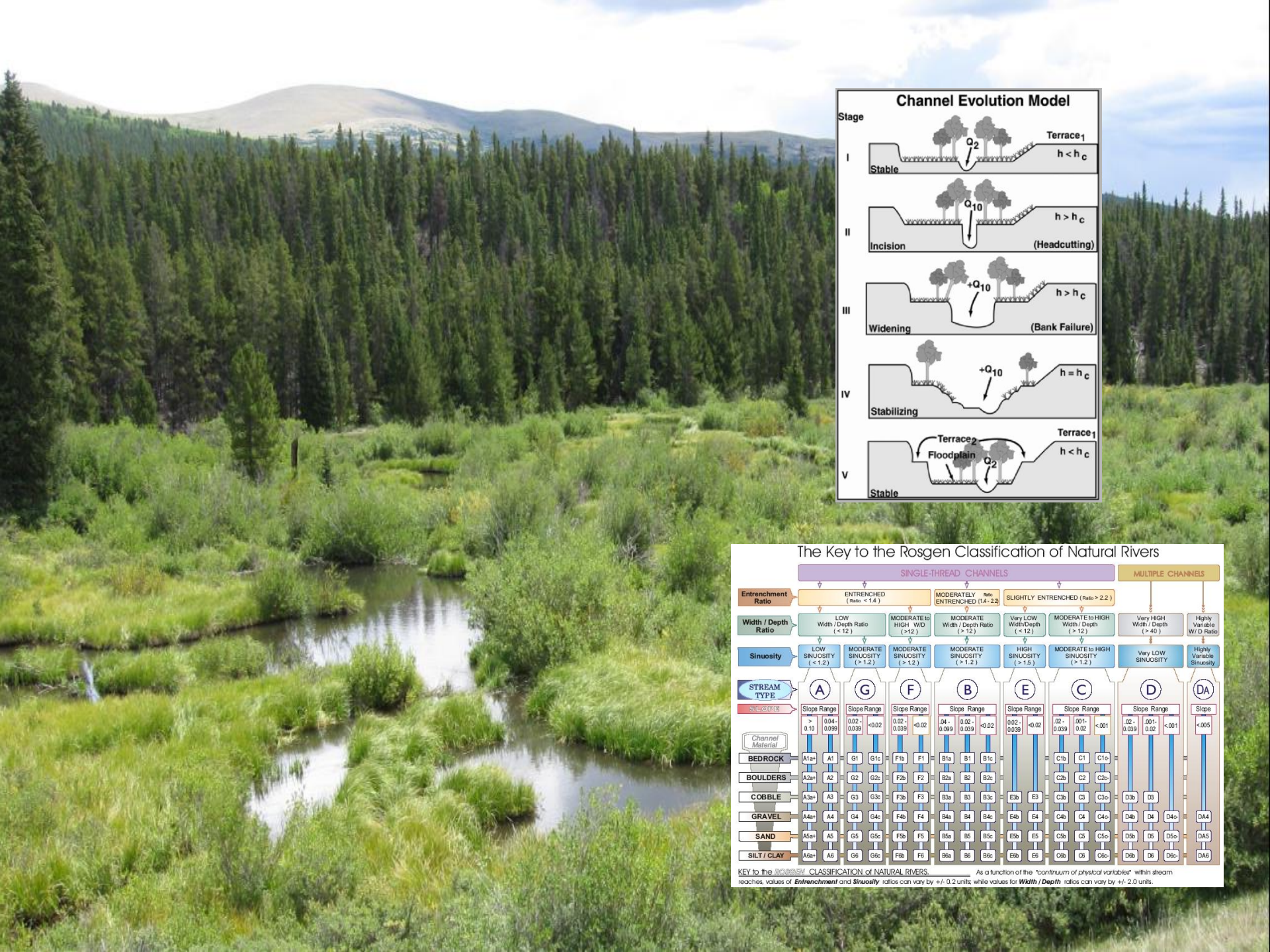
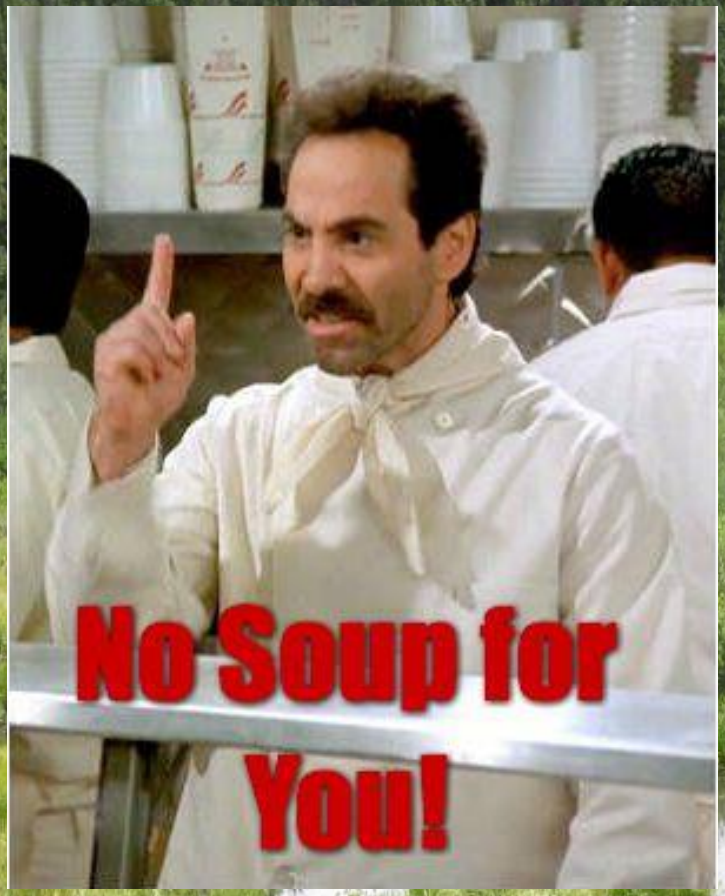
Stage 0: Using a Channel Evolution Model to Set Restoration Goals

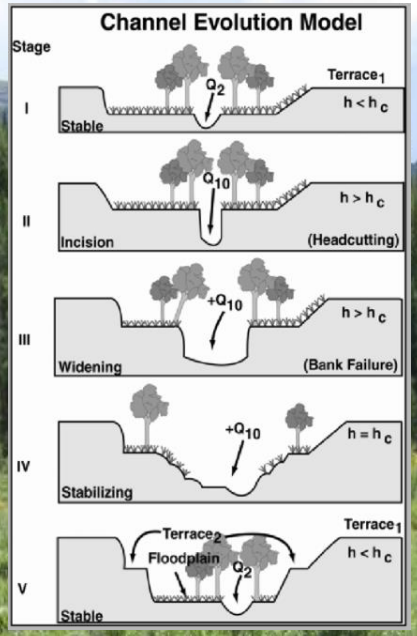
Stage 0: Using a ~~Channel~~ Evolution Model to Set Restoration Goals ^Stream


SOUP


Channel Evolution Model
Stage
I
Stable
Terrace1
Q2
h < hc
II
Incision
Q10
h > hc
(Headcutting)
III
Widening
+Q10
h > hc
(Bank Failure)
IV
Stabilizing
+Q10
h = hc
V
Terrace2
Floodplain
Terrace1
Q2
Stable
h < hc

The Key to the Rosgen Classification of Natural Rivers
SINGLE-THREAD CHANNELS
MULTIPLE CHANNELS
Entrenchment Ratio
ENTRENCHED (Ratio < 1.4)
MODERATELY ENTRENCHED (1.4 - 2.2)
SLIGHTLY ENTRENCHED (Ratio > 2.2)
Width / Depth Ratio
LOW Width / Depth Ratio (< 12)
MODERATE to HIGH W/D (>12)
MODERATE Width / Depth Ratio (> 12)
Very LOW Width/Depth (< 12)
MODERATE to HIGH Width / Depth (> 12)
Very HIGH Width / Depth (> 40)
Highly Variable W/ D Ratio
Sinuosity
LOW SINUOSITY (< 1.2)
MODERATE SINUOSITY (> 1.2)
MODERATE SINUOSITY (> 1.2)
MODERATE SINUOSITY (> 1.2)
HIGH SINUOSITY (> 1.5)
MODERATE to HIGH SINUOSITY (> 1.2)
Very LOW SINUOSITY
Highly Variable Sinuosity
STREAM TYPE
A
G
F
B
E
C
D
DA
SLOPE
Slope Range
Channel Material
BEDROCK
BOULDERS
COBBLE
GRAVEL
SAND
SILT / CLAY
KEY to the ROSGEN CLASSIFICATION of NATURAL RIVERS.
As a function of the "continuum of physical variables" within stream reaches, values of Entrenchment and Sinuosity ratios can vary by +/- 0.2 units; while values for Width / Depth ratios can vary by +/- 2.0 units.


No Soup for You!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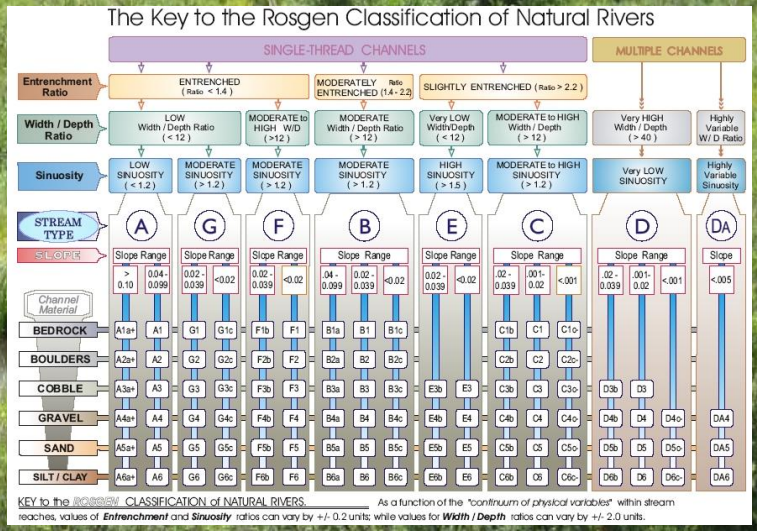
Terrace2
Floodplain
Terrace1
Q2
h < hc
Stable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Highly Variable W/ D Ratio
Sinuosity
LOW SINUOSITY (< 1.2)
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MODERATE SINUOSITY (> 1.2)
HIGH SINUOSITY (> 1.5)
MODERATE to HIGH SINUOSITY (> 1.2)
Very LOW SINUOSITY
Highly Variable Sinuosity
STREAM TYPE
A
G
F
B
E
C
D
DA
SLOPE
Slope Range
> 0.10
0.04 - 0.099
0.02 - 0.039
<0.02
0.02 - 0.039
<0.02
.04 - 0.099
0.02 - 0.039
<0.02
0.02 - 0.039
<0.02
.02 - 0.039
.001 - 0.02
<.001
.02 - 0.039
.001 - 0.02
<.001
Slope
<.005
Channel Material
BEDROCK
BOULDERS
COBBLE
GRAVEL
SAND
SILT / CLAY
KEY to the ROSGEN CLASSIFICATION of NATURAL RIVERS.
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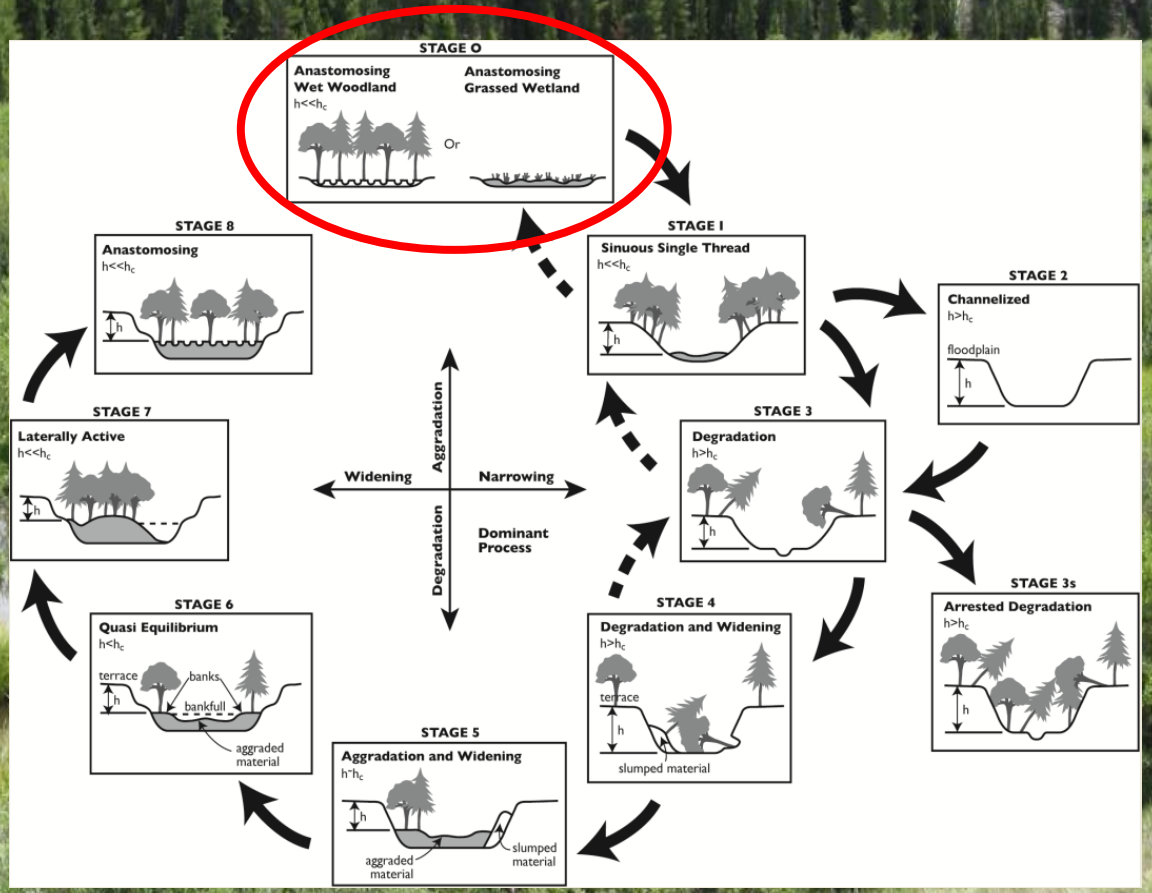
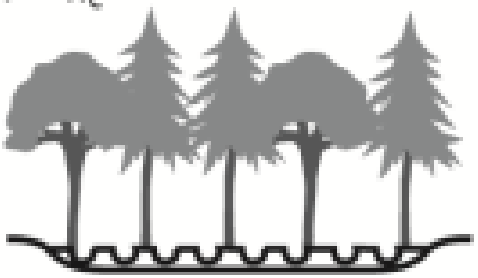


Cluer and Thorne (2014)

STAGE 0

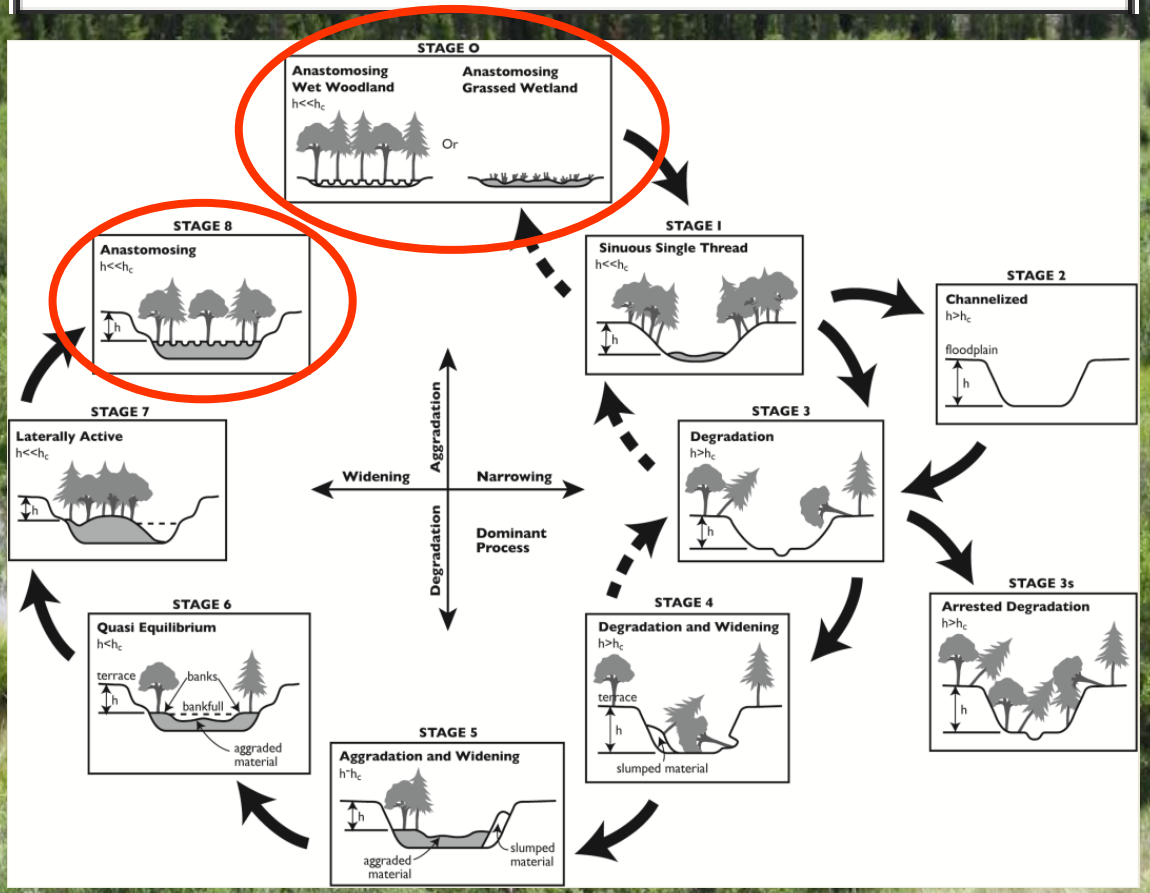
Anastomosing Wet Woodland

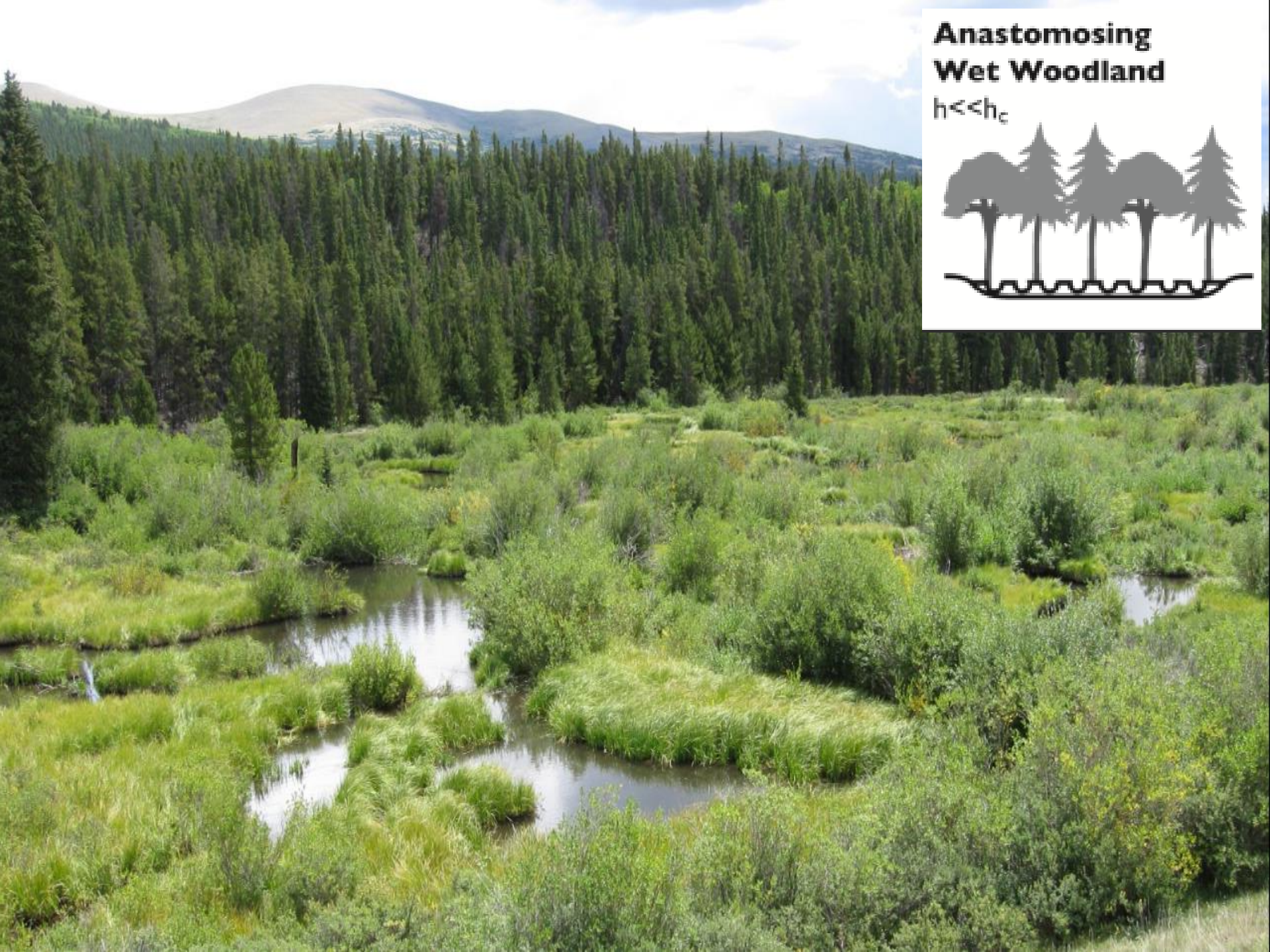
$h << h_c$

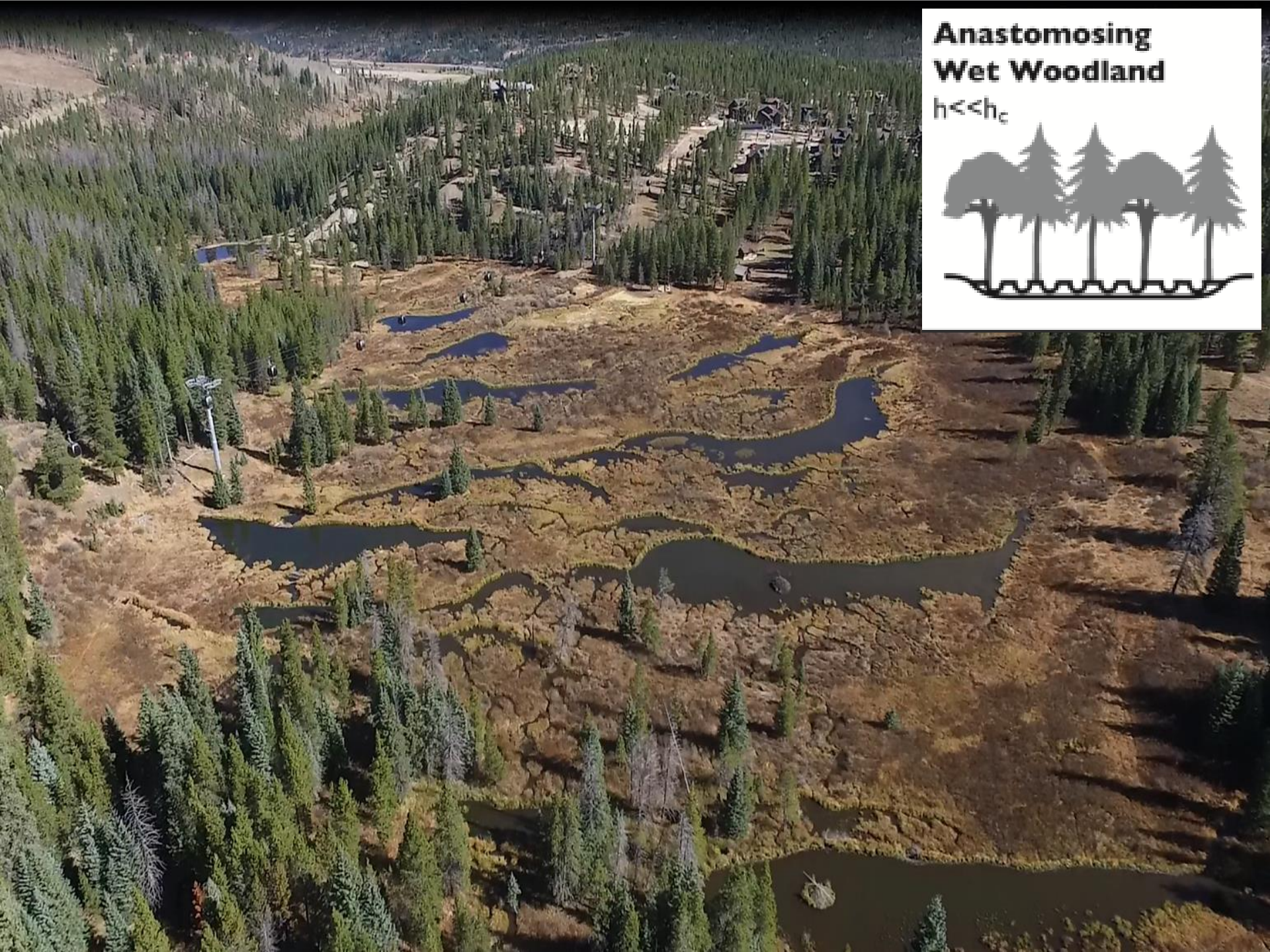


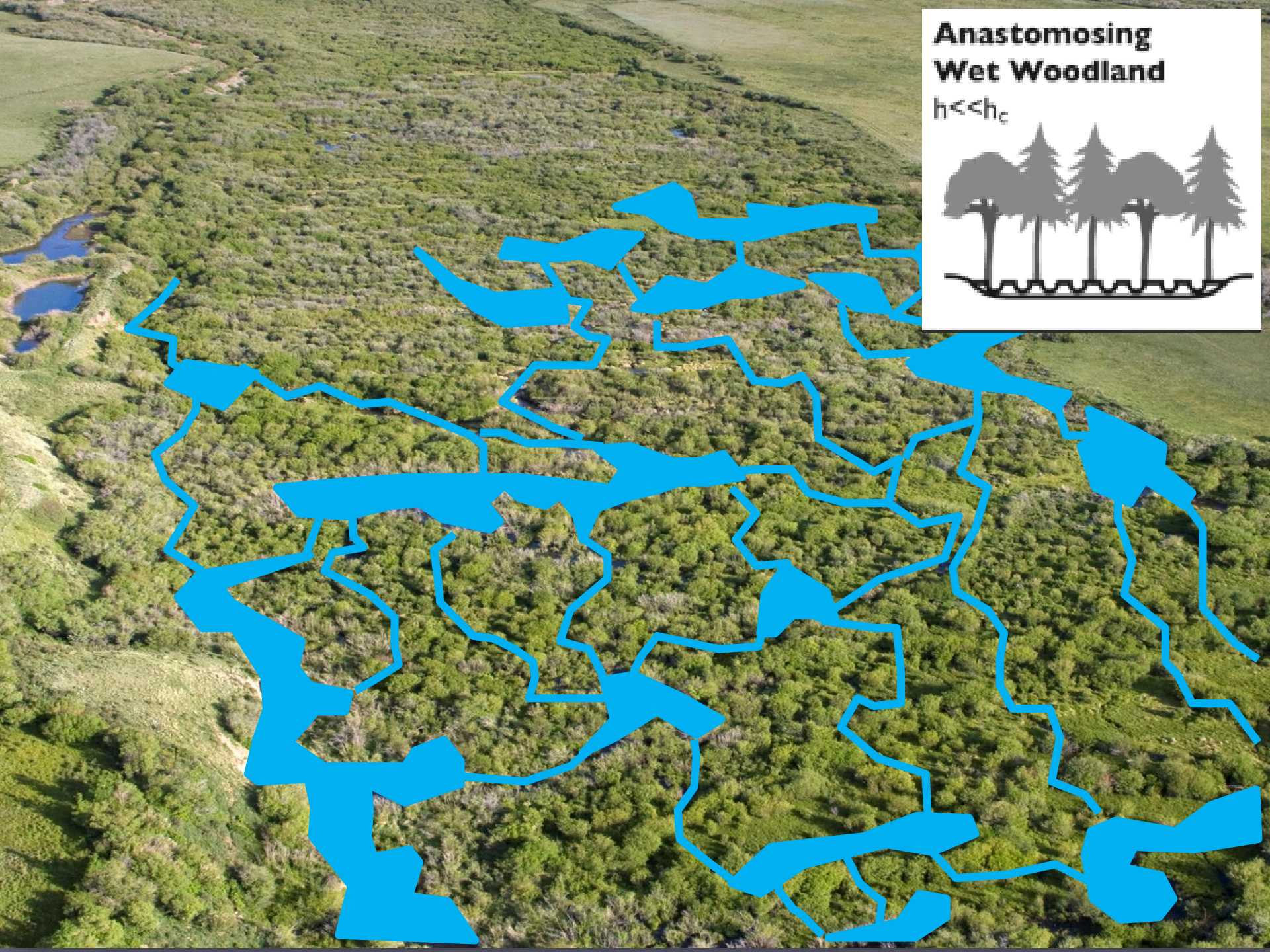
Or

Anastomosing Grassed Wetland



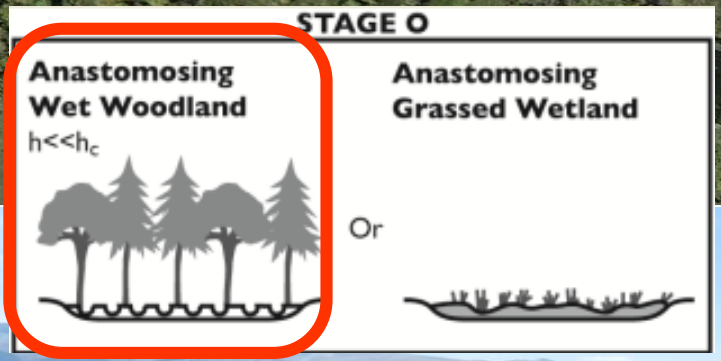

Anastomosing
Wet Woodland
h<<h$_c$


Anastomosing
Wet Woodland
h<<h$_c$

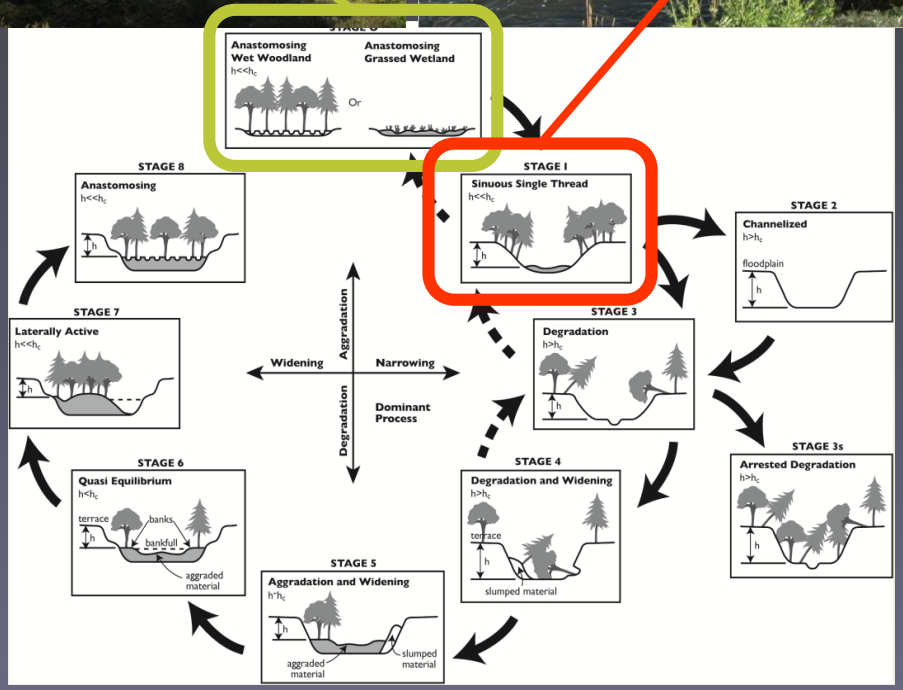

Anastomosing
Wet Woodland
h<<h$_c$

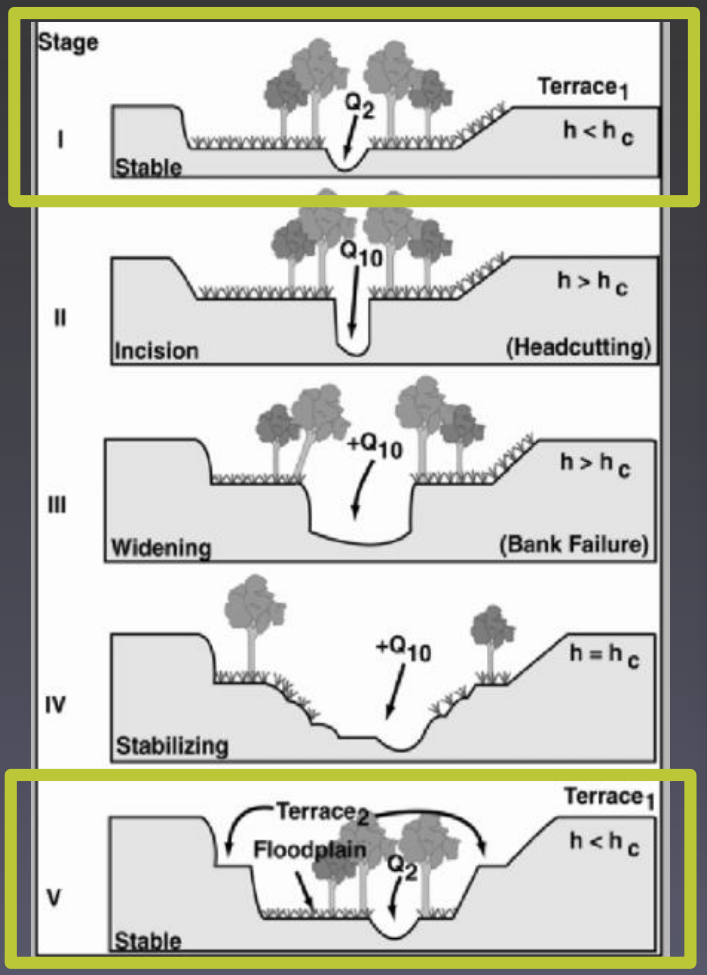

Anastomosing
Grassed Wetland

- ✓ Watershed hydrology
- ✓ Water quality
- ✓ Soil builders
- ✓ Ecologically rich
- ✓ Fish and wildlife habitat
- ✓ Dynamic and resilient
- ✓ Stable



✓ NATURAL!

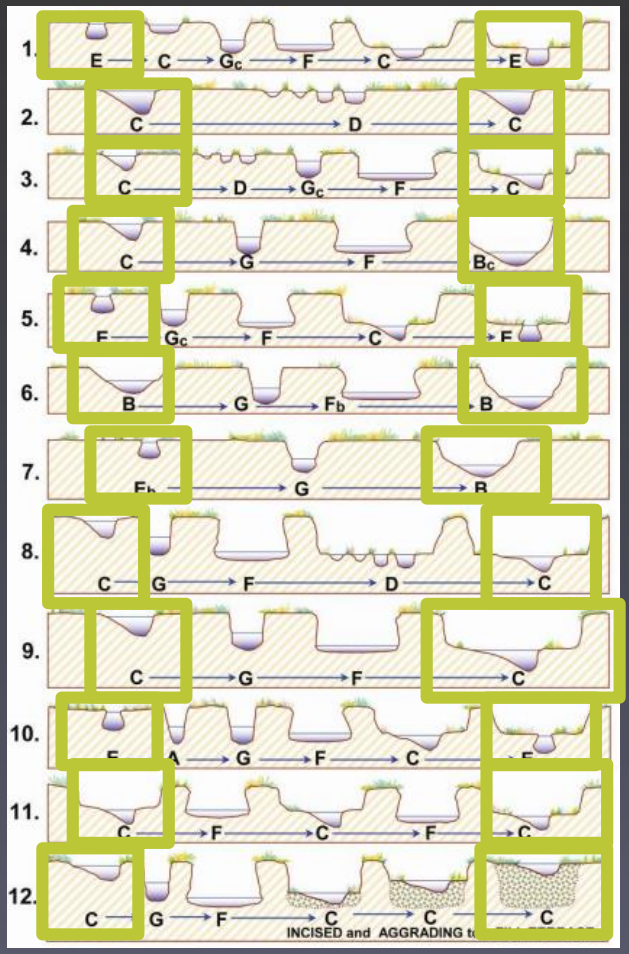

Anastomosing
Wet Woodland
h<<h_c
Anastomosing
Grassed Wetland
Or
STAGE 8
Anastomosing
h<<h_c
h
STAGE I
Sinuous Single Thread
h<<h_c
h
STAGE 2
Channelized
h>h_c
floodplain
h
STAGE 7
Laterally Active
h<<h_c
h
Aggradation
Widening
Narrowing
Degradation
Dominant
Process
STAGE 3
Degradation
h>h_c
h
STAGE 6
Quasi Equilibrium
h<h_c
terrace
banks
h
bankfull
aggraded
material
STAGE 4
Degradation and Widening
h>h_c
terrace
h
slumped material
STAGE 3s
Arrested Degradation
h>h_c
h
STAGE 5
Aggradation and Widening
h>h_c
h
aggraded
material
slumped
material



Channel Evolution Model (Schumm 1984)

Q_2 Channel

(Overbank once every 2 years +/-)

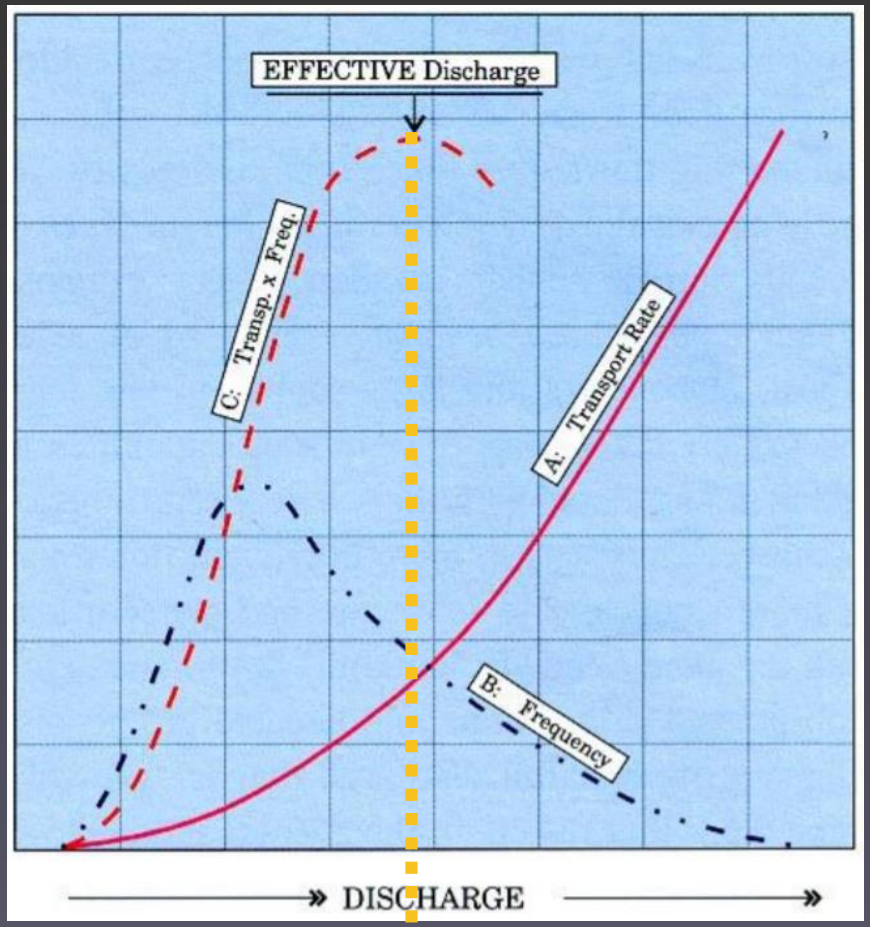


Channel Succession Scenarios (Rosgen 1998, etc.)

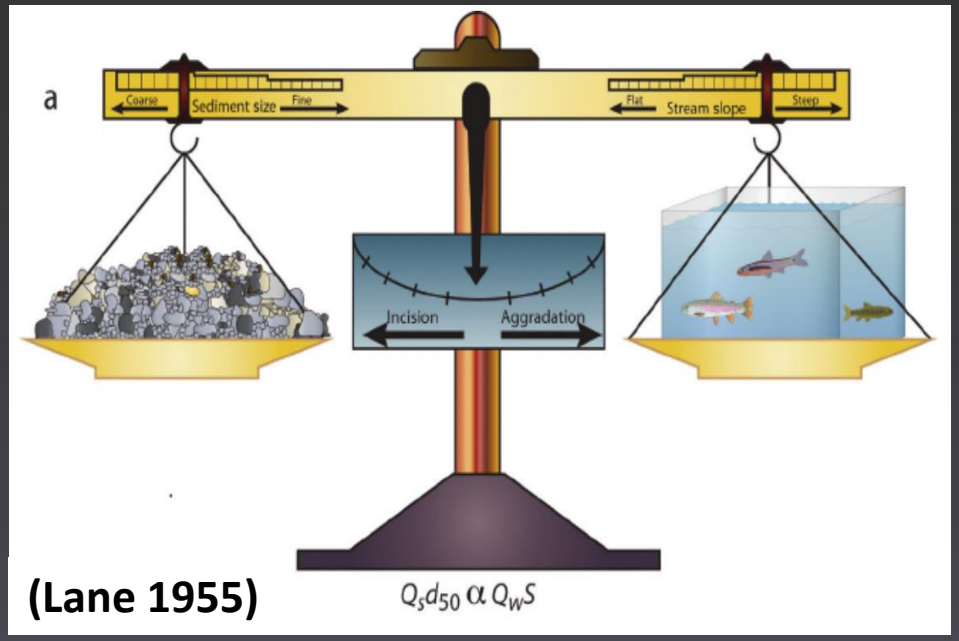
Q_2 Channel

(Overbank once every 2 years +/-)

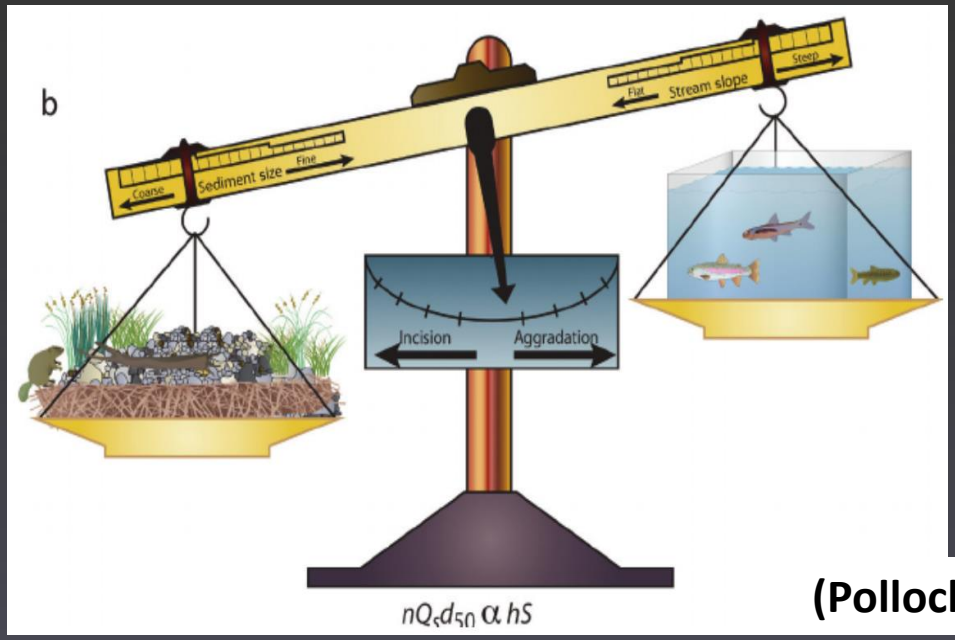
(Rosgen 1996, Wolman and Miler 1960)

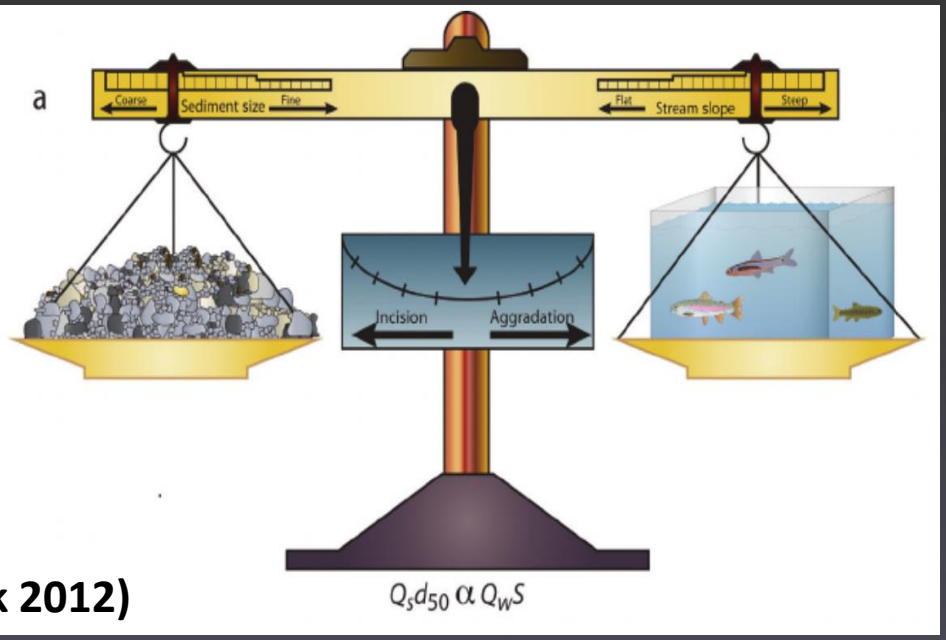


Q_2 (+/-)



(Lane 1955)

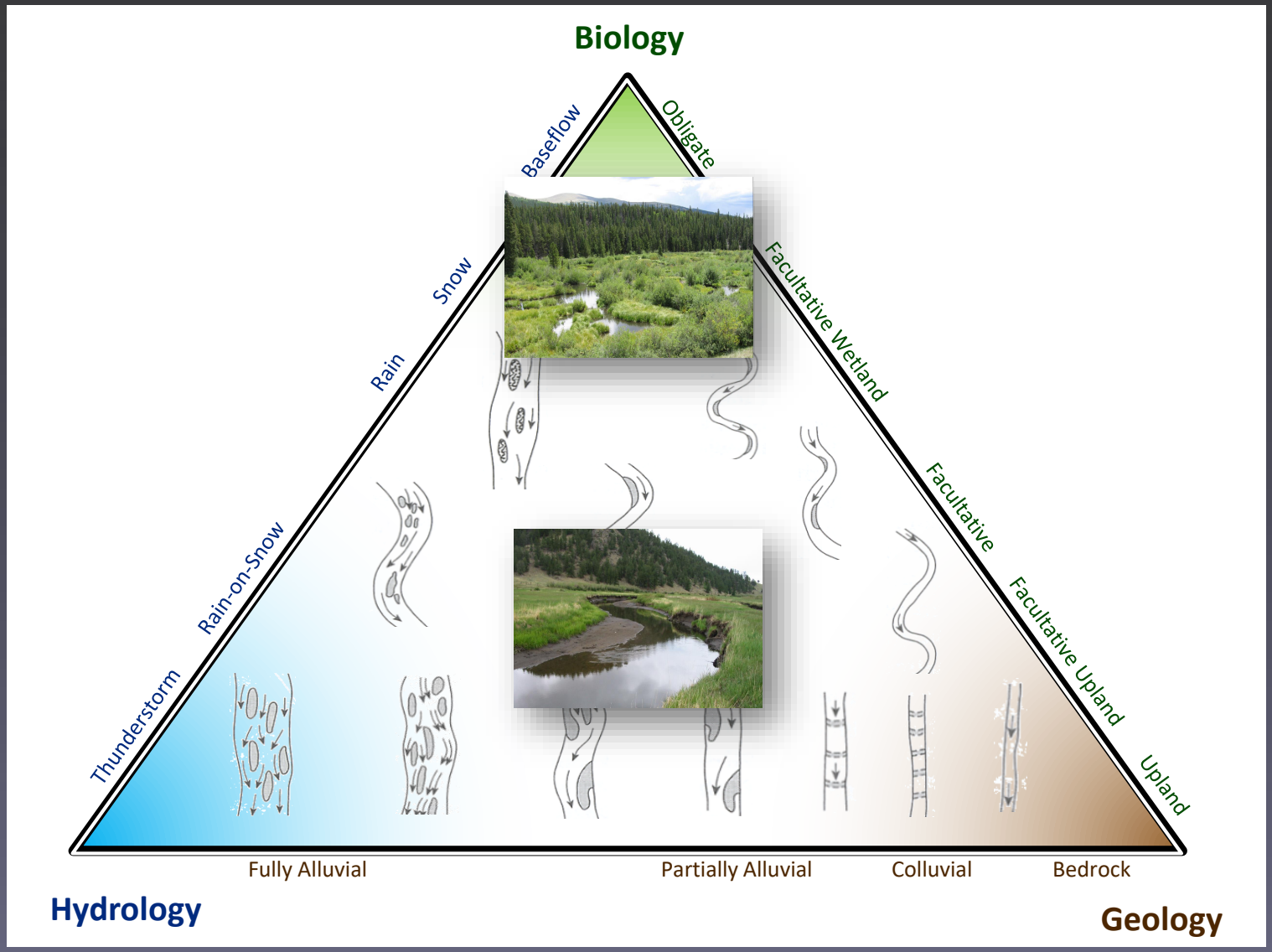


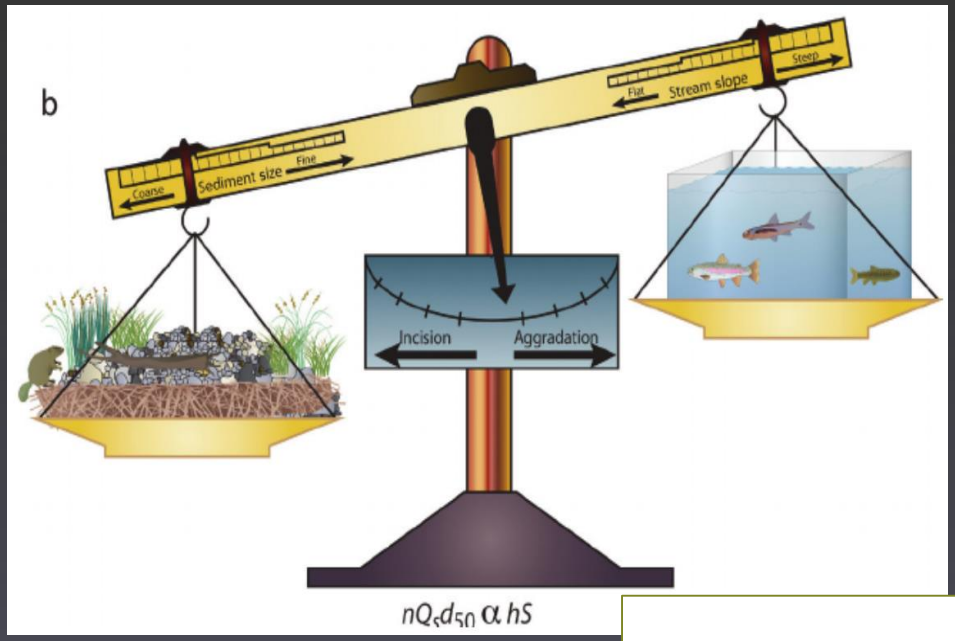


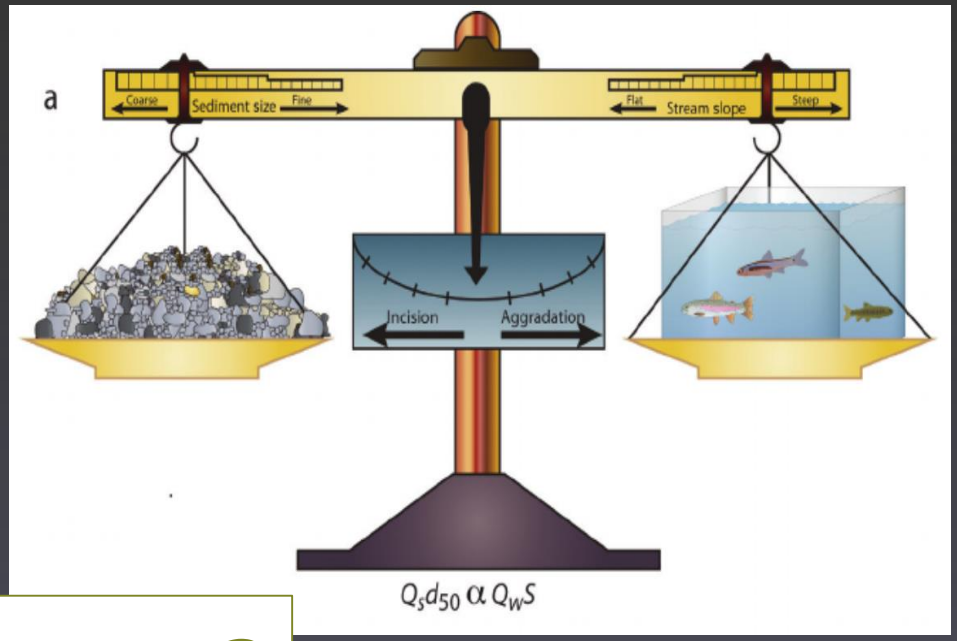
(Pollock 2012)

Stream Evolution Triangle (Castro and Thorne 2018 in prep.)

(with stream types from Schumm 1985)







STABILITY?

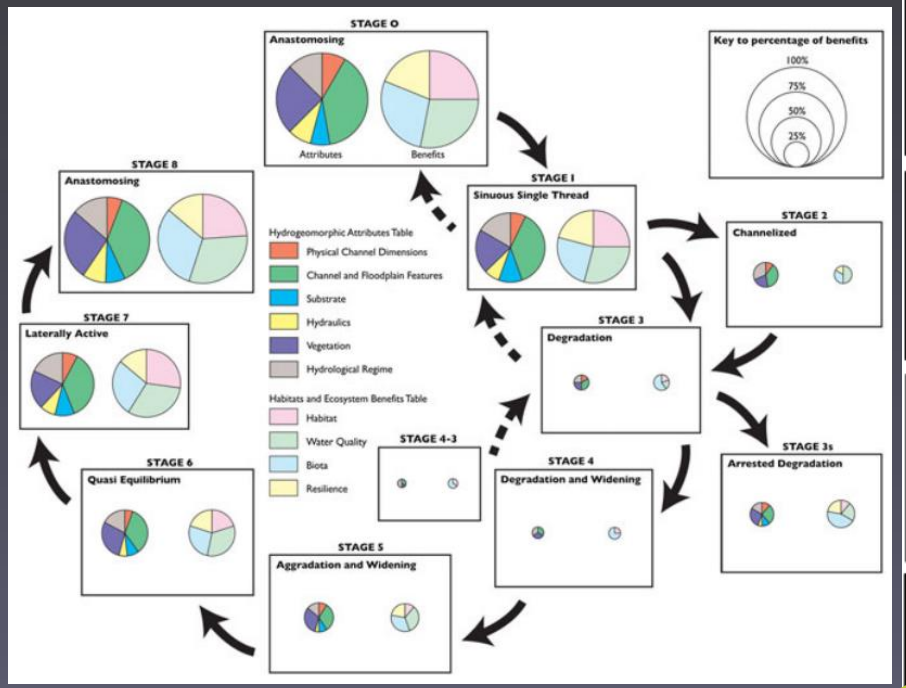
Rosgen (Natural Channel Design ™) (2006):
Stability is a stream's ability to transport the streamflows and sediment of its watershed in such a manner that it maintains its dimension, pattern and profile without either aggrading or degrading.

The reference reach

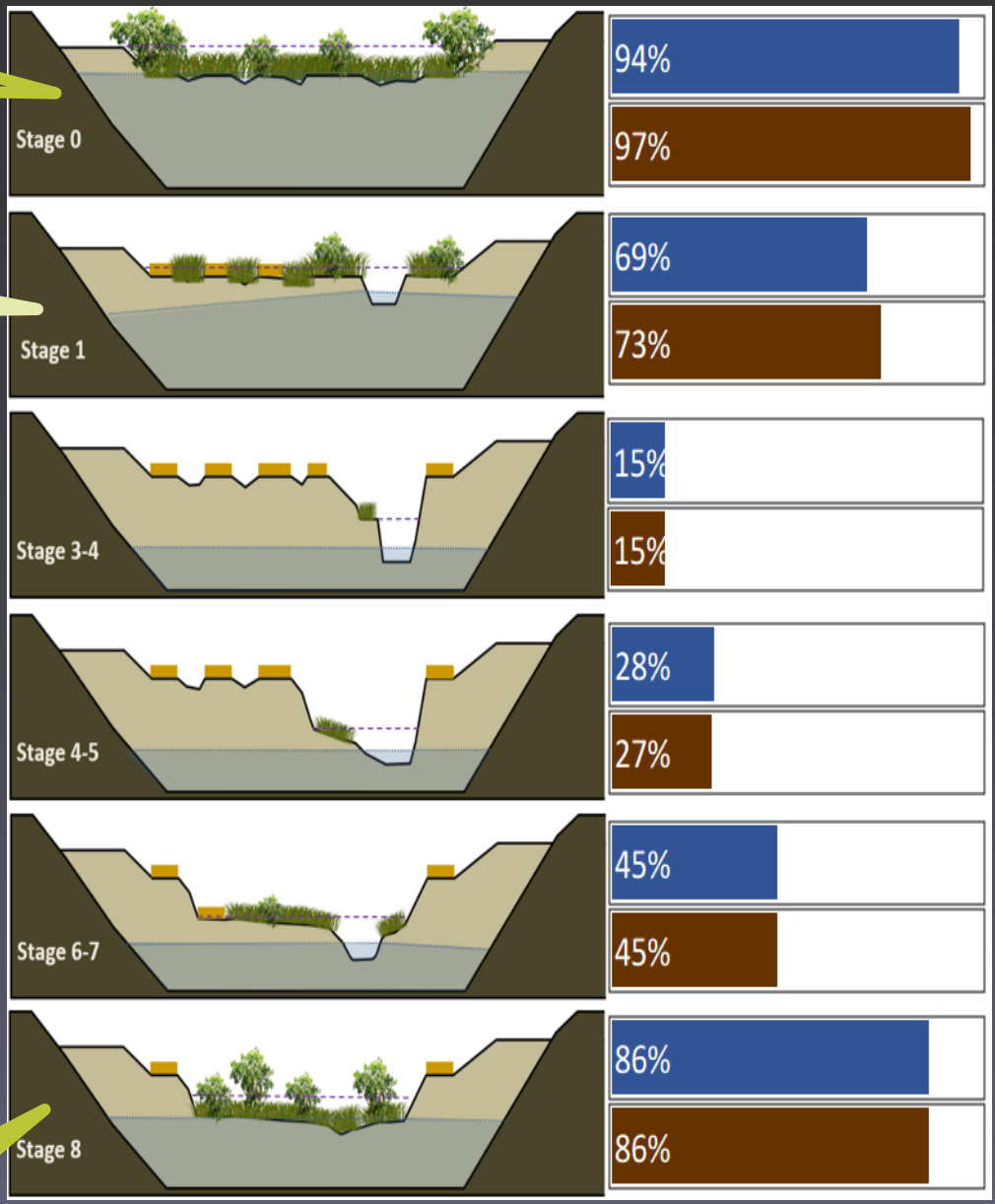
- *Standard for assessment*
- *Template for design*
- *Restoration goals*

Go to Zero
… You're a hero!

Go to One
… Ho hum.



But if it's too late
… Eight is great!



Hydrogeomorphic attributes
Habitat and ecosystem benefits

Stage 0: Using a Stream Evolution Model to Set Restoration Goals

Mark Beardsley, M.S. mark.ecometrics@gmail.com

Challenges/questions

Monitoring and evaluation

Water law interpretation and implications

Permitting, mitigation, stream quantification tools

Beaver relocation/assisted migration

Restoration techniques

Infrastructure conflicts

Riparian Reconnect