RESTORING RIVERS TO STAGE 0: A PROCESS- BASED APPROACH TO RETURNING A DEPOSITIONAL RIVER VALLEY TO AN ANASTOMOSING CHANNEL NETWORK

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Google Earth

What is Stage 0?

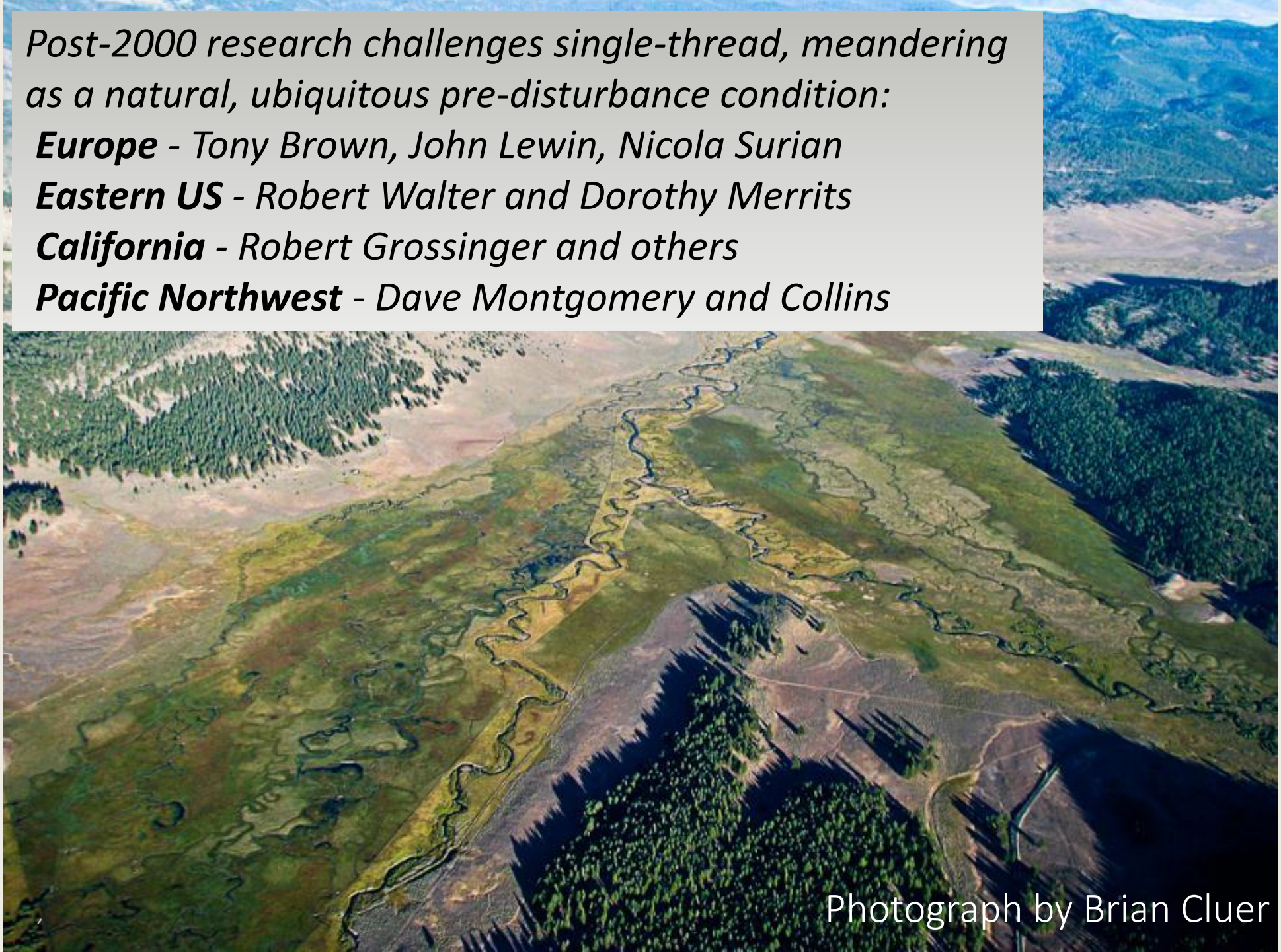
Post-2000 research challenges single-thread, meandering as a natural, ubiquitous pre-disturbance condition:

Europe *- Tony Brown, John Lewin, Nicola Surian*

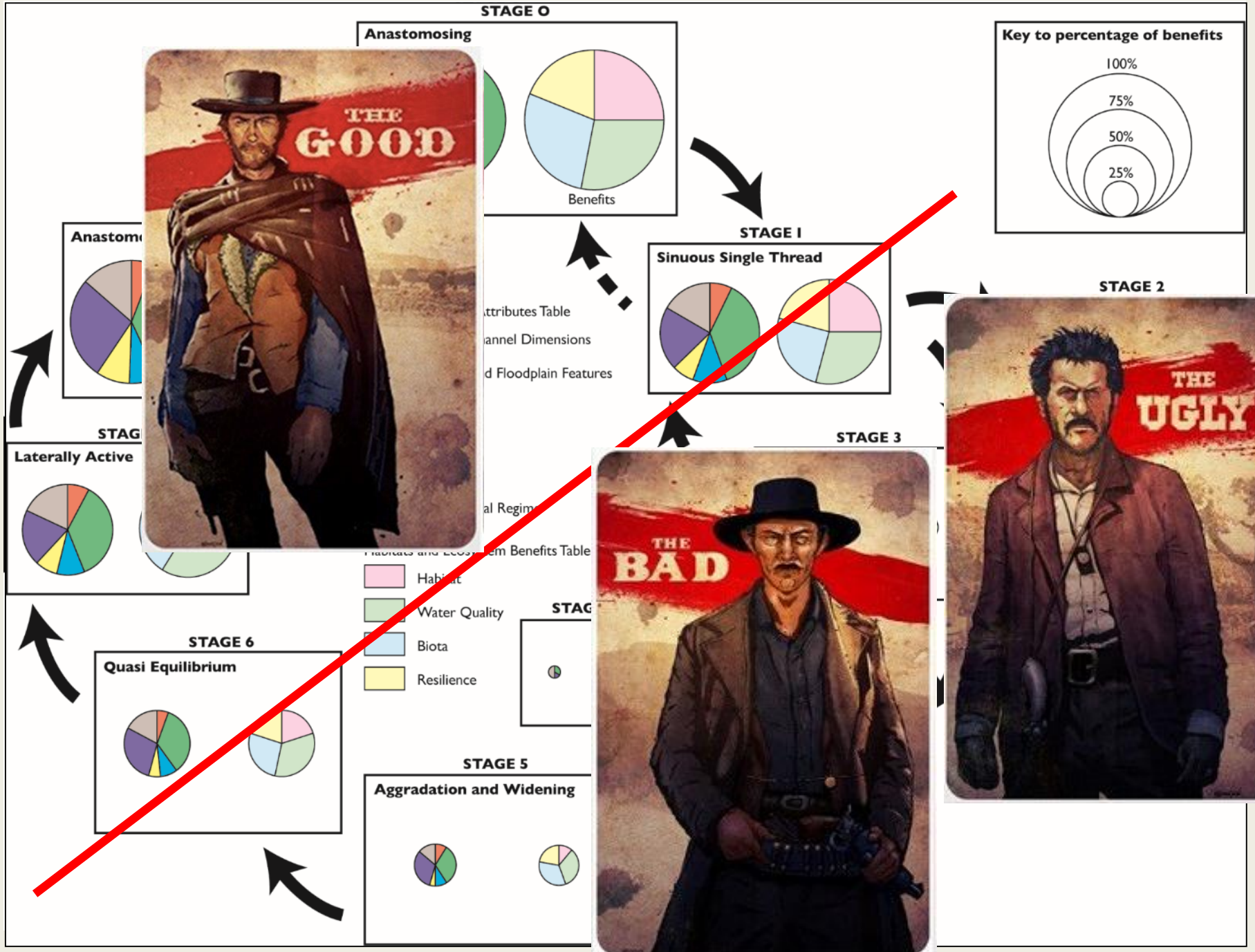
Eastern US *- Robert Walter and Dorothy Merrits*

California *- Robert Grossinger and others*

Pacific Northwest *- Dave Montgomery and Collins*



Photograph by Brian Cluer

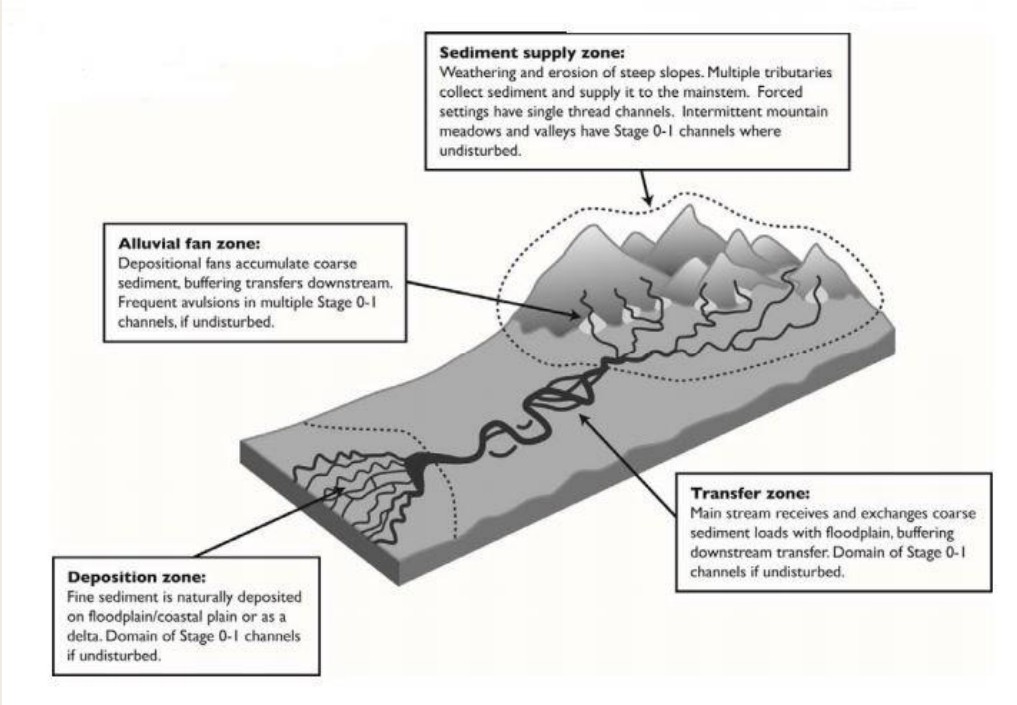


Cluer and Thorne, RRA, 2013

What Distinguishes Stage 0 and Why Restore to Stage 0?

Attributes

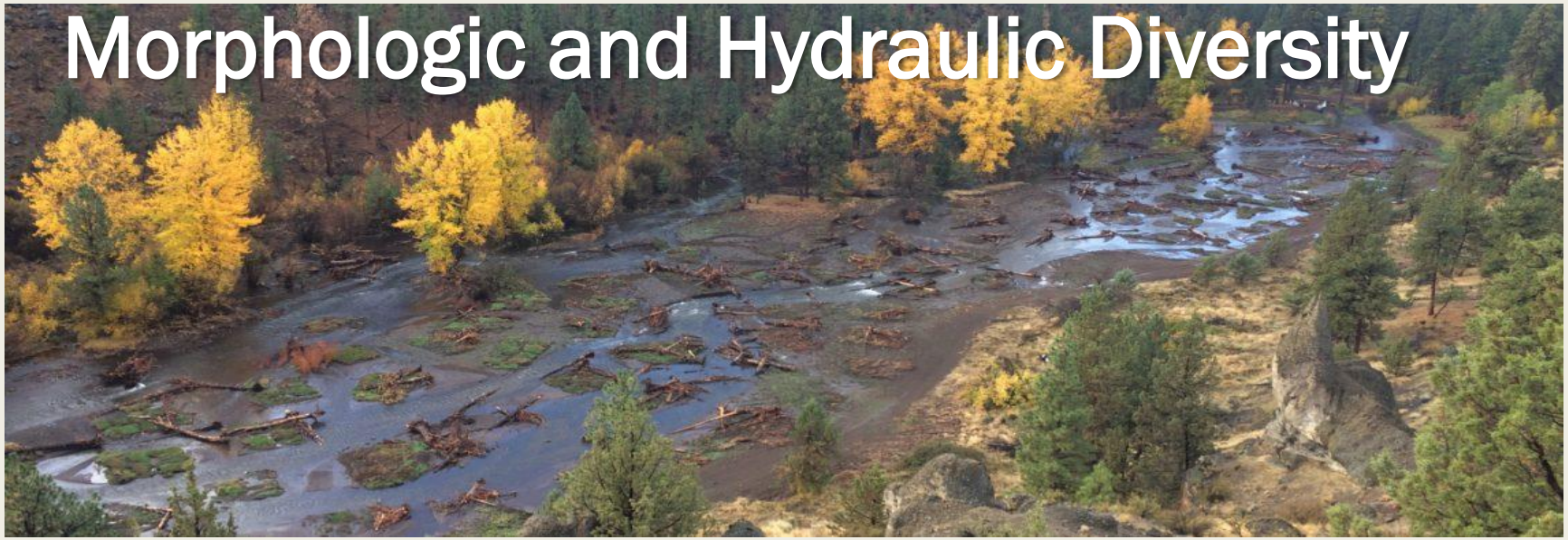
- 1. Depositional Zones
  - *Transport capacity limited*
  - *When mature, supply and capacity may balance, with strong particle exchange and sorting*
- 2. Large Space
  - *Max flood attenuation*
  - *Max GW exchange*
  - *Max sediment pulse attenuation*
  - *Resilient to entire range of watershed processes and pulses*



Benefits

High Water Table

Prolific Riparian Zone

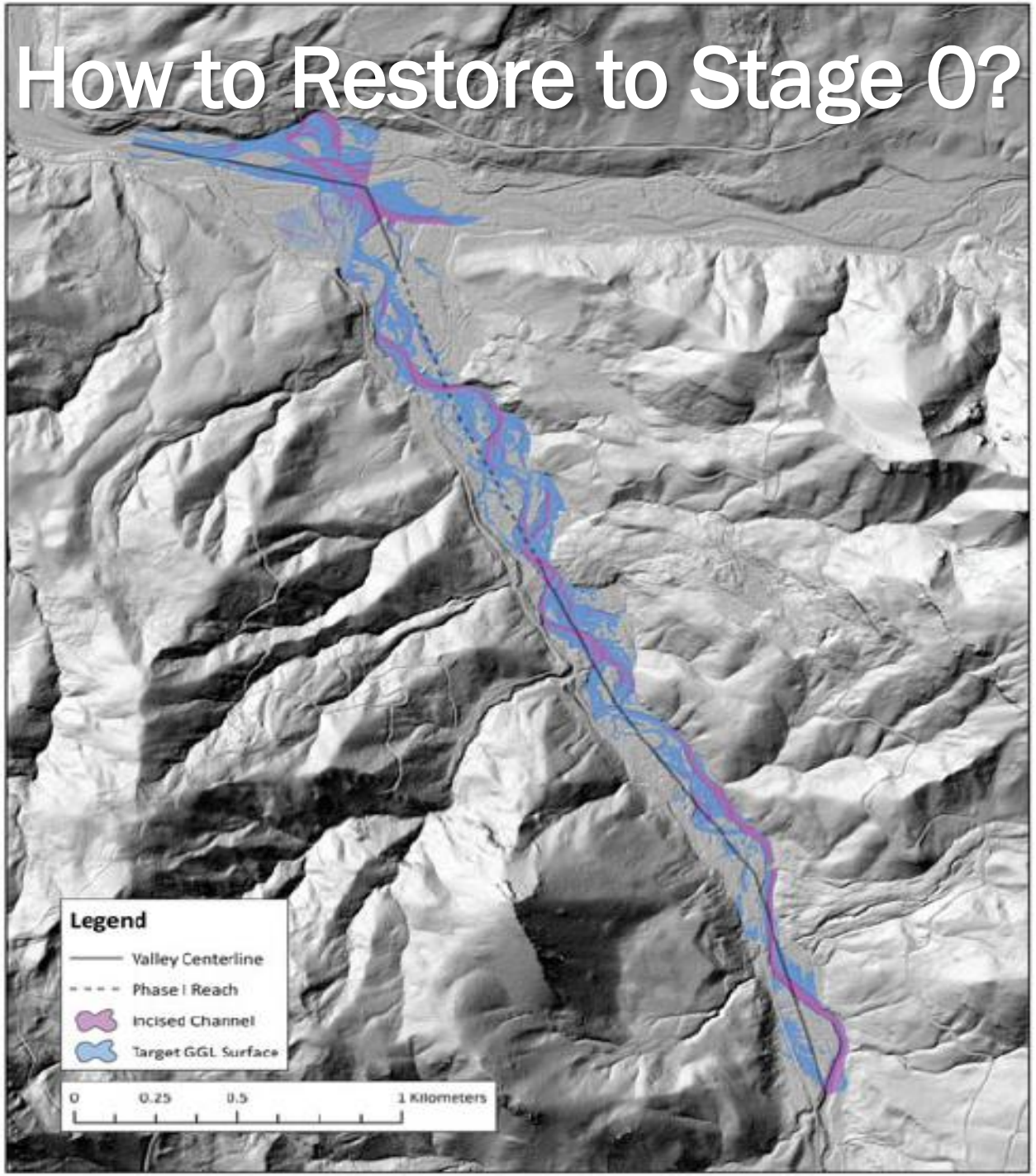

Morphologic and Hydraulic Diversity

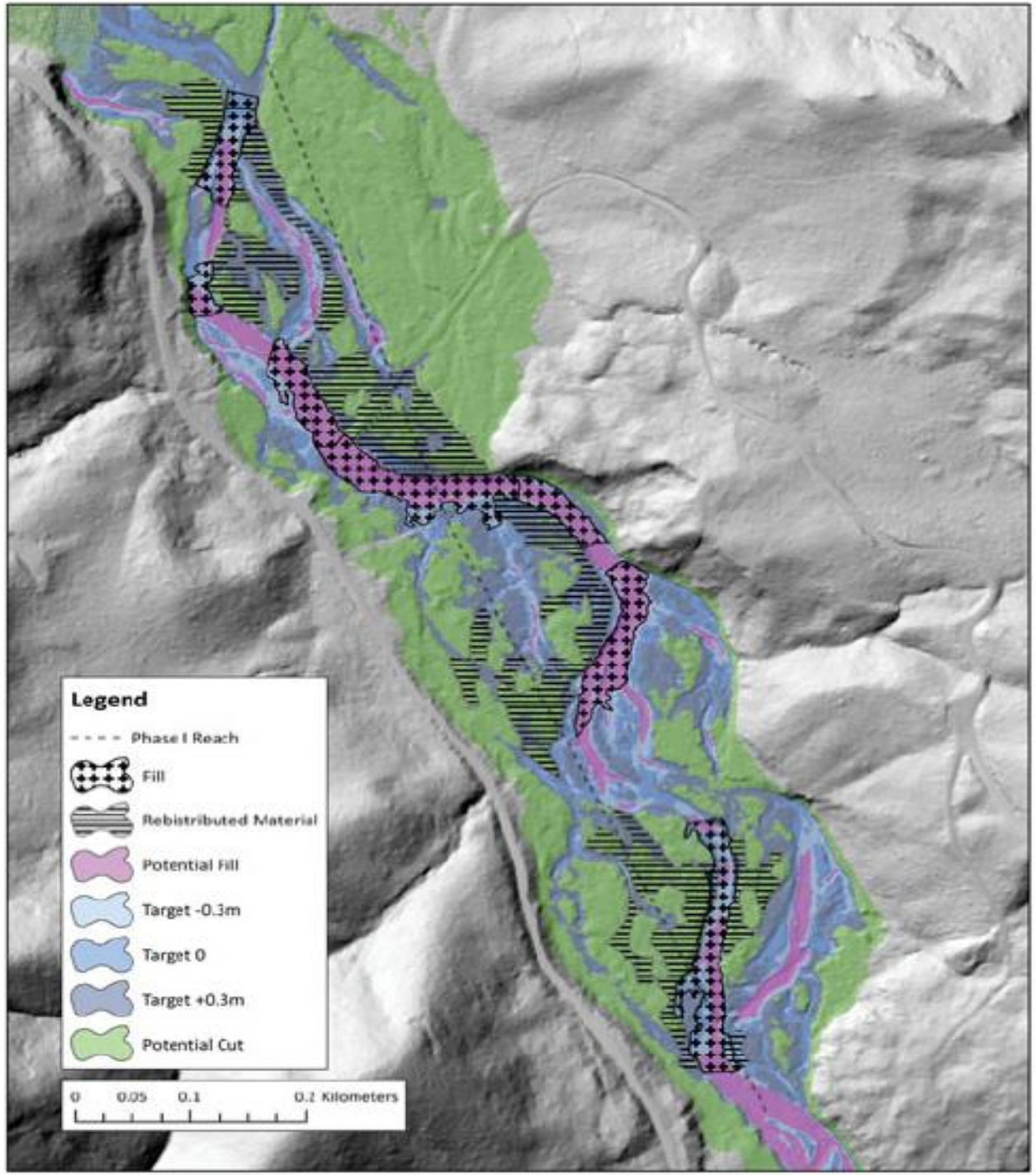
Benefits

Significant Biodiversity and Biological Function

High Water Quality

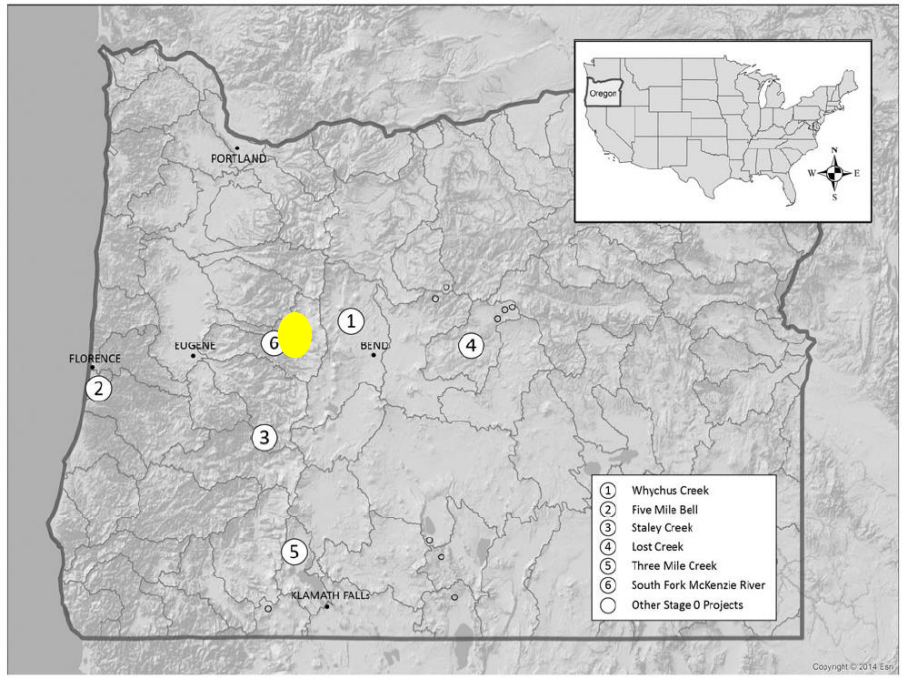
How to Restore to Stage 0?





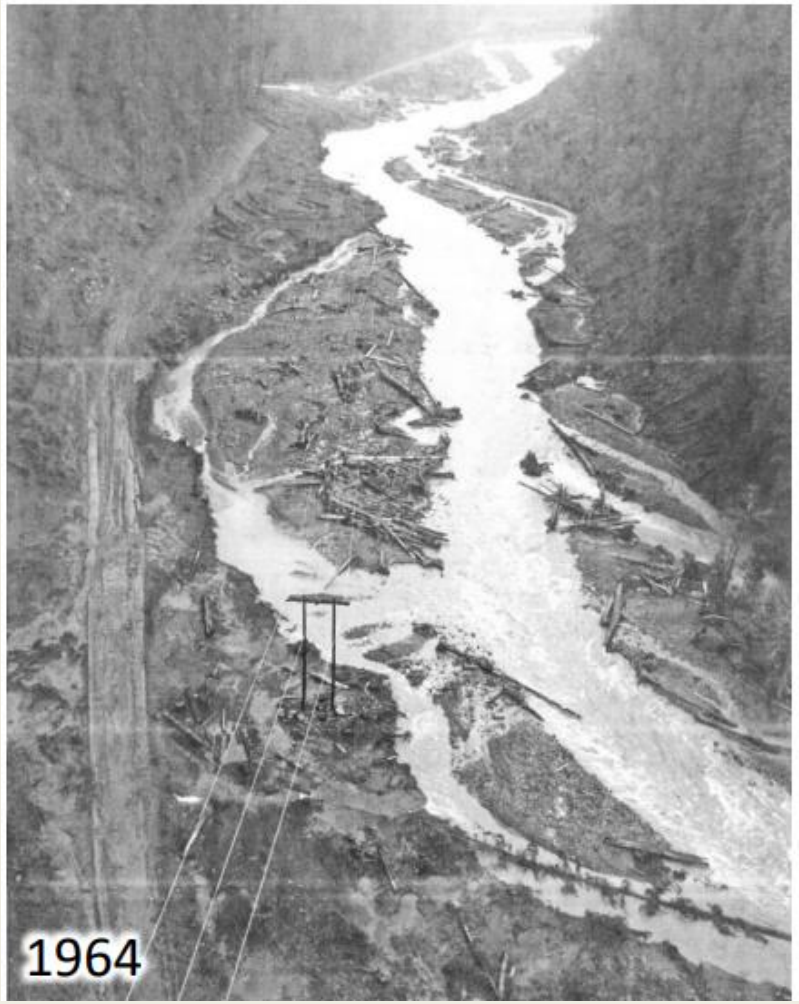
Deer Creek Stage 0 Restoration Project

- Historically . . .
  - Depositional alluvial valley (high wood load, sediment storage)
  - Spawning and rearing habitat for ESA-Threatened spring Chinook salmon and foraging habitat for ESA-Threatened bull trout
  - Productive habitat for cutthroat and rainbow trout, sculpin, etc.

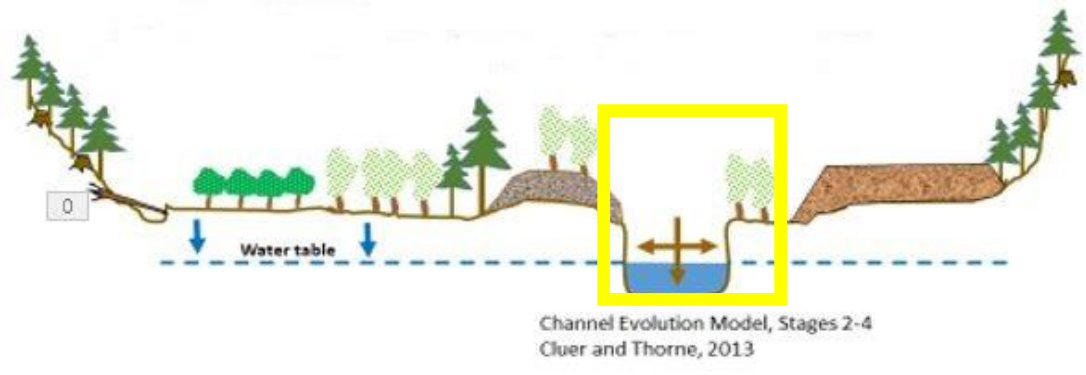


Deer Creek – Land Management History

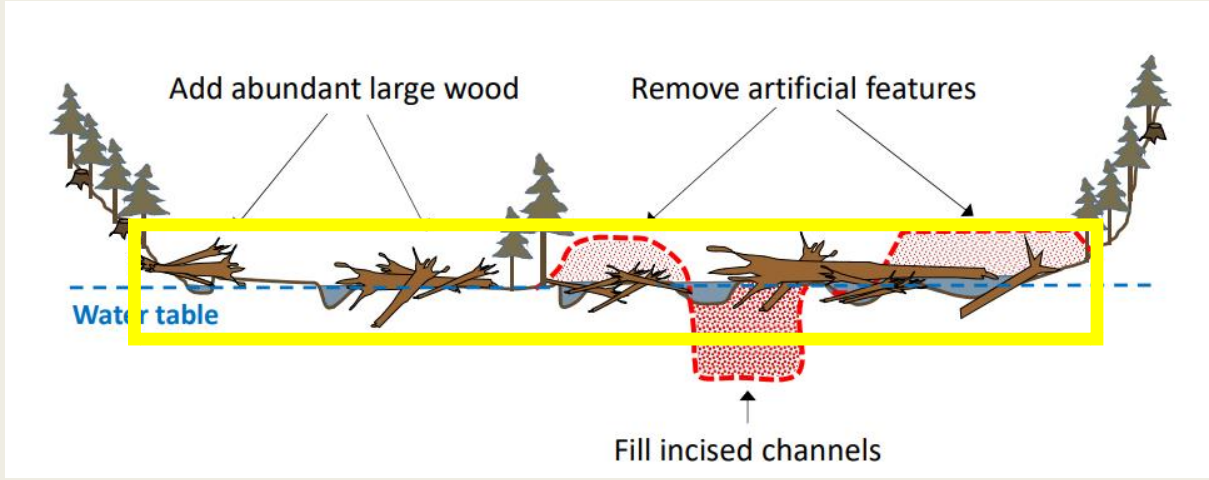
- Historic riparian logging and stream clean-out reduced channel and floodplain roughness
  - *1964 flood scoured entire valley bottom*
- Constructed berms and channelized the stream
- Created a single-thread transport channel with minimal floodplain connectivity



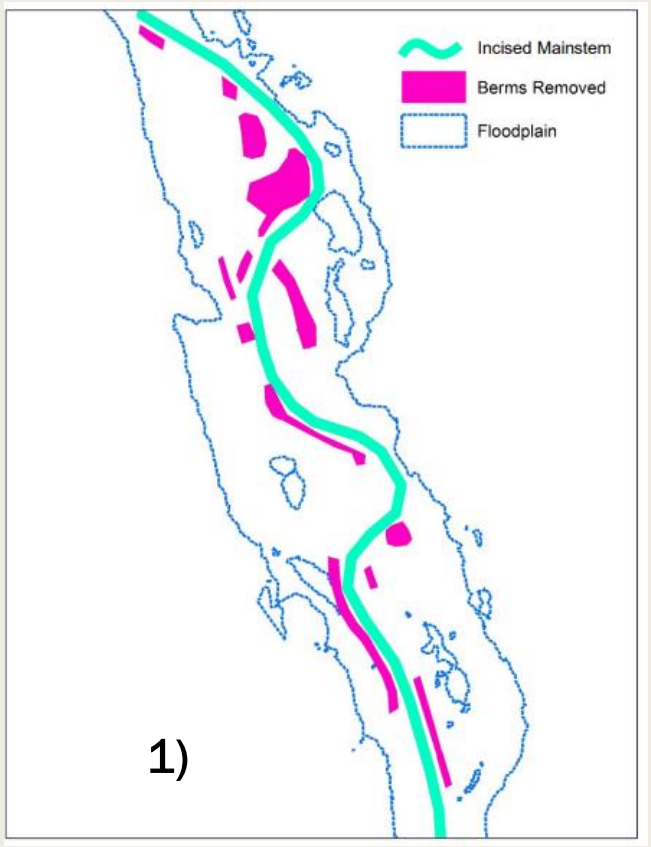
Deer Creek Project Goal



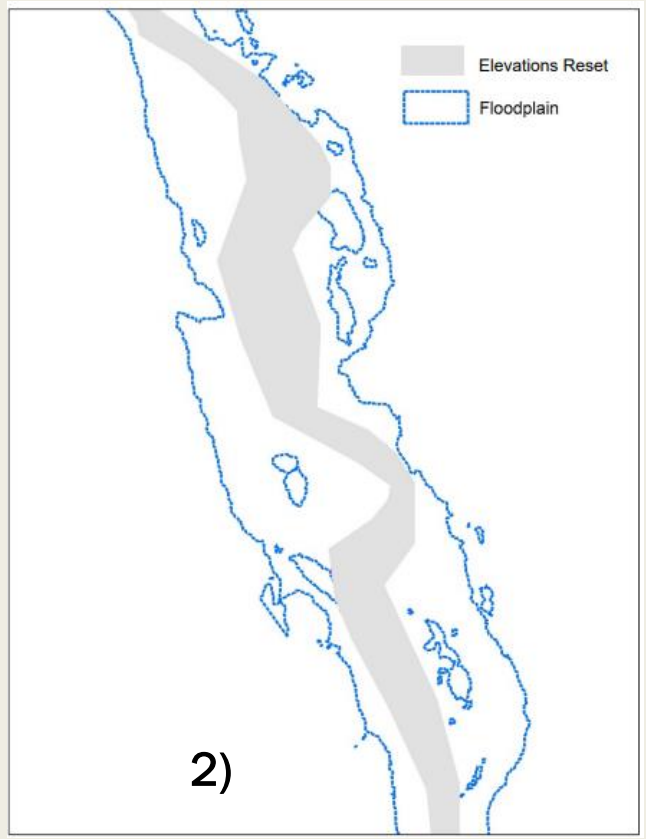
Channel Evolution Model, Stages 2-4
Cluer and Thorne, 2013



Deer Creek Design



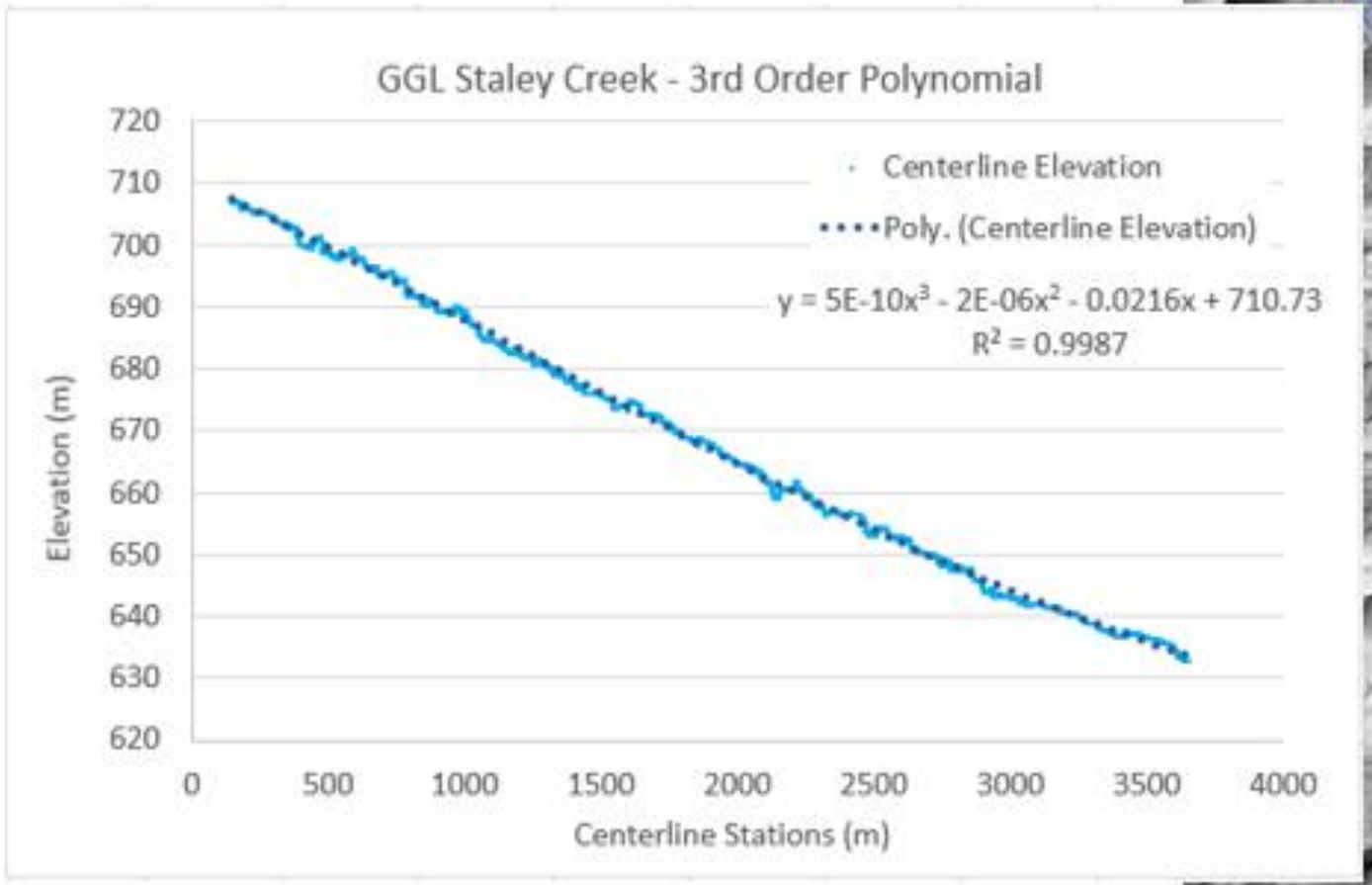
1) Identify all artificial berms and features

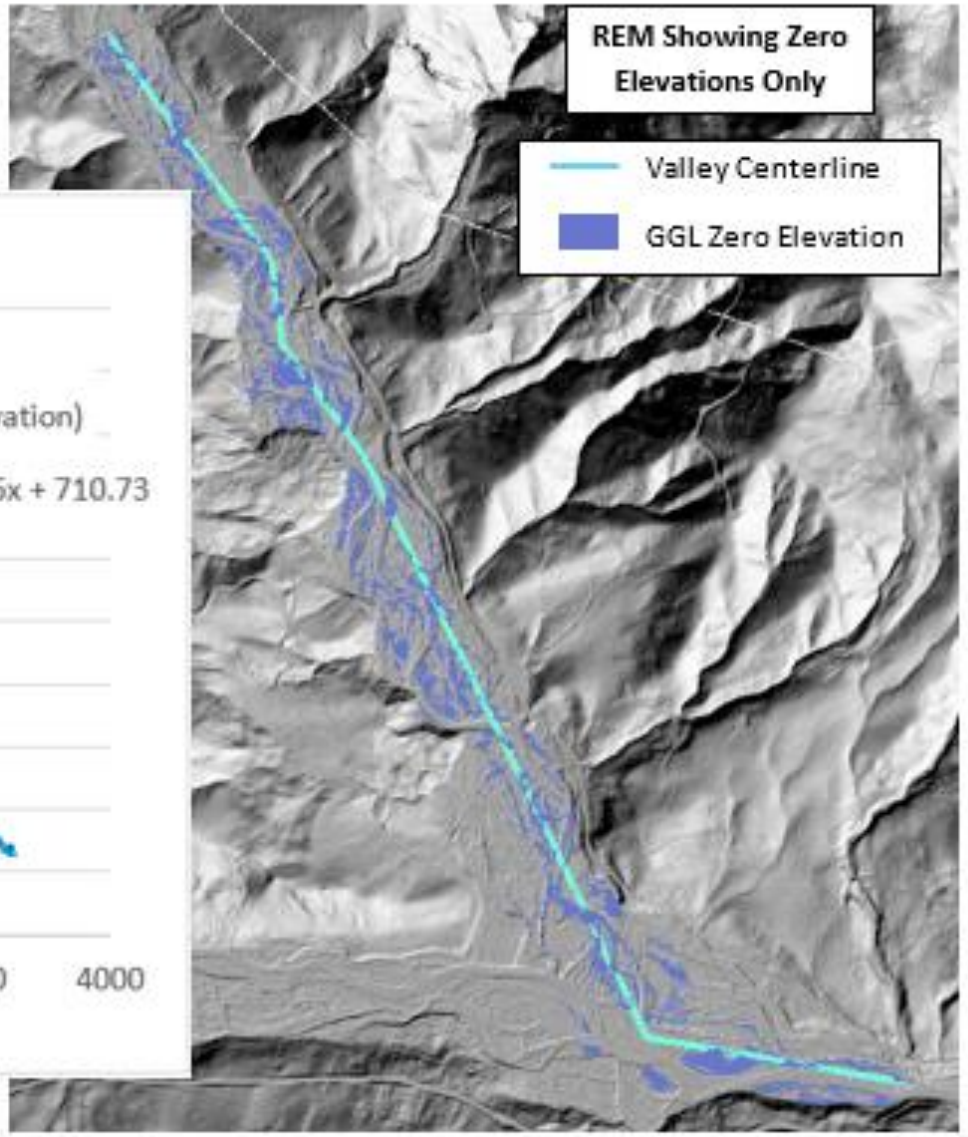


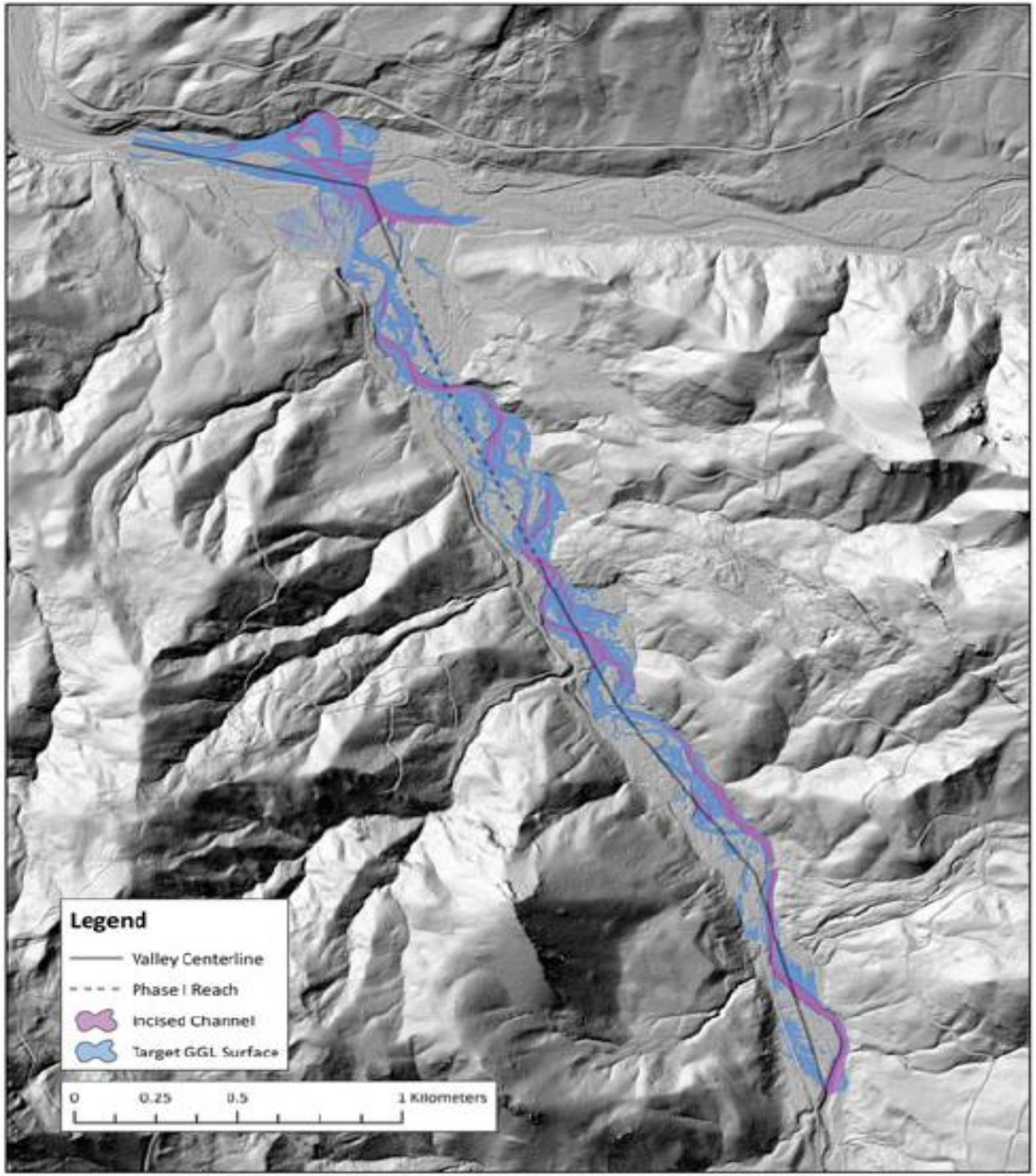
2) “Reset” valley bottom elevations for full connectivity by redistributing berm material into incised channel

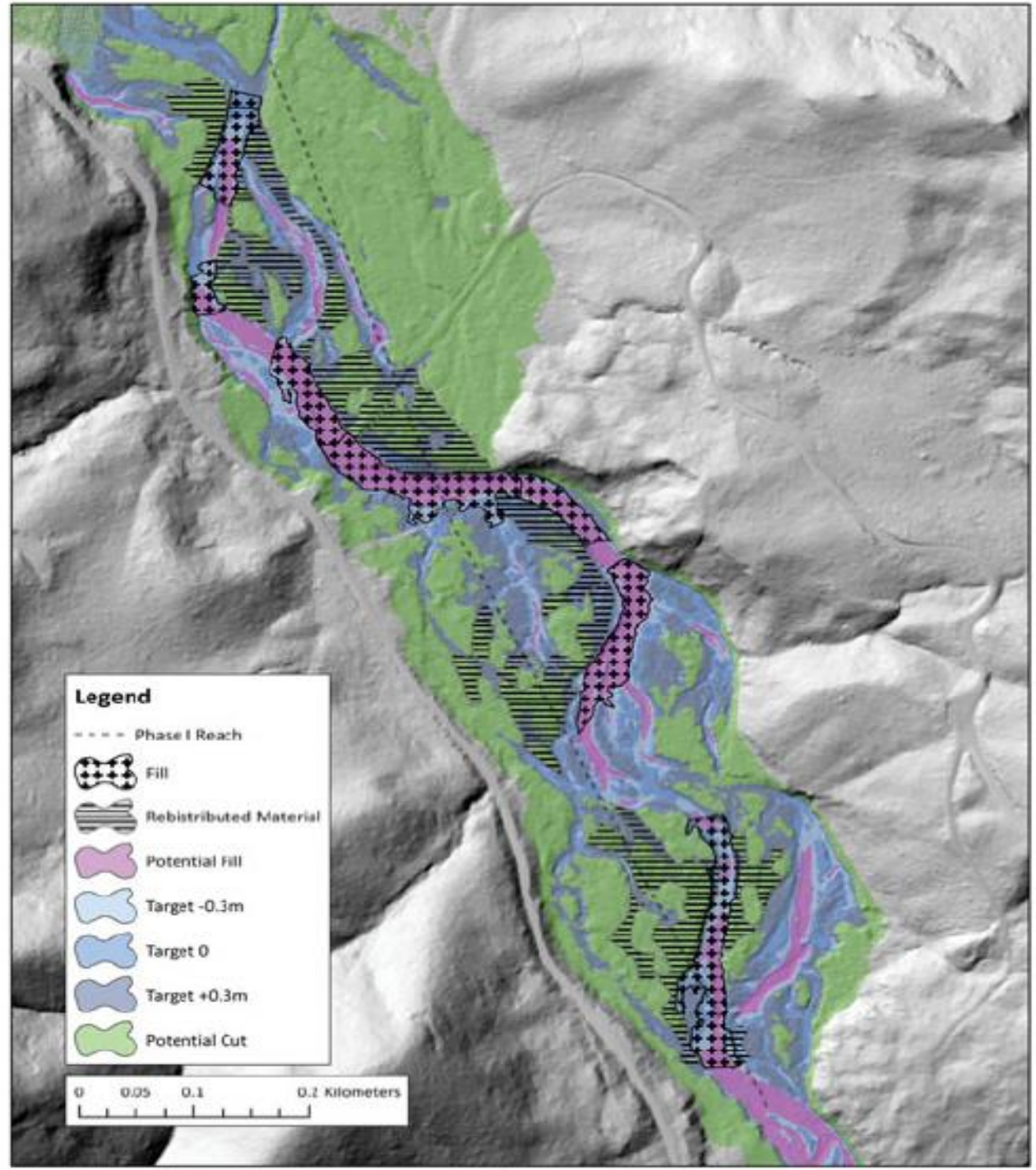
3rd Order GGL and Zero Elevation REM

ArcMap GGL/REM Toolbox
Provided by USFS
Powers et al. 2018

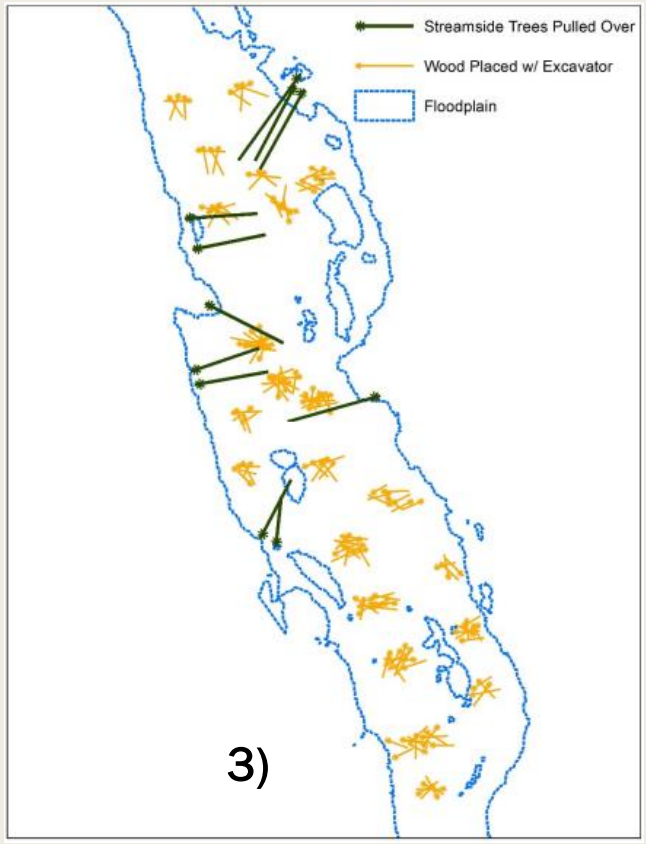




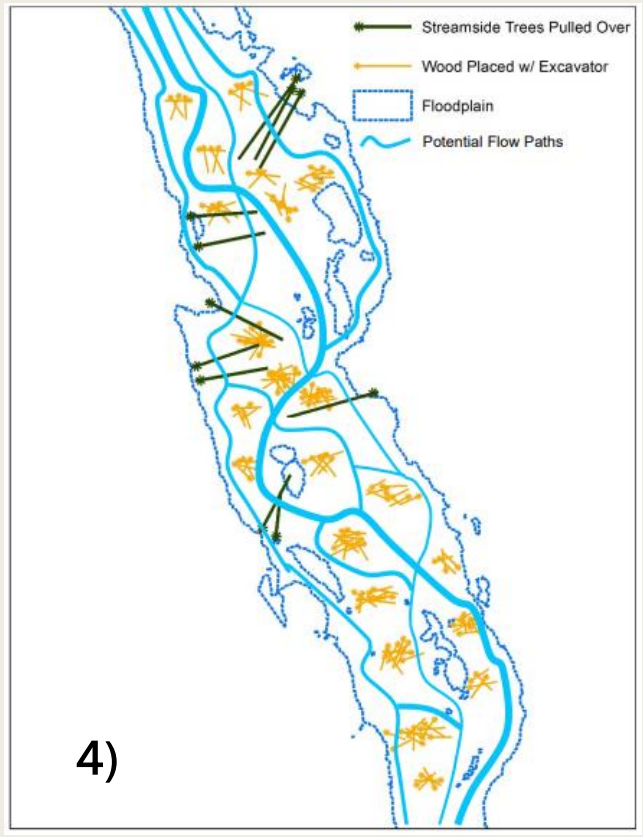

Legend
Valley Centerline
Phase I Reach
Incised Channel
Target GGL Surface
0
0.25
0.5
1 Kilometers


Legend
Phase I Reach
Fill
Rebistributed Material
Potential Fill
Target -0.3m
Target 0
Target +0.3m
Potential Cut
0
0.05
0.1
0.2 Kilometers

Deer Creek Design



3) Add large wood throughout the valley bottom to create hydraulic complexity and dissipate energy wherever channels may migrate



4) Allow natural processes to create dynamic channels, islands, bars, and complex habitat

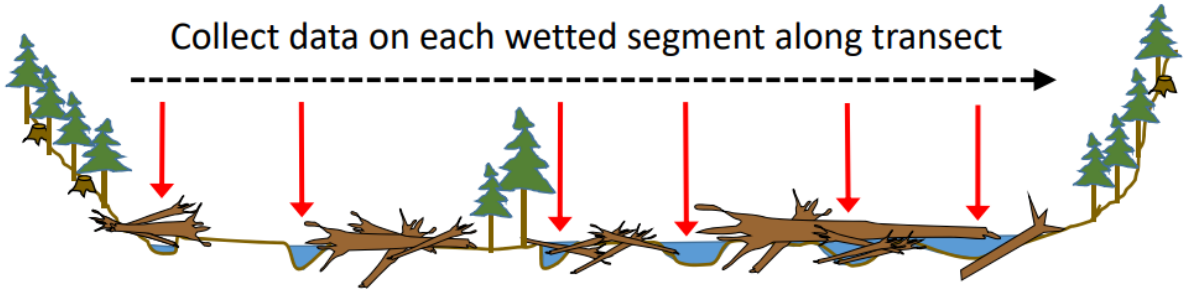
Implementation

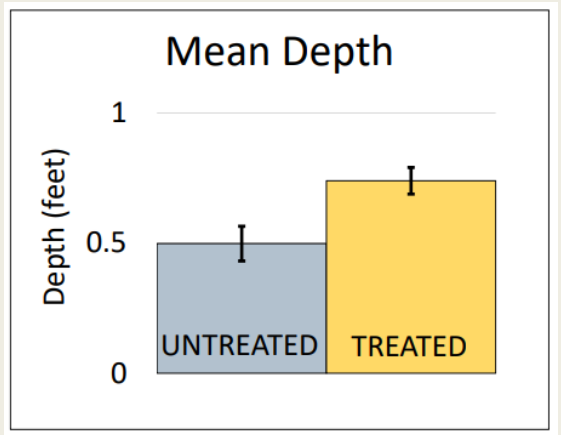
- 200 trees pushed over and placed
- Berms were pushed into incised channel
- 450 pieces of large wood were placed in jams and single pieces throughout valley bottom

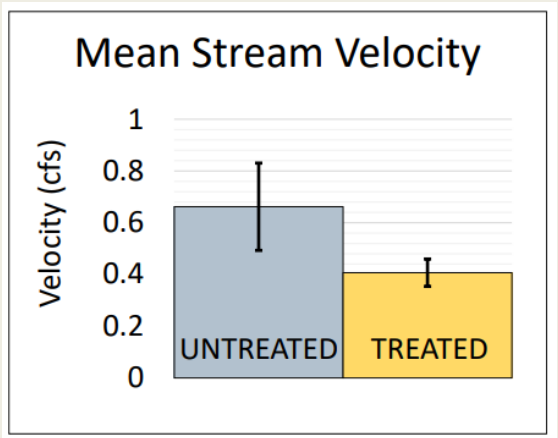
Monitoring Results Untreated and Treated

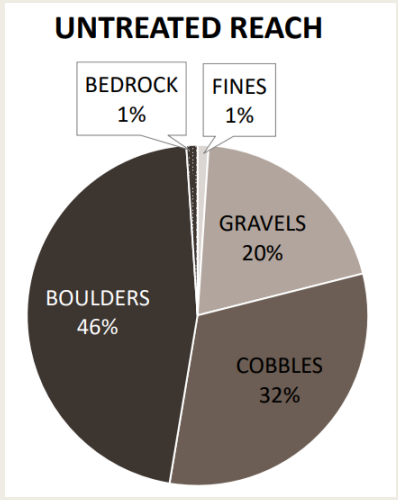
Wetted Segment Data

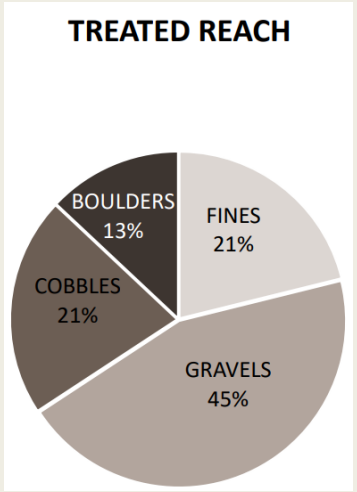
- *Depth*
- *Velocity*
- *Temperature*
- *Substrate Size*
- *Geomorphic Feature*
- *LWM*
- *Riparian Vegetation*

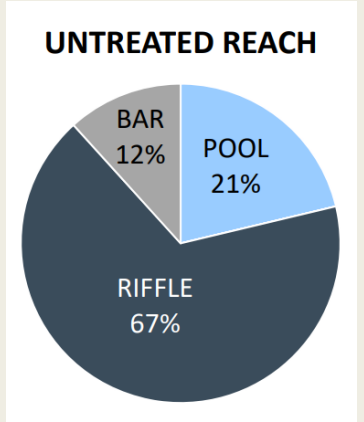


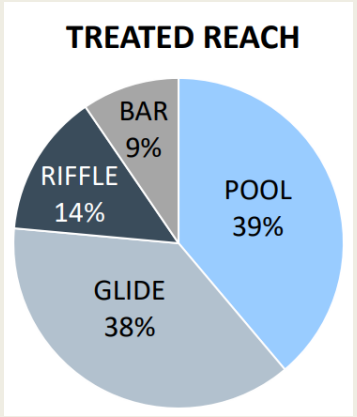








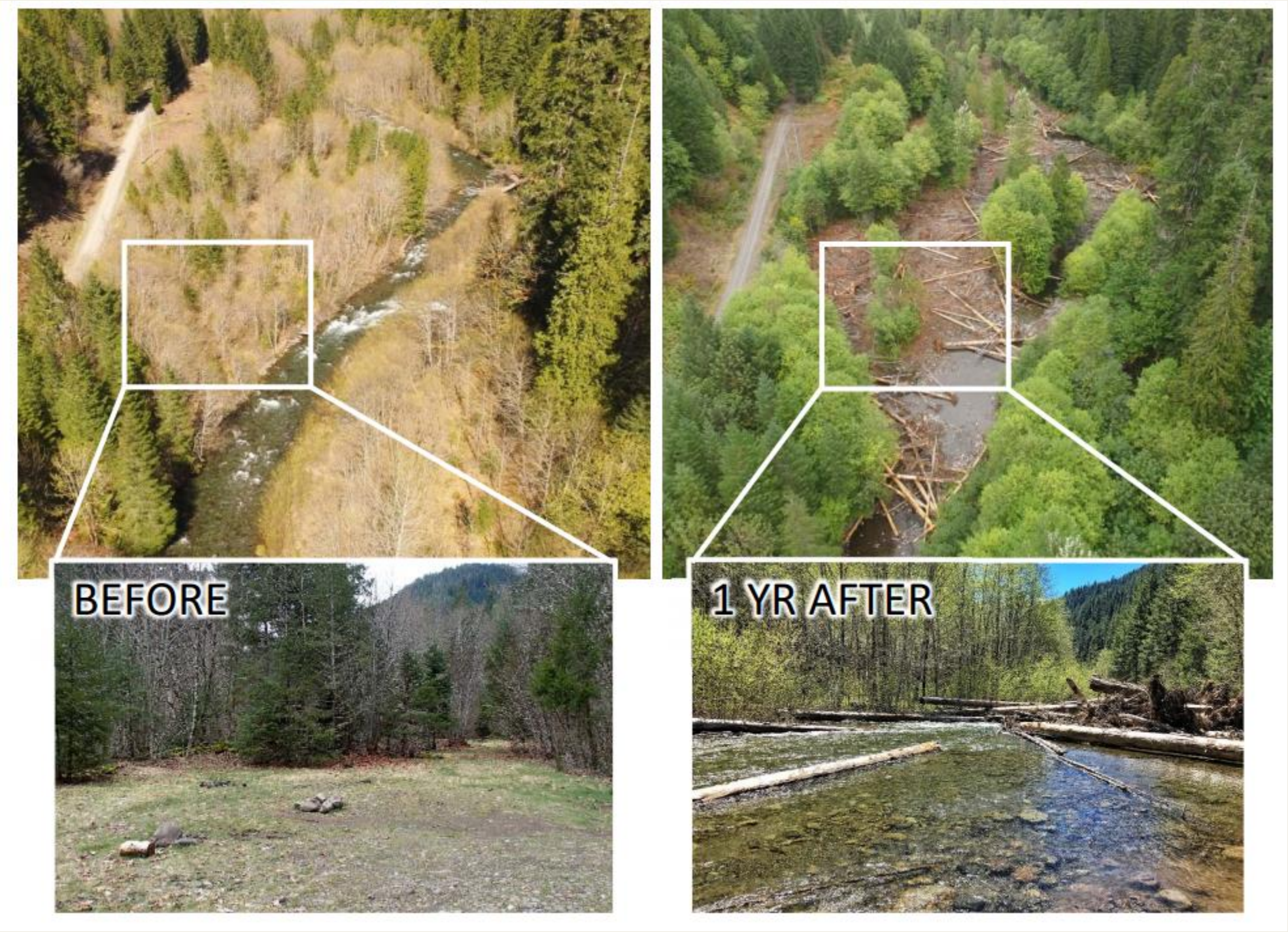




April 2016
BEFORE

September 2016
IMMEDIATELY AFTER

September 2017
ONE YEAR AFTER


BEFORE
1 YR AFTER

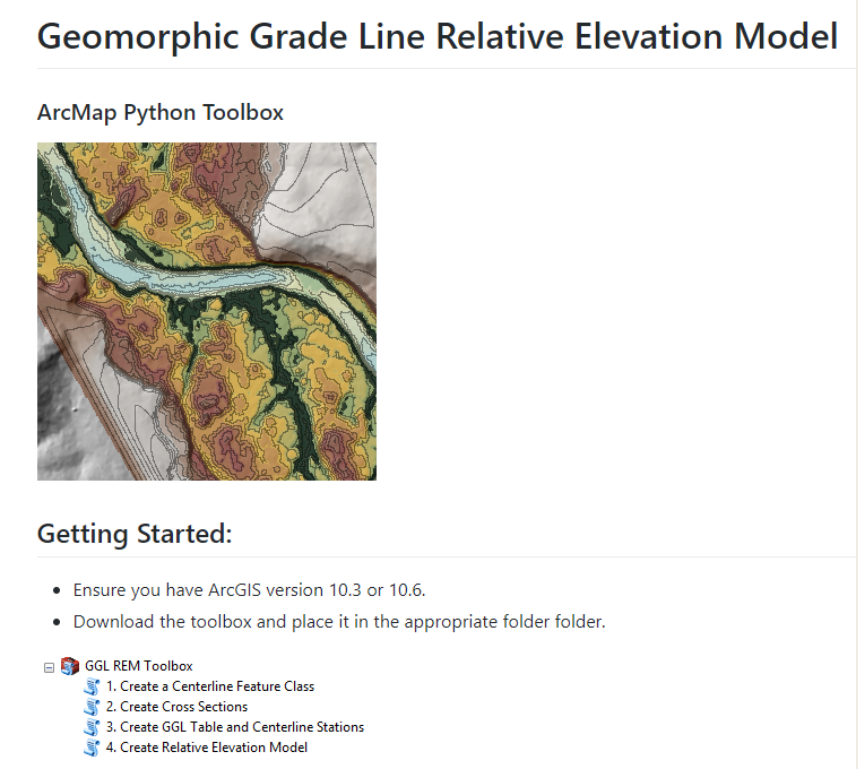
WHEN??

WHY??

Embrace the restoration of dynamism and diversity through restoring the processes that create multifaceted river systems that provide long term resiliency, meta-stability, and more complex and diverse habitat and optimal ecosystem benefits.
Open Your Eyes to the Possibilities!

References

- *Cluer and Thorne (2013)*
  - The Stream Evolution Model
  - *River Research and Applications*
- *Powers, Helstab, and Niezgoda (2018)*
  - Applying the Geomorphic Grade Line Method to Design Stage 0 Depositional River Valleys
  - *River Research and Applications*
- *RRNW*
  - Stage 0 Short Course
    - *Oct 22-24, Sisters, OR*
  - Northwest Stream Restoration Symposium
    - *First week of Feb each year*
    - *Stevenson, WA (Columbia River Gorge)*



River Restoration Northwest