Riparian Concepts
Fluvial Geomorphology
Vegetation Complex's
STMs

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Valley Types
Stream Types

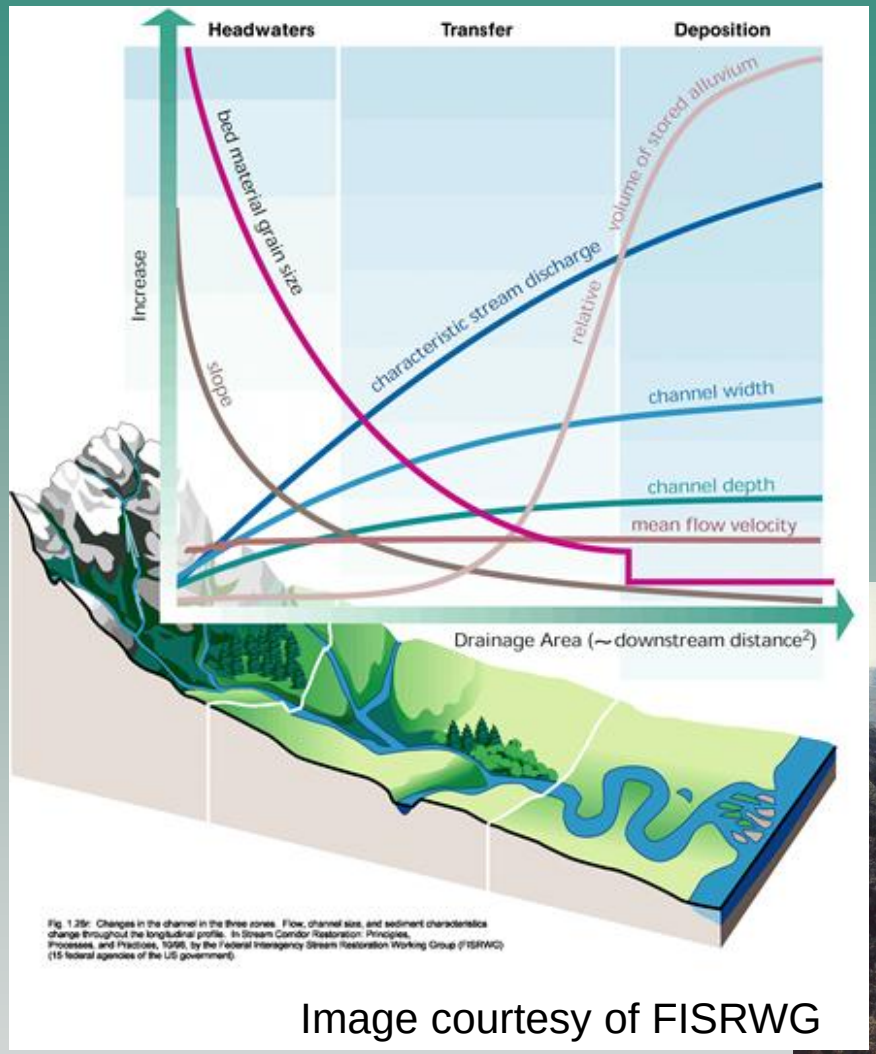
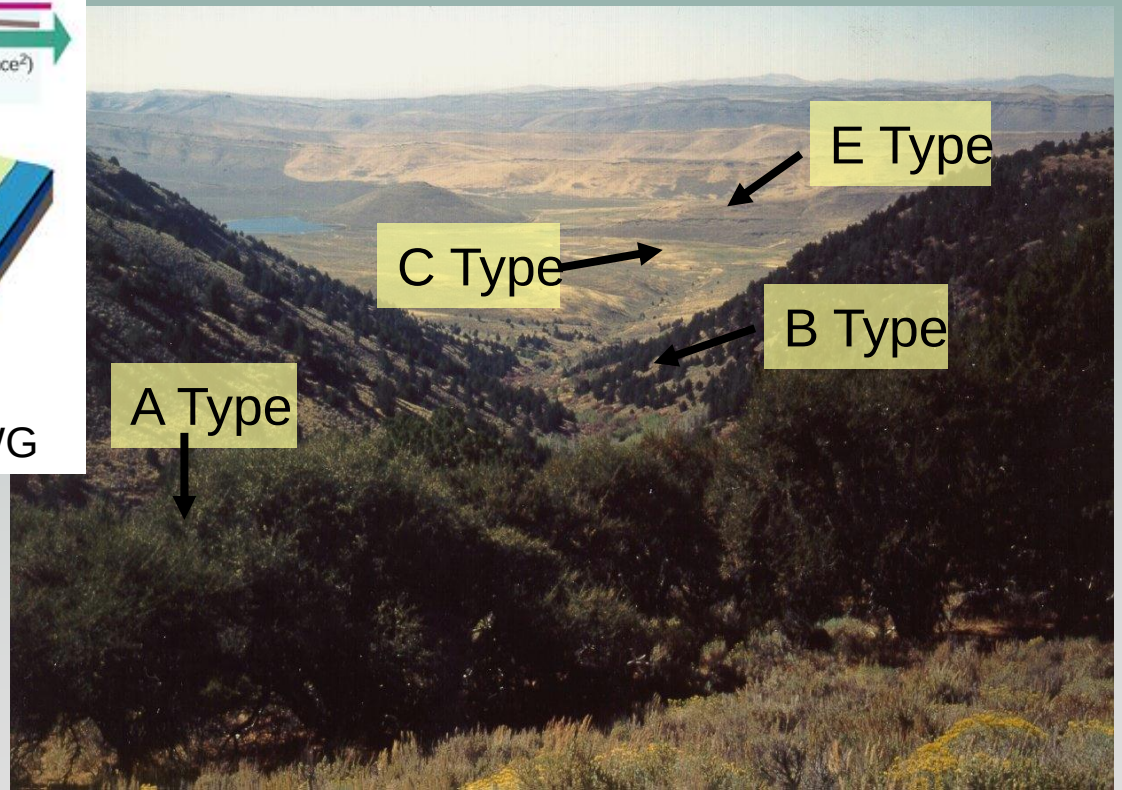
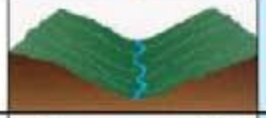
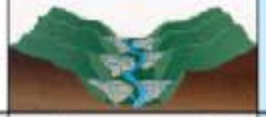
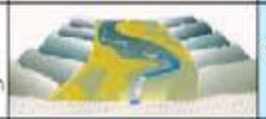
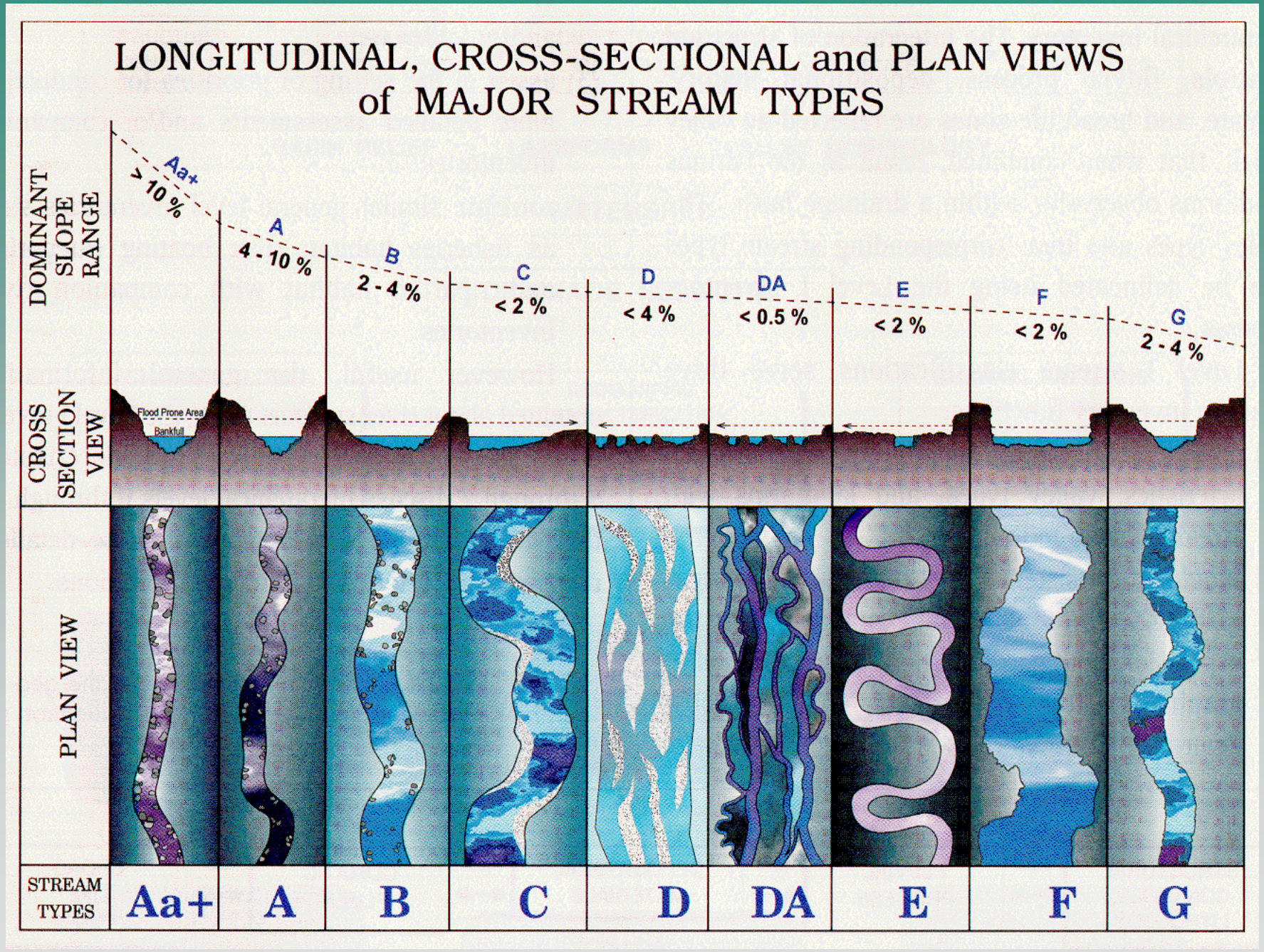


Image courtesy of FISRWG



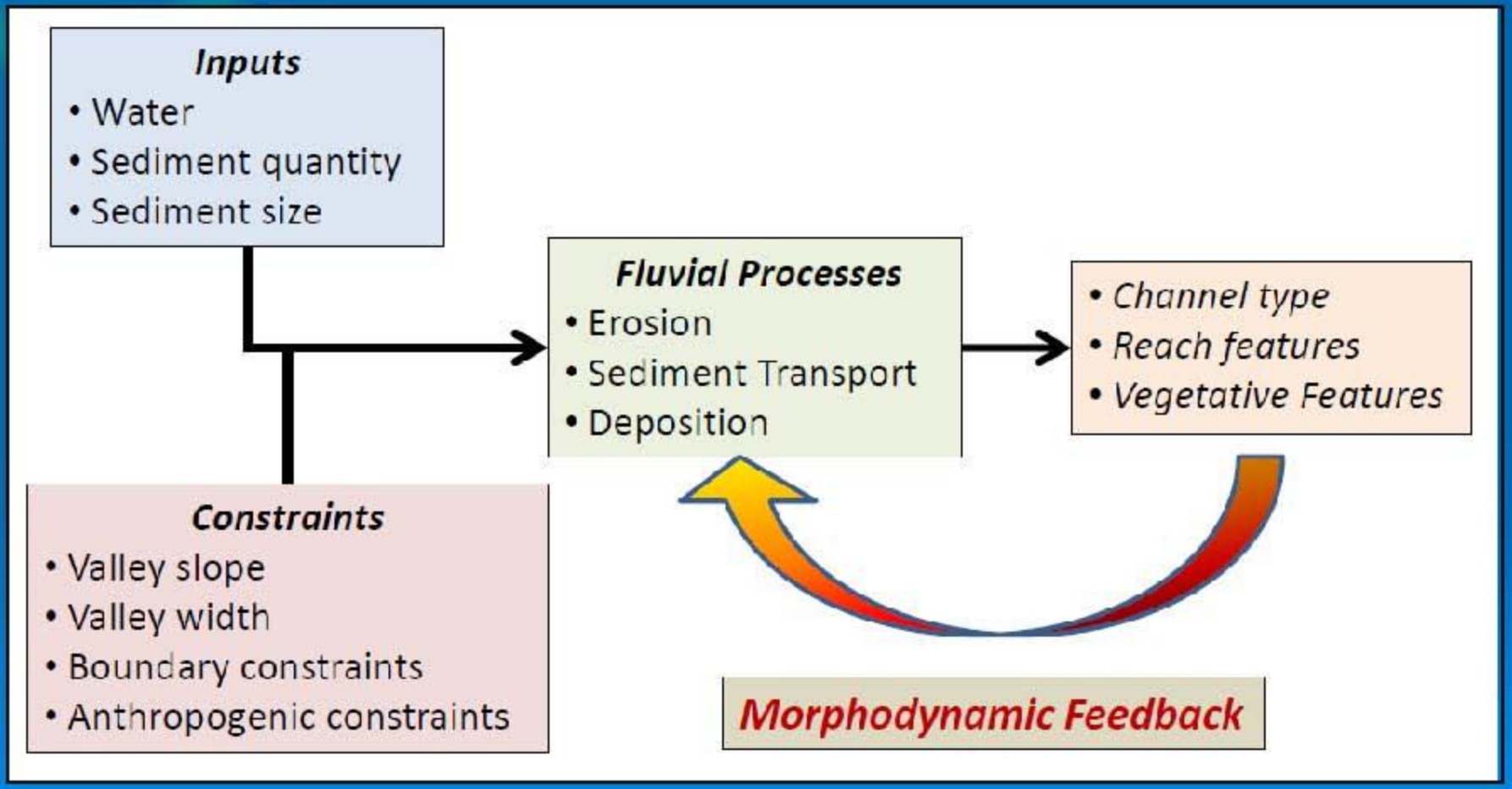
Valley Type	Summary Description of Rosgen Valley Types		Stream Types
I	Steep, confined V-shaped highly dissected fluvial slopes greater than 2%, rejuvenated sideslopes.		A, Aa+, G
II	Moderate relief gentle sloping side slopes with a parabolic valley bottom form often in colluvial valleys.		B, [G]
III	Alluvial fans and debris cones. Primarily depositional, usually steep, greater than 2% valley slope with debris-colluvium or alluvial fan landform.		A, B, G, D
IV	Gentle gradient canyons, gorges and confined alluvial and bedrock-controlled valleys such as the Grand Canyon. Valley floors are typically less than 2%.		F, G, [C]
V	Moderately steep U-shaped glacial-fluvial troughs with slopes generally less than 4%. Landforms typically include lateral or terminal moraines, alluvial terraces and flood plains. Trough is typically the result of glacial scouring process.		C, D, G, [B]
VI	Moderately steep, fault, joint, or bedrock (structural) controlled valleys. Structurally controlled and dominated by colluvial slope building processes. Moderately steep with slopes less than 4%. G stream types observed under fault disequilibrium.		B, C, F, [G]
VII	Steep, fluvial dissected, highly dissected high-drainage density alluvial slopes typically in either colluvium, alluvium or in residual soil. Active lateral and vertical accretion (Badlands of SD).		A, G
VIII	Mature, wide, gentle valley slopes with well developed flood plain features adjacent to river terraces and/or glacial terraces– alluvial valley fills. Alluvial terraces and flood plains are the predominate landforms.		C, D, E, F, [G]
IX	Glacial outwash and/or eolian sand dunes. Broad, moderate to gentle slopes. High sediment supply either single or multiple threaded channels.		C, D
X	Very broad and very gentle slopes with extensive flood plain development. Often associated with glacio- and non-glacio-lacustrine and gentle alluvial slopes. G and F streams are common when local base grades have been changed.		C, DA, E, F, G
XI	Large river deltas and tidal flats constructed of fine alluvial materials originating from riverine and estuarine depositional processes. Extremely gentle slopes with base grade controlled by sea or lake levels. Most often distributary channels, wave or tide dominated.		C, DA, E

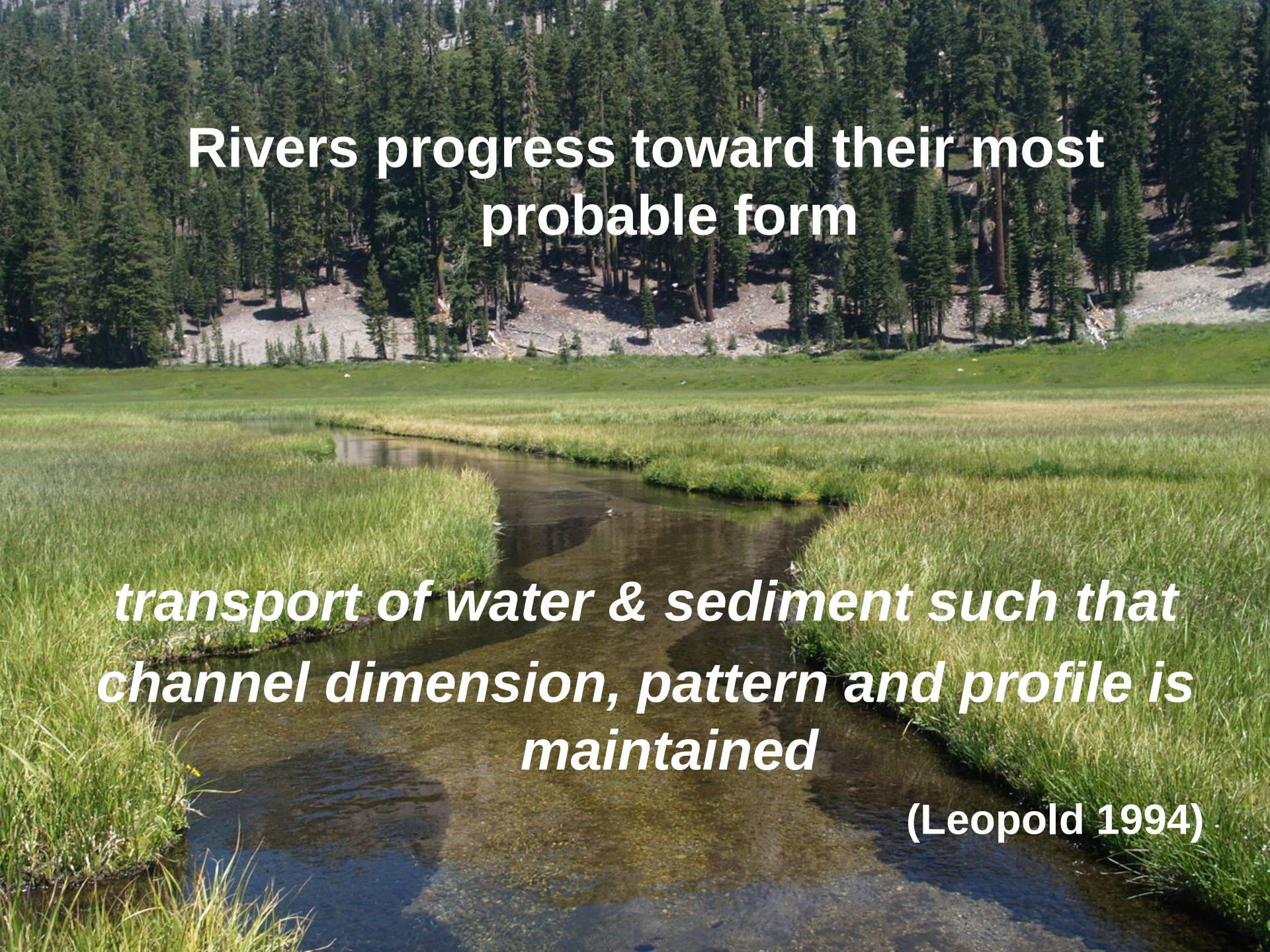
- Only certain stream types occur in each valley type
- Valley type influences stream behavior and predictability
- Ecological sites are delineated on valley type and stream type



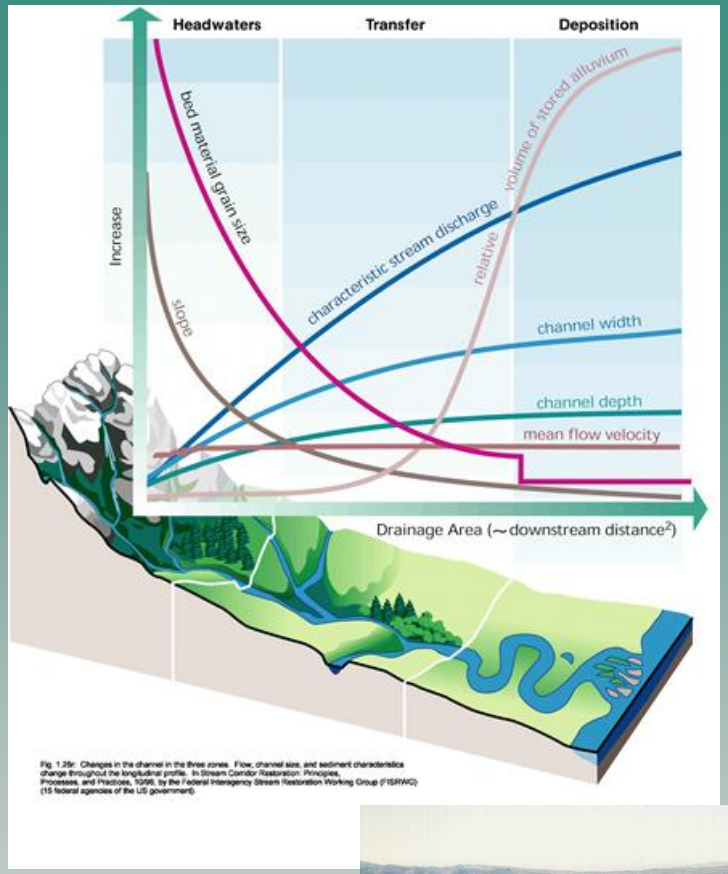
From Rosgen 1996.

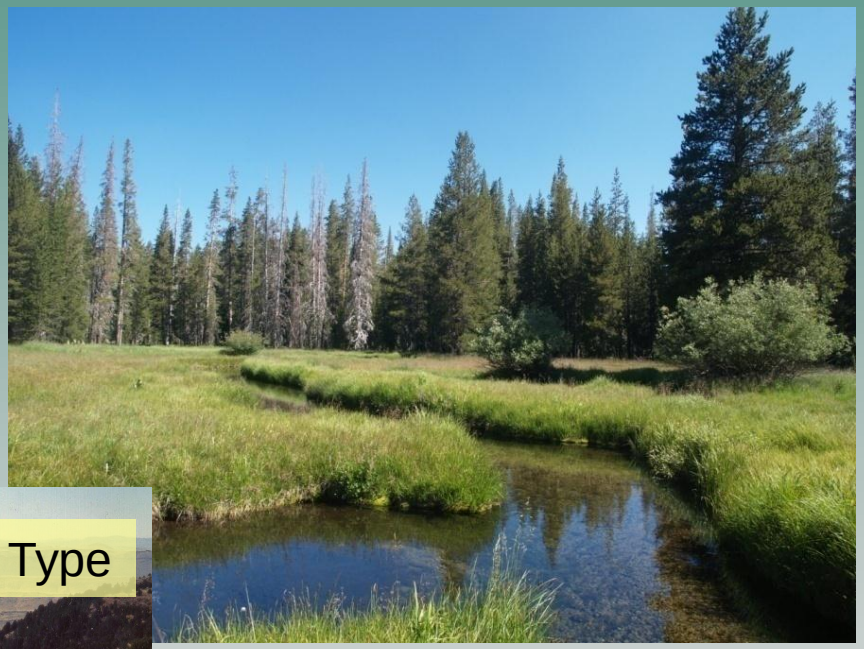
Stream Classification: Form and Process

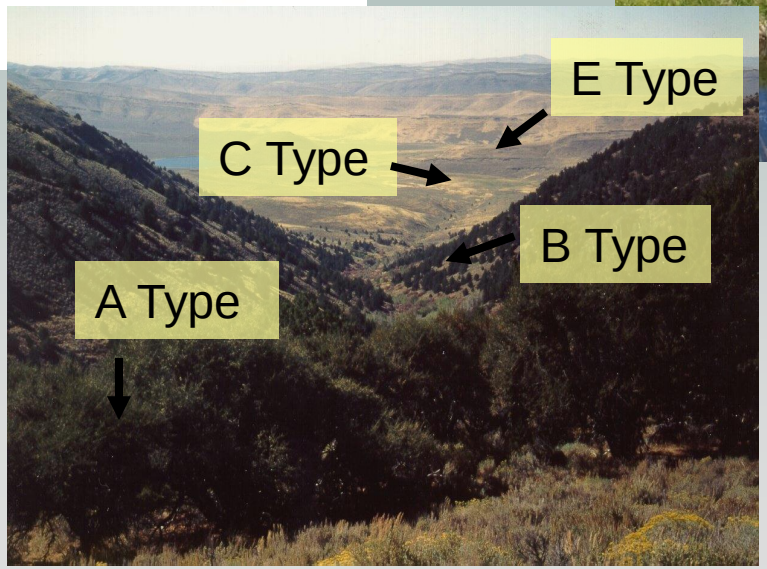



Rivers progress toward their most probable form
transport of water & sediment such that channel dimension, pattern and profile is maintained
(Leopold 1994)

Valley Types
Stream Types
Vegetation







Riparian Complex

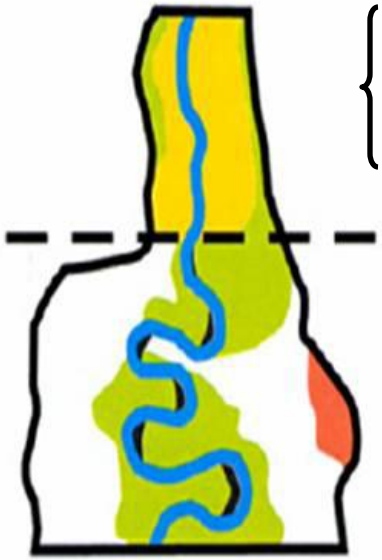
- **A unit of land with a unique set of biotic and abiotic factors (Winward 2000)….***that differs from other kinds of land in its ability to produce a distinctive riparian complex defined by distinctive riparian community types.*

- Factors: geomorphology, substrate characteristics, stream gradient and associated water flow features and general vegetation patterns (Winward 2000)

- Riparian complex describes the full width of the riparian area across a particular portion of a valley.


Complex A
Complex B

Riparian Complex: Illustrated

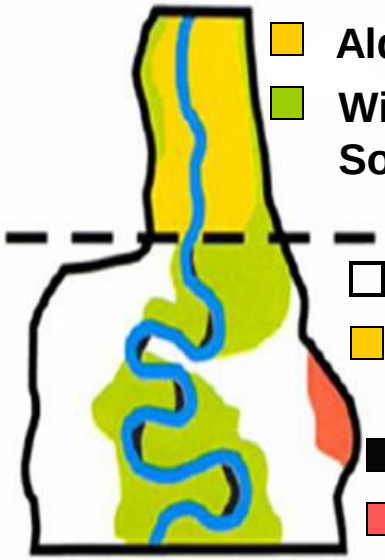


Complex 1

Alder / Dogwood
Narrow Valley
Steep Gradient

Complex 2

Tufted Hairgrass
Wide Valley
Low Gradient



Composition

Alder/Dogwood 85%

Willow & Soloman Seal 15%

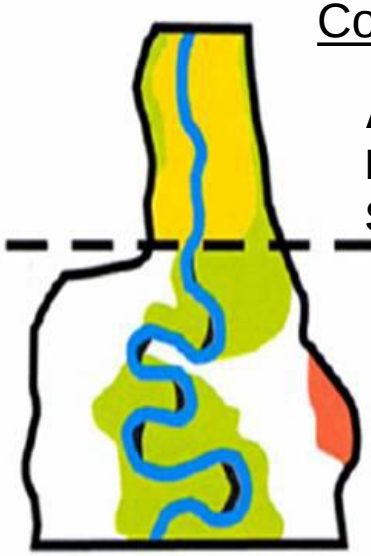
Hairgrass 50%

Willow/Soloman Seal 40%

Water sedge 4%

Silver sage 6%

Winward 2000



Complex 1

Alder – Dogwood
Narrow Valley
Steep Gradient

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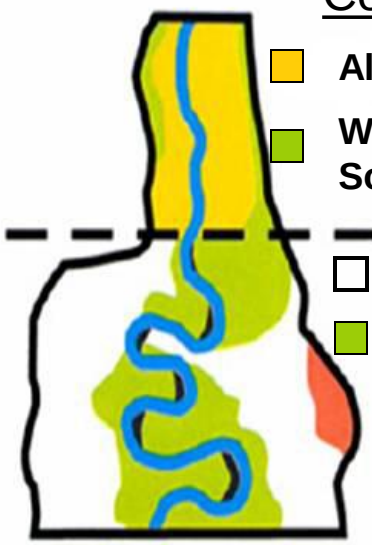
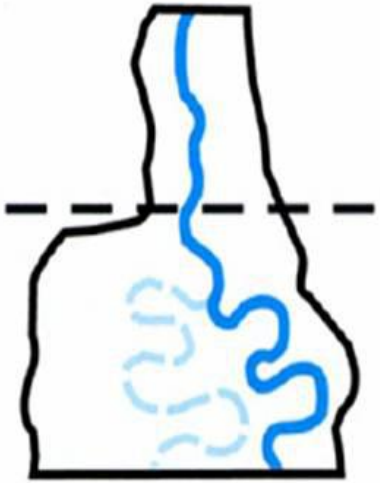
Tufted Hairgrass
Wide Valley
Low Gradient



Composition

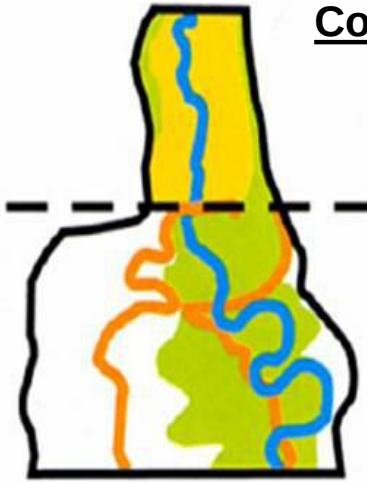
- **Alder Dogwood 85%**
- **Willow & Solomon Seal 15%**
- **Hairgrass 50%**
- **Willow/Solomon Seal 40%**
- **Water sedge 4%**
- **Silver sage 6%**

Channel Change



- **Abandoned Channel**
- **Current Channel**

Willow / Solomon Seal Community Type

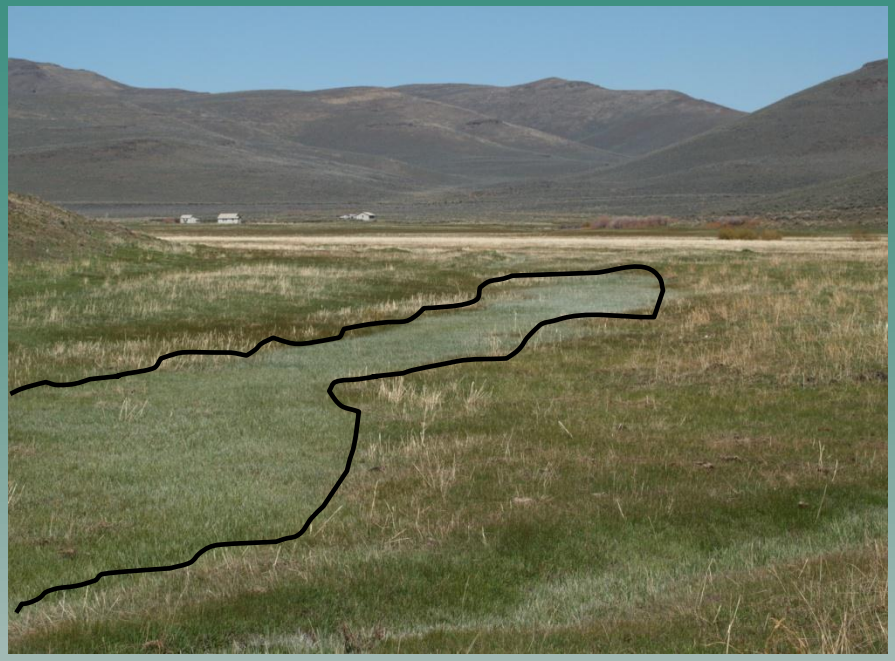


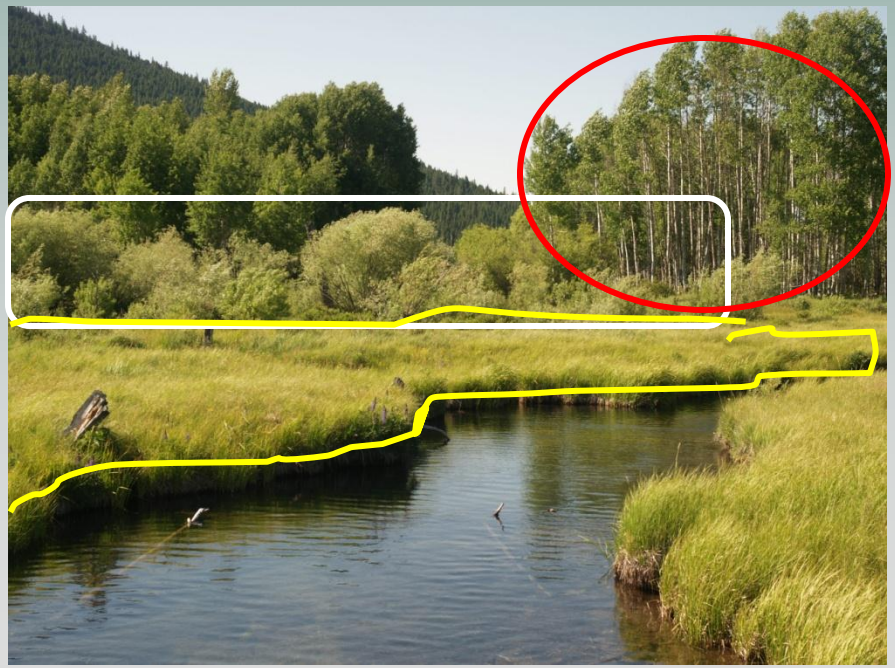
- **Old Boundary**
- **New Location**

Winward 2000

Vegetation and Channel Relationships

- Mosaic pattern of community types (CT) within the riparian complex
- Riparian complex's most often have 6 to 12 CTs
- Distribution is tied to the soils or more likely the water table features within the complex
- Water table is most often controlled by channel location and the dimension, pattern and profile of the channel



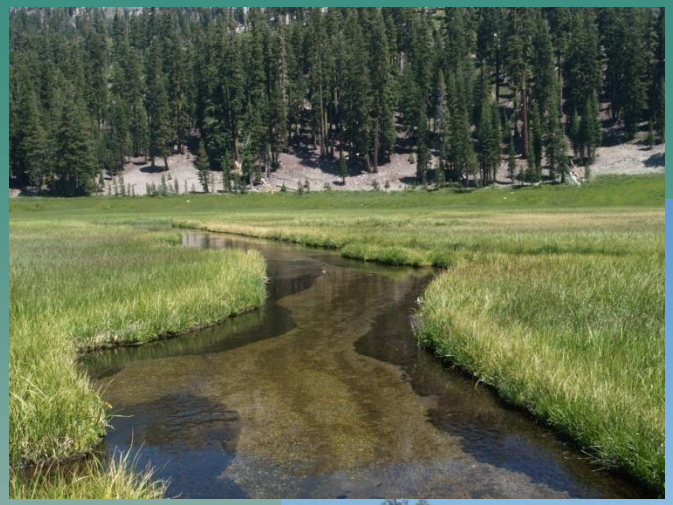


Riparian Community Components:

Assemblage of plant species…

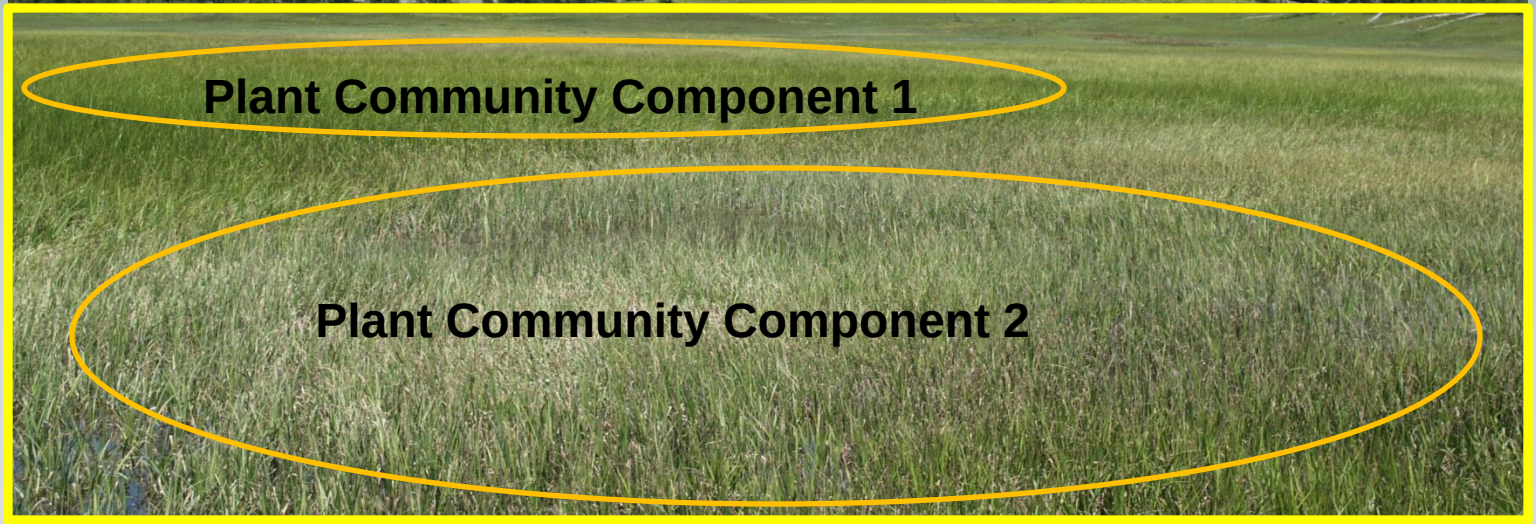
Represent the structure & composition of community phases….

Occur in patches, stringers, islands…



Riparian Community Phase & Community Components

Community Phase



Process of Change

- Function of valley type, stream type, substrates

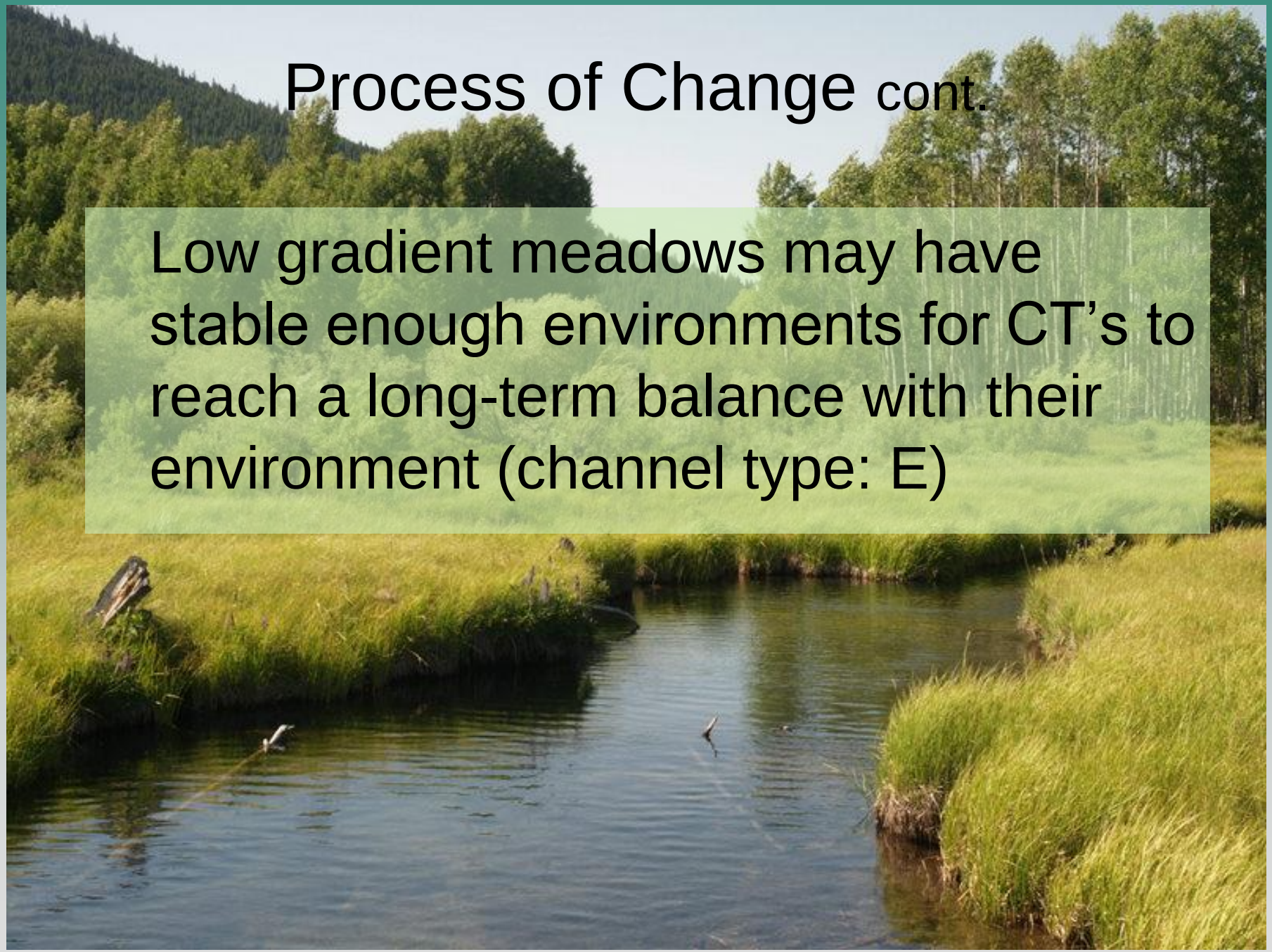
- Stable plant communities *such as those found in uplands* can be short lived even under natural conditions

Process of Change cont.

Long term, self-perpetuating plant communities on a specific area are more often achieved in armored settings where bedrock or large boulders / cobbles keep the stream intact (channel types: A & B)

Process of Change cont.

Low gradient meadows may have stable enough environments for CT's to reach a long-term balance with their environment (channel type: E)



Process of Change cont.

Low gradient valleys MAY NOT exhibit long term stable plant communities due to frequent disturbances

Vegetation Associated with Functional Stream Types

- General Rules
  - High gradient (> 2%) = woody riparian plants
  - Low gradient (< 2%) = herbaceous plants

Why would high gradient channels support a dominance of woody riparian plants?

Vegetation Associated with Functional Stream Types

- Additional guidelines
  - Gradients between 1 – 2% often support a mix stand of riparian woody's and herbaceous vegetation
  - Typically C-type channels that naturally experience cutting of outside bends and deposition on point bars with common out-of-bank flows

Vegetation Associated with Functional Stream Types cont.

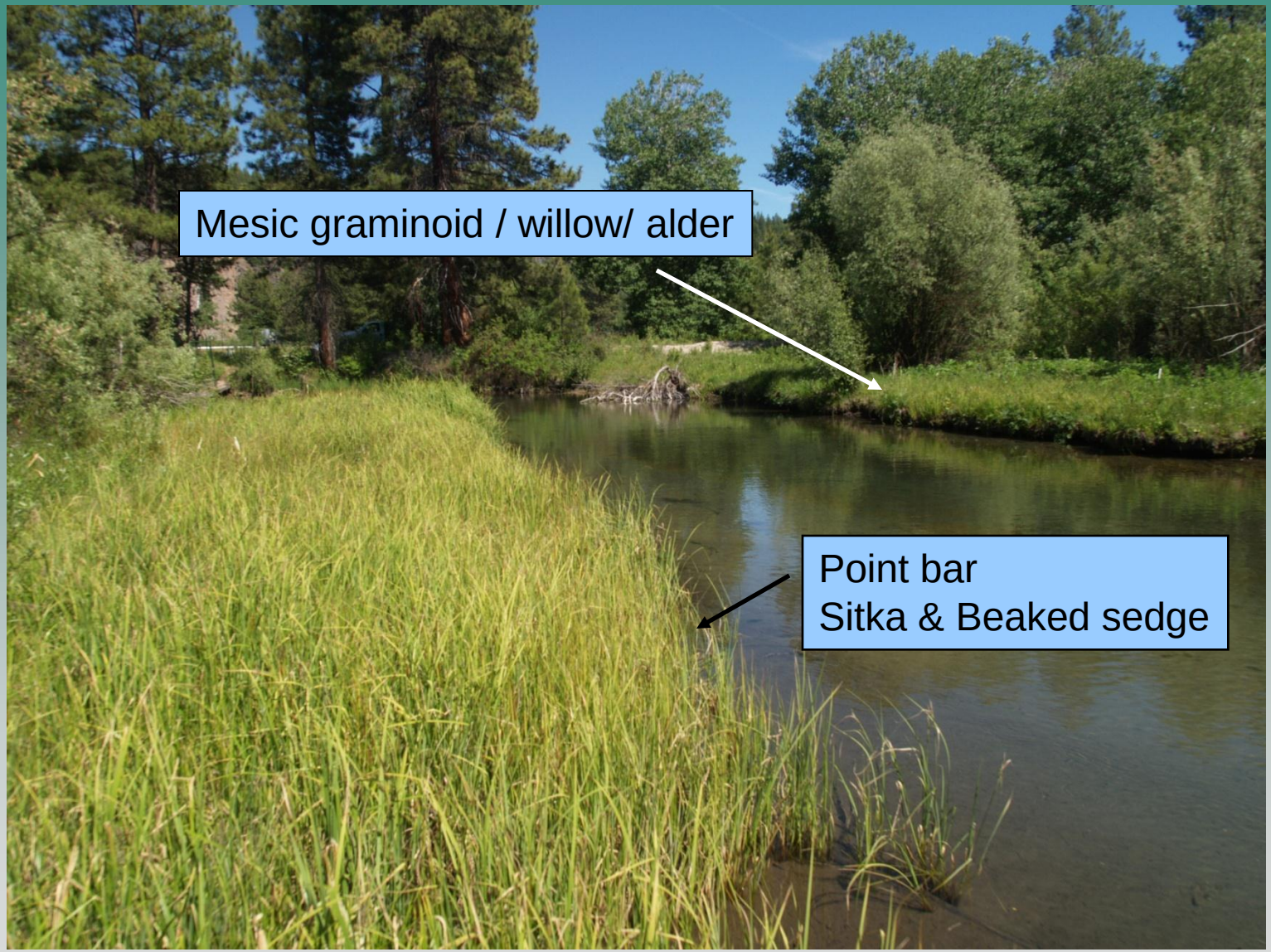
- Cottonwood, alder, birch and willow species require or at least regenerate best on disturbed or open ground.
- Require some level of aeration in the soil profile during periods of the growing season
- Soils with coarse materials such as sands or gravels are more likely to support woody vegetation

Vegetation Associated with Functional Stream Types cont.

- “Flat” channels (gradients < 1%) typically are finer sediment supporting obligate or facultative wetland plants
- E and C type channels

Channel type, water table, vegetation General Rules

- E types = water table near or at surface during growing season; OBL and FACW
- C types = water table drops slightly through the growing season; OBL, FACW, and FAC
- B types = water table drops through growing season; OBL (rare), FACW, FAC and FACU (rare)
- A types = water table drops though out growing season: FACW, FAC, and FACU (rare)



C type channel; gradient < 1%; point bars vegetating; mesic graminoid – Willow/alder type on opposite bank

Soil sample taken from the sedge dominated area indicating potential for willow establishment IF water table lowers during growing season.

Surface: sandy loam

Note the dark colored subsurface coarse sands, starting at approximately 10 centimeters from the soil surface.

Profile indicates a young soil with on-going sedimentation.

E Channel with Sitka sedge as the dominant; Lemmon and Geyers willow present beyond bankfull.

E type channel dominated by Sitka sedge. No willows within the Riparian Complex. Soil saturated to surface. Subsoil consists of layers of diatomaceous earth.

B type channel; gradient > 2%; bedrock / boulder controlled; large wood important to channel complexity; vegetation = alder / fir

Conclusions

- Steam type, water table, soil, climate and watershed hydrology determines vegetation
- Riparian complex concept incorporates channel type, soils, landform, climate and allows for multiple community types
- Community types may drift within the complex based on channel change
- CT’s more stable in A and B type channels

Riparian Concepts Review

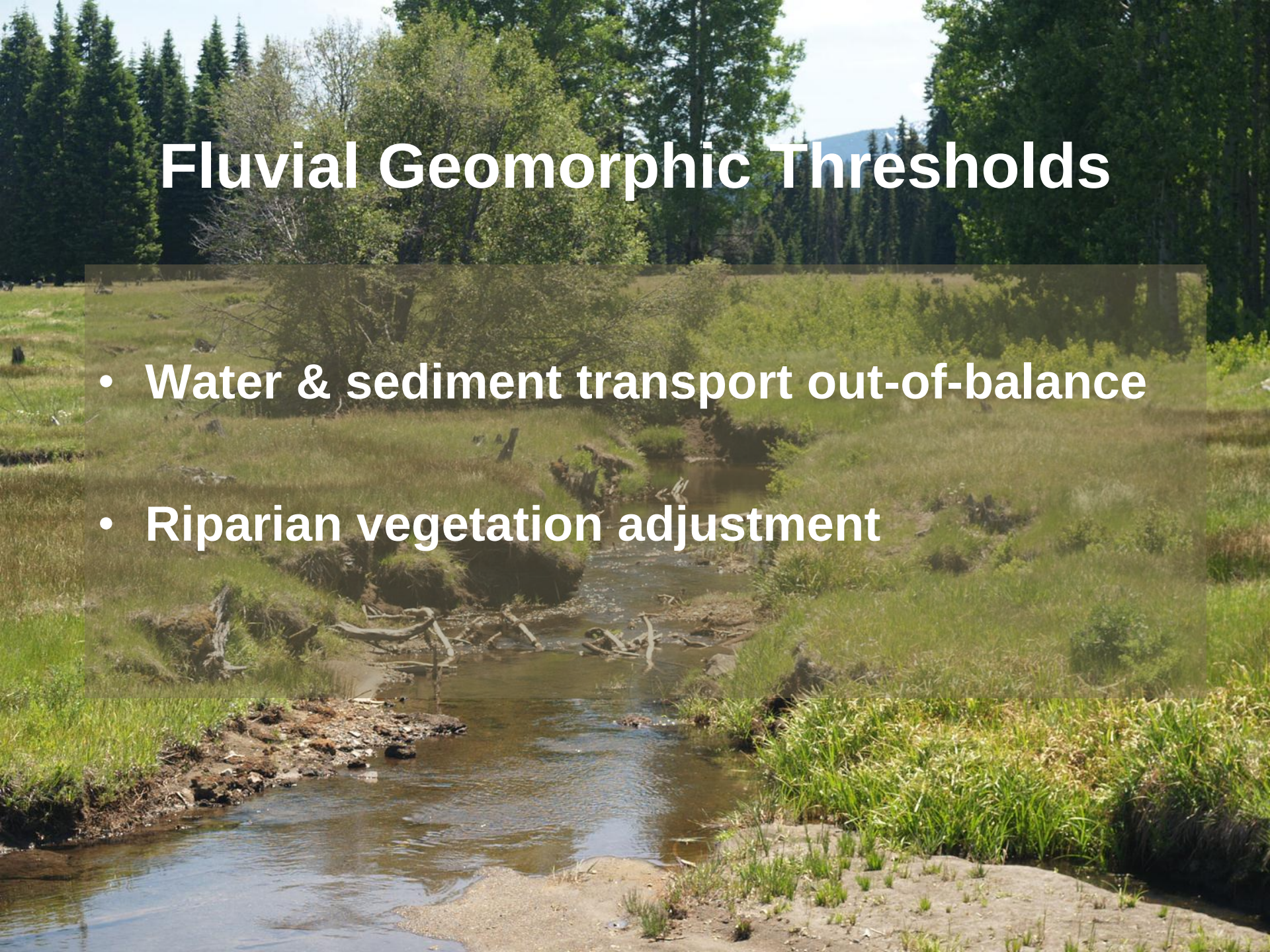
- Fluvial Geomorphology
  - Valley Type
  - Stream Types
- Riparian Vegetation
  - Relationship to valley and stream type
  - Vegetation Complex
- State-and-Transition Model Concepts

Valley type
Watershed size
Stream type
Channel materials
Gradient
Vegetation

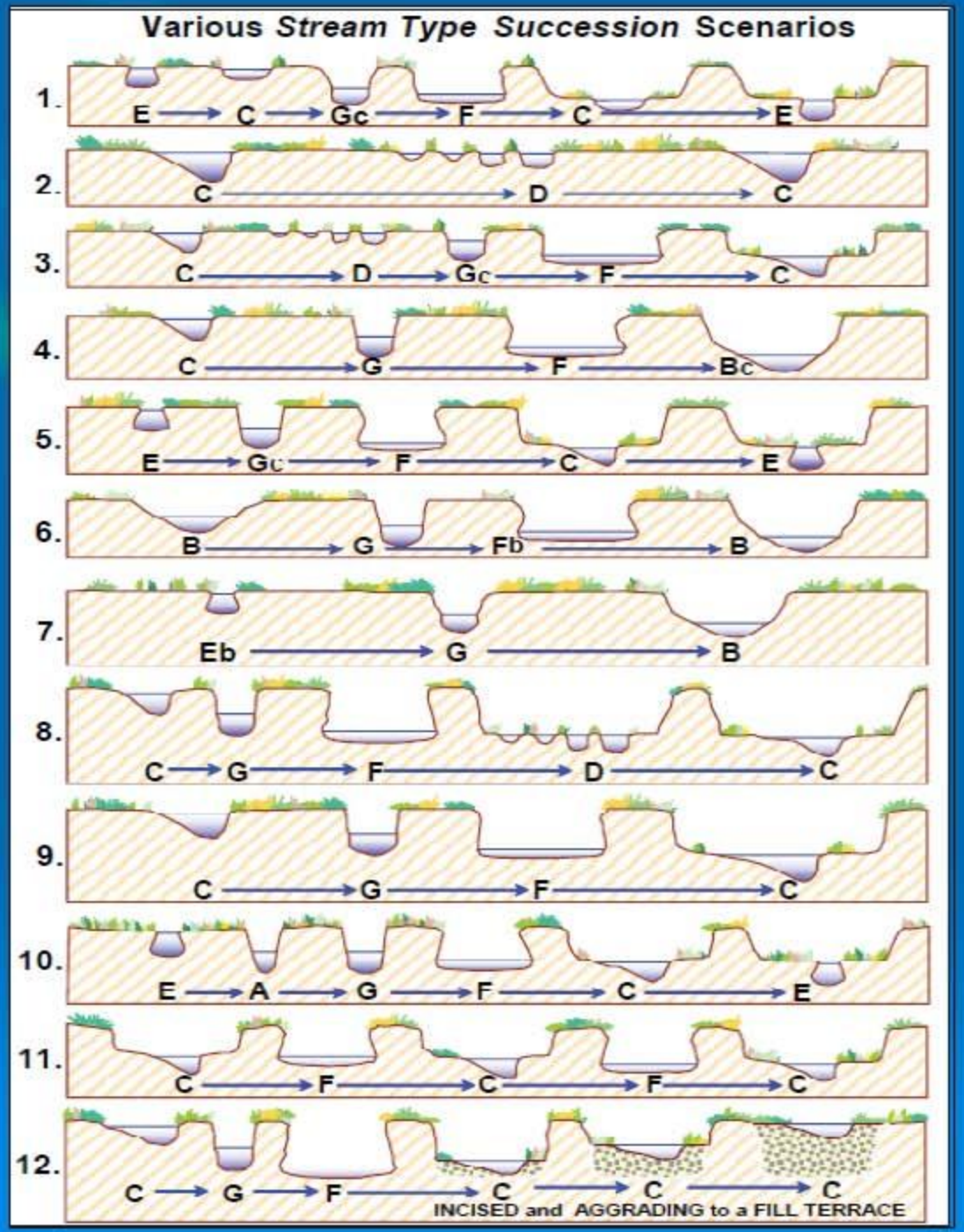
Reference

Resiliency

Fluvial Geomorphic Thresholds

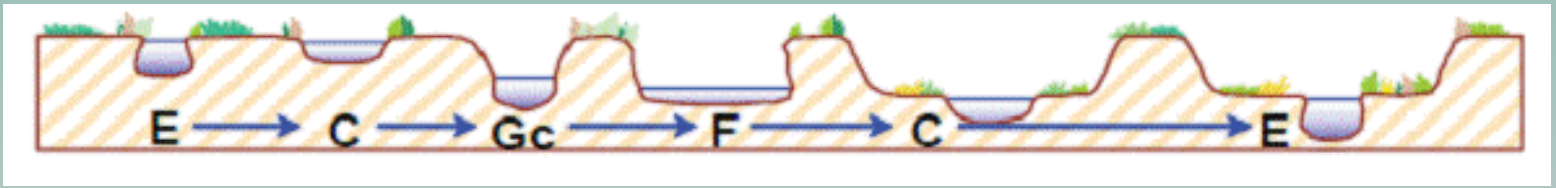


- Water & sediment transport out-of-balance
- Riparian vegetation adjustment



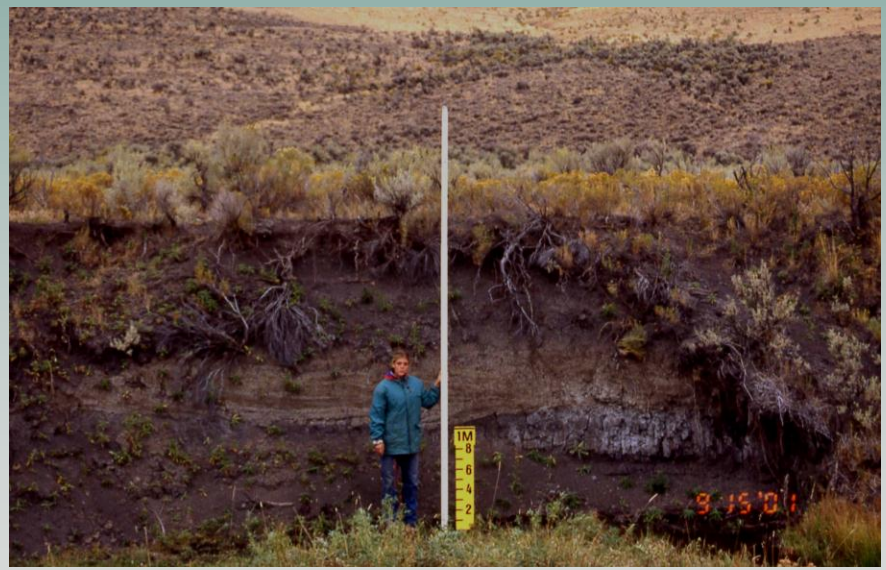
- Stage of succession helps explain stream type differences noted in the field
- Succession scenarios provide the basis for state & transition models
- These 12 are the most common, well-documented scenarios (there *are* others)

Channel Evolution: E to C

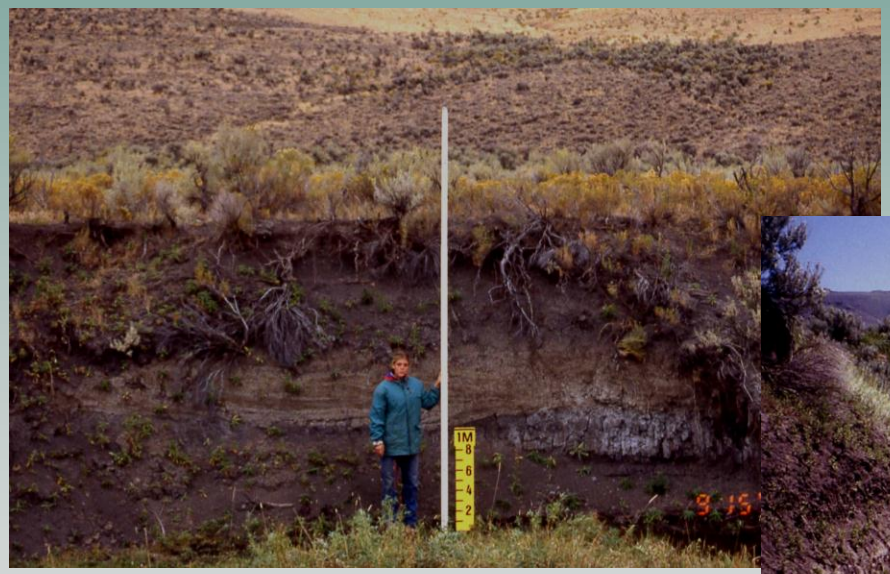


Channel Evolution: E to C to G

Channel Evolution: E to C to G to F



Channel Evolution: E to C to G to F to C



Channel Evolution: E to C to G to F to C to E

Identification of At-risk Channels

- Bank Height Ratio

  top of bank / max depth bankfull

- Greenline vegetation composition

  Obligate wetland

  Facultative wet

  Facultative

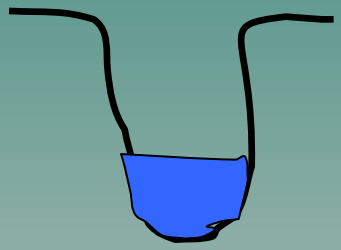
  Upland

Bank Height Ratios & Channel Stability

BHR = 1.0

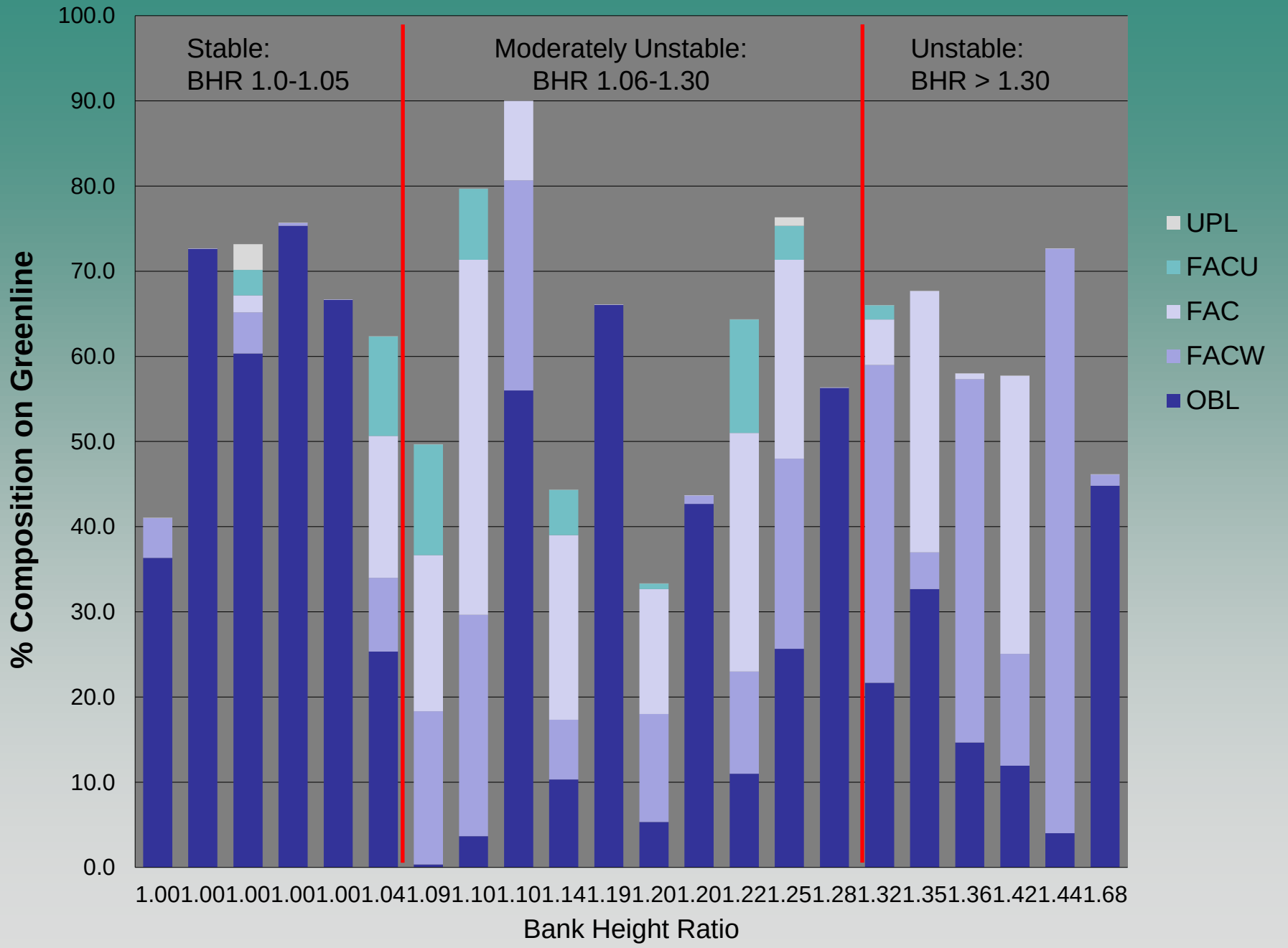
?

BHR = 2.0



Stability Rating	BHR
Stable (low risk of degradation)	1.0-1.05
Moderately unstable	1.06-1.3
Unstable (high risk of degradation)	1.3-1.5
Highly unstable	>1.5

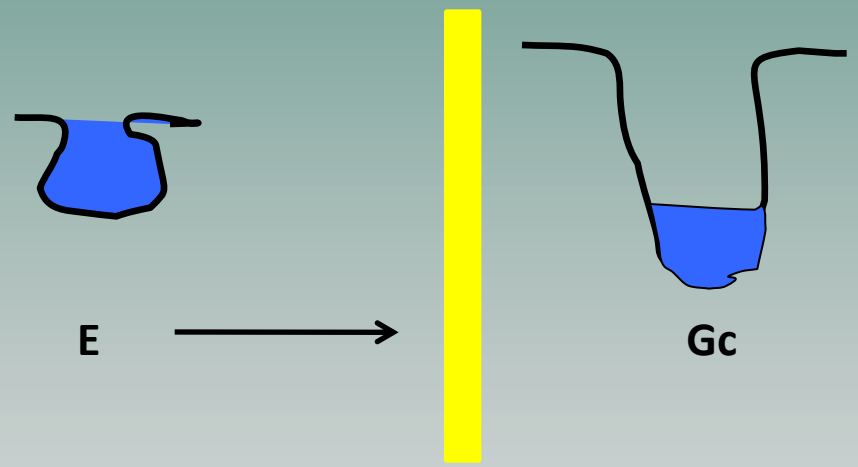
Rosgen 2001


Stable:
BHR 1.0-1.05
Moderately Unstable:
BHR 1.06-1.30
Unstable:
BHR > 1.30
% Composition on Greenline
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1.00 1.00 1.00 1.00 1.00 1.04 1.09 1.10 1.10 1.14 1.19 1.20 1.20 1.22 1.25 1.28 1.32 1.35 1.36 1.42 1.44 1.68
Bank Height Ratio
UPL
FACU
FAC
FACW
OBL

Component of Riparian STM

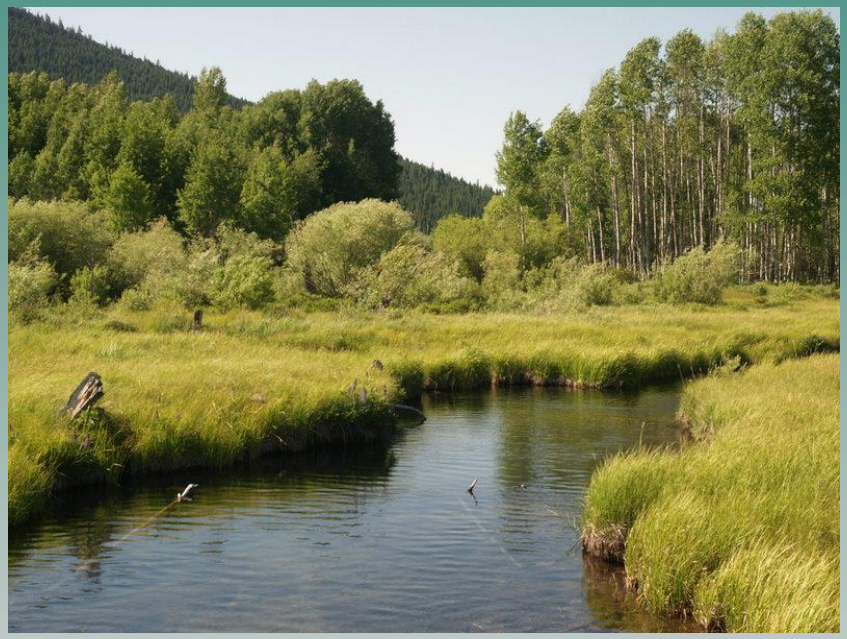
Channel Evolution Models:

(Schumm 1984, Rosgen 1996)



What happens between E and G?

State-and-Transition Model



Riparian State 1 = reference state

- Channel connected to floodplain
- Water table supports OBL and FACW species

At-Risk CP

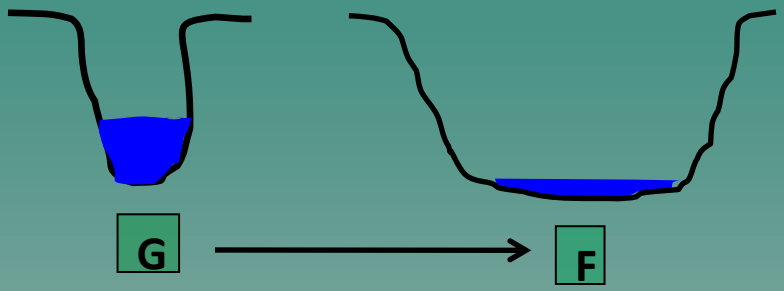
- Bank height ratio increasing
- Channel widening
- Vegetation composition reflects lowering of the water table

State-and-Transition cont.

At- Risk Phase within State 1
Transitional type

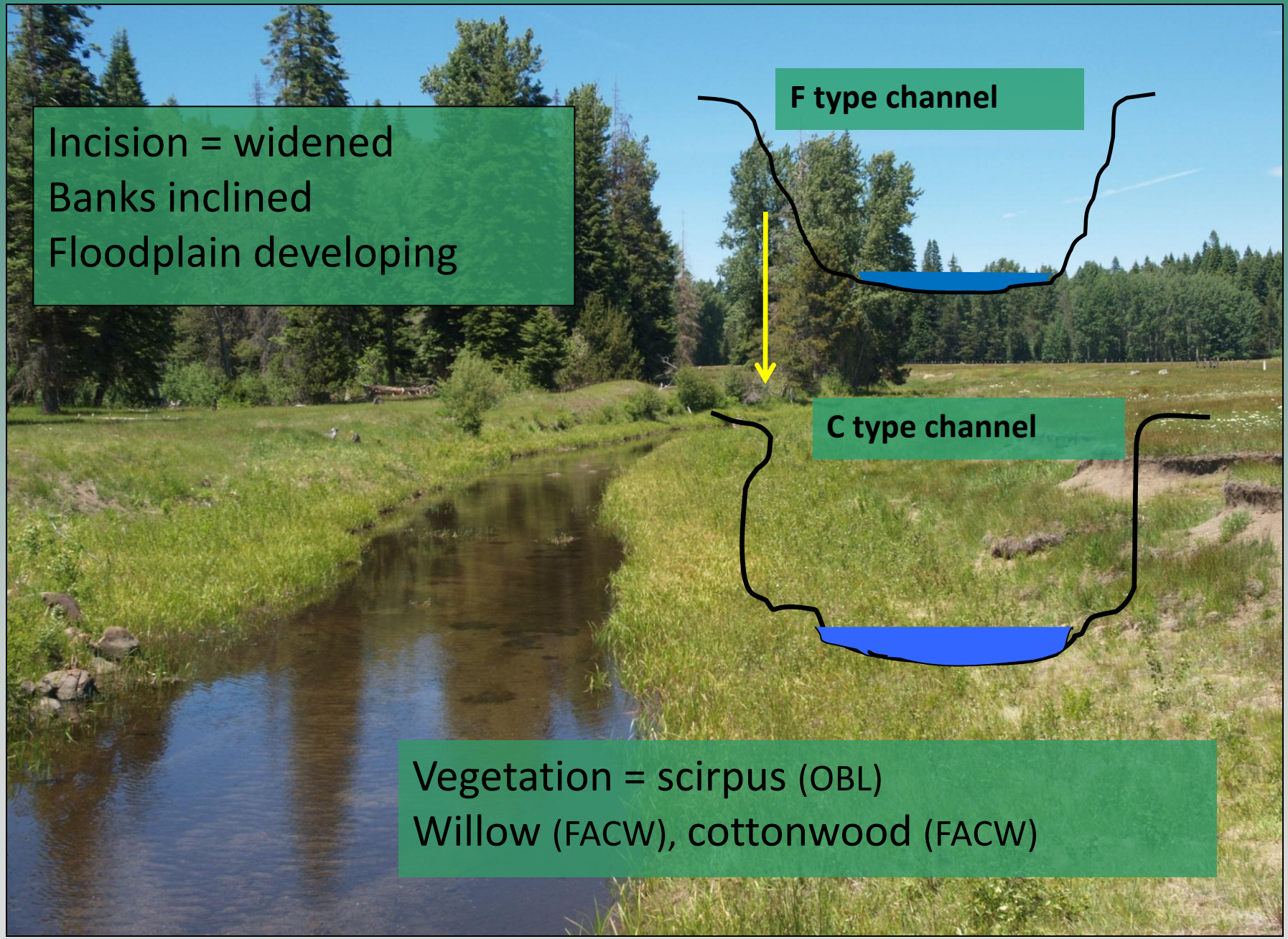
State 2

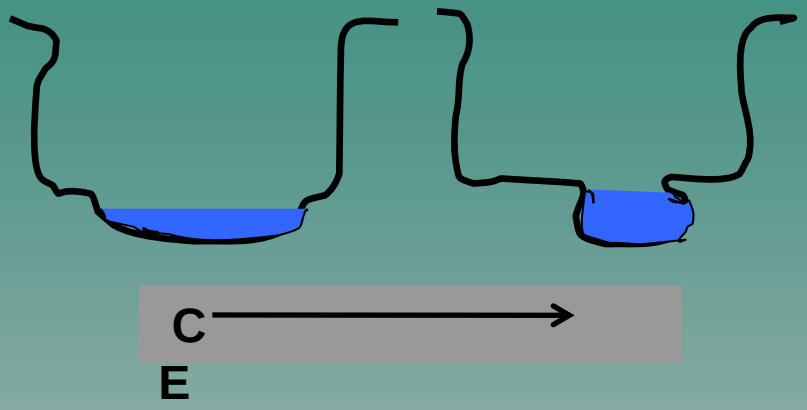
Bankfull flow contained in channel
Disconnect with floodplain
Erosion
Active Restoration Required



- **entrenched G type channel**
  - **Banks are vegetated with FAC and FACW species**
  - **Banks are unstable**
  - **Channel widening necessary to develop floodplain**
- **entrenched F type channel**
  - **Incision width has increased**
  - **Limited to no floodplain development**
  - **Banks unstable**

May be additional CP within this State that occur between “G” and “F” morphologies


Incision = widened
Banks inclined
Floodplain developing
F type channel
C type channel
Vegetation = scirpus (OBL)
Willow (FACW), cottonwood (FACW)

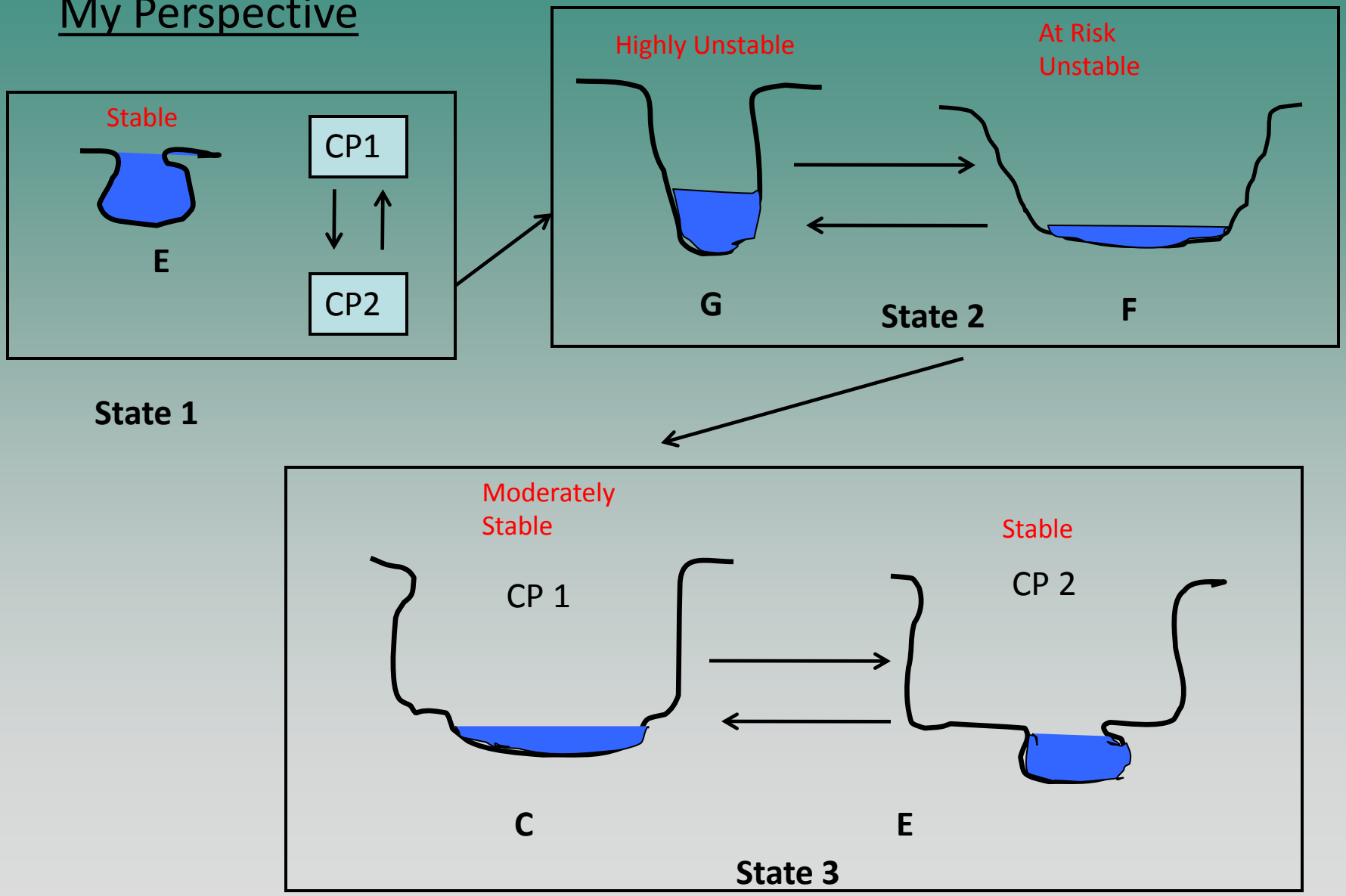


State 3

- CP 1: C type channel that exhibits increasing sinuosity, point bar development and vegetation capable of holding banks during high flow events

- CP 2: E type channel similar in dimension to the reference state channel however no longer connected to the original floodplain

My Perspective



Components of Riparian STMs

- Channel Evolution Models
  - Valley Type
  - Channel Type
  - Hydrology
- Soils / Substrates
- Vegetation Phases
  - Plant community components
- Floodplain connection

State 1

State 2

State 3