the approval and the participation of the Grantors, may mark the general boundaries of the River Corridor Protection Area.

- Vermont Agency of Natural Resources Clean and Clear Program
  - River Corridor Grants
    - Geomorphic Assessment
    - Corridor Planning (Identification River Restoration Opportunities)
  - Restoration of the dynamic equilibrium leads to minimized erosion rates

Vermont RMP Goal and Objectives

Public and Private Property Protection

Water Quality Improvement

River Ecosystem Restoration

Economically and ecologically sustainable relationship with rivers by managing toward *equilibrium conditions*

Fluvial Erosion Hazard (FEH) Mitigation

Protect flood attenuation assets and adopt municipal plans and ordinances to minimize fluvial erosion hazards.

Sediment and Nutrient Load Reduction

Increase floodplain storage, riparian vegetation, and stream bank stability to reduce sediment and nutrient loads in a watershed.

River & Riparian Habitat Restoration and Protection