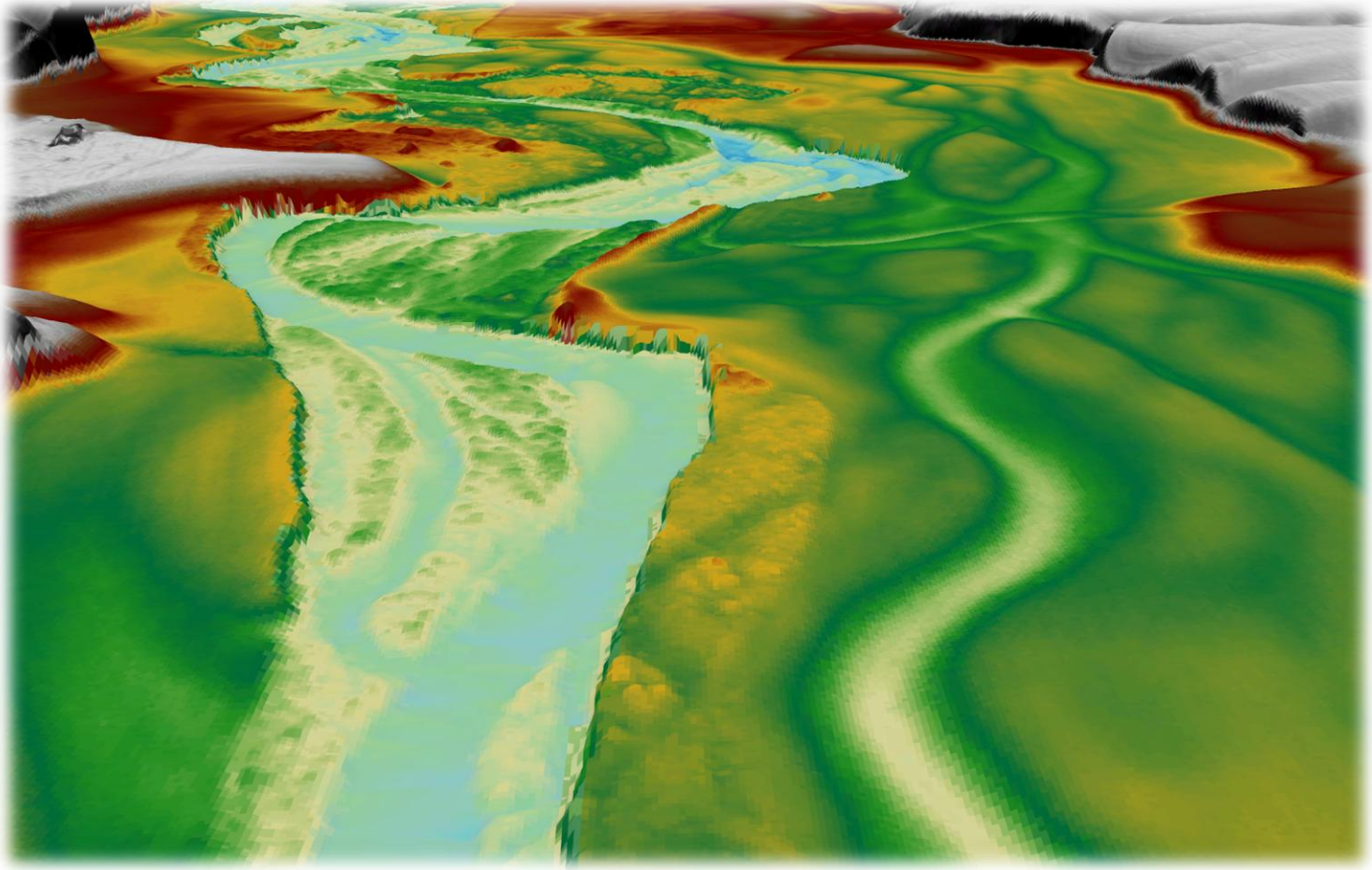
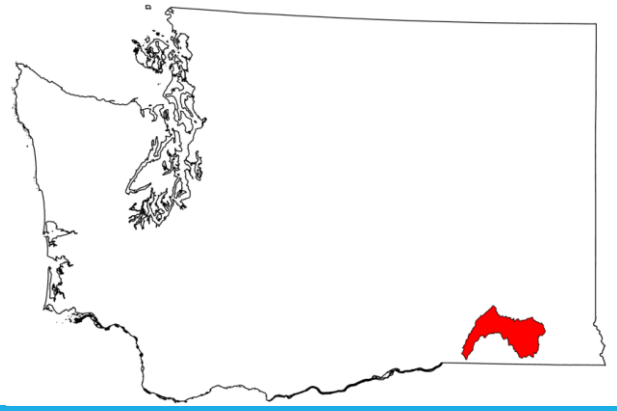
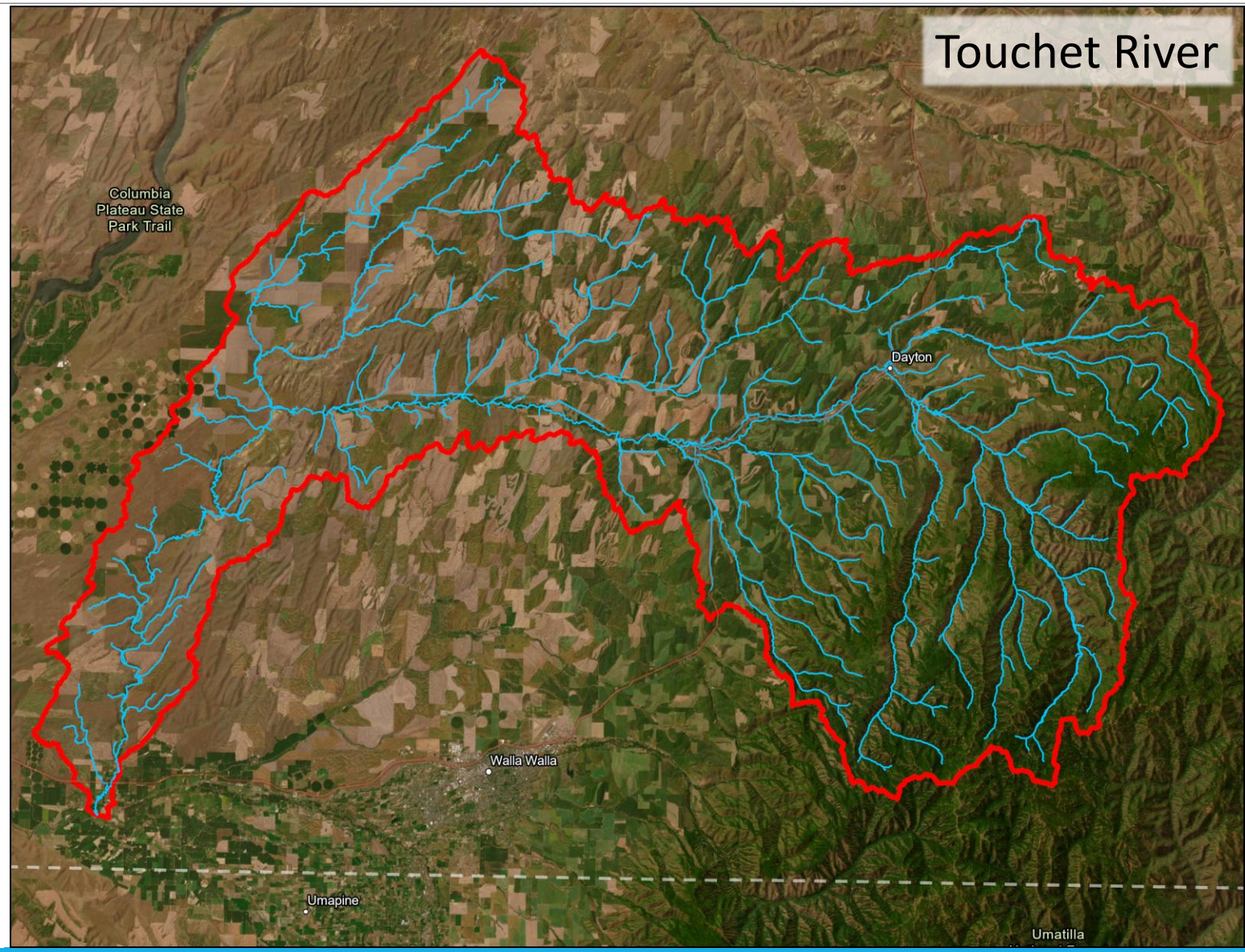
Reconstructing Lost Rivers:
Revealing the Hidden Geomorphology Beneath Modern Landscapes



For PBR, how do we know what to design?

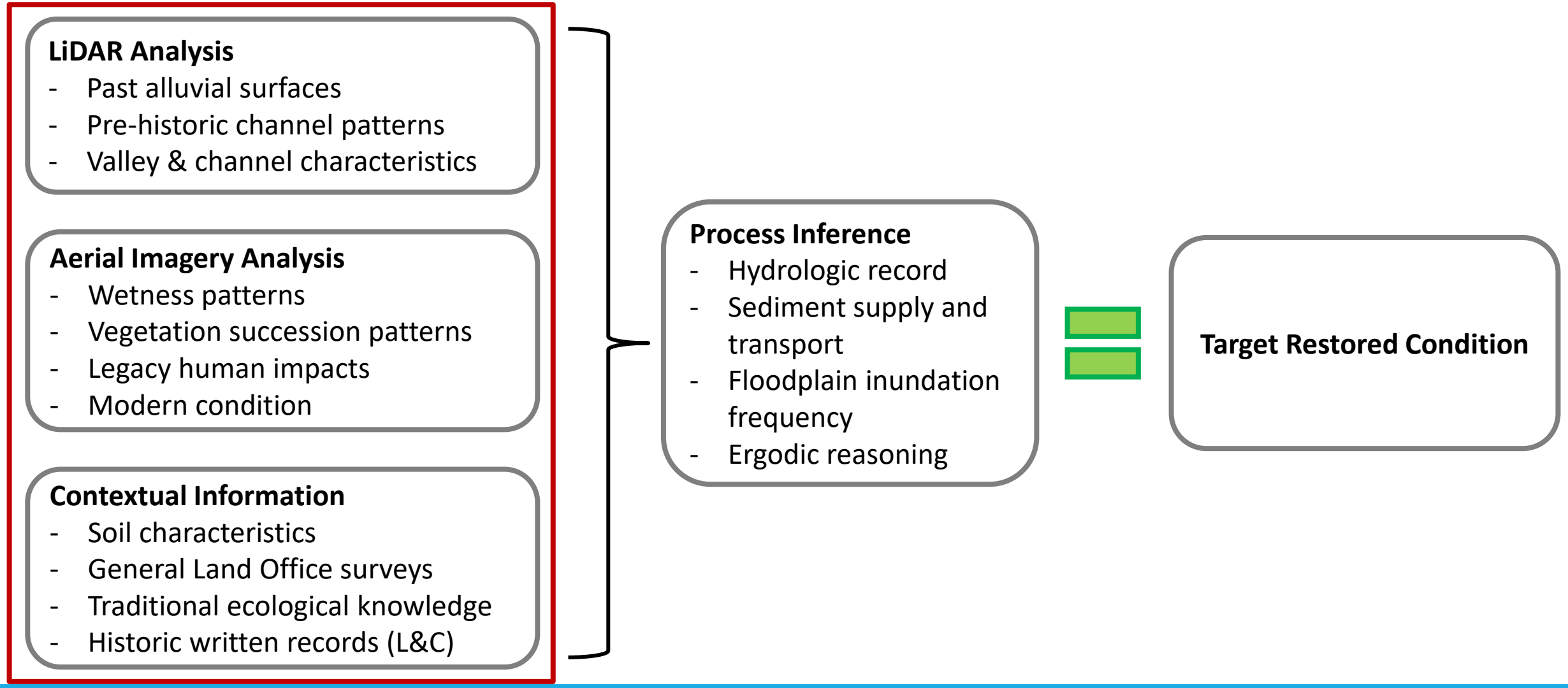
- Locate a suitable reference site and mimic those conditions
  - Reference sites rarely exist
  - Least impacted locations are usually in upper watershed
  - Reference sites often misused (e.g., reach types are not comparable)



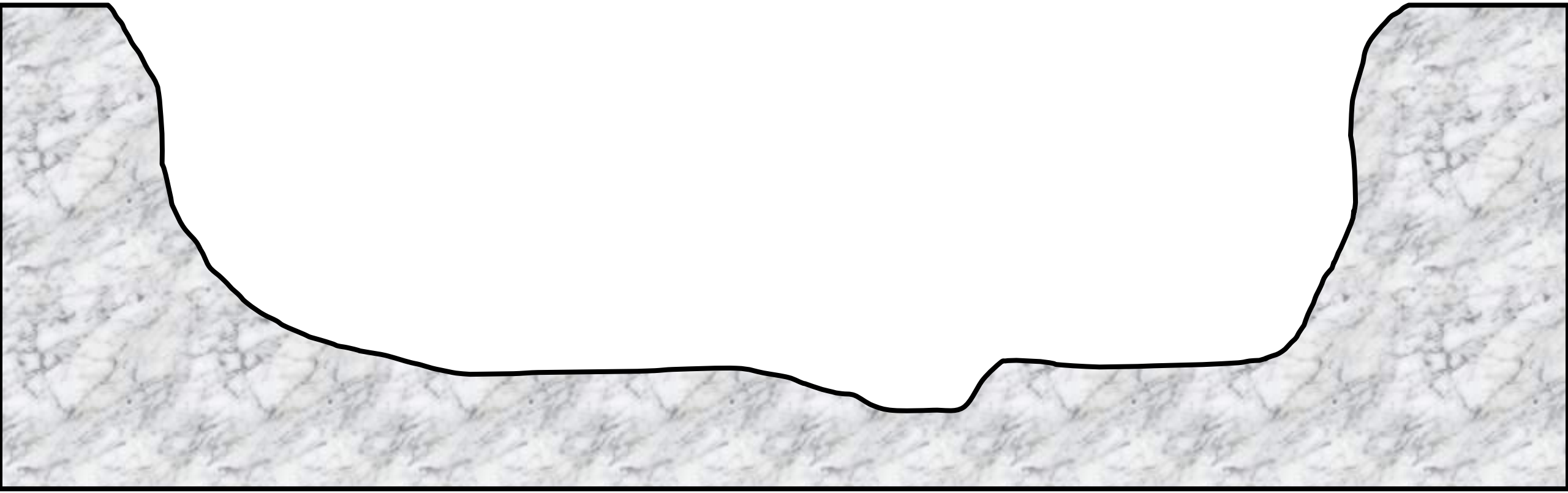


Conduct a Fluvial Autopsy

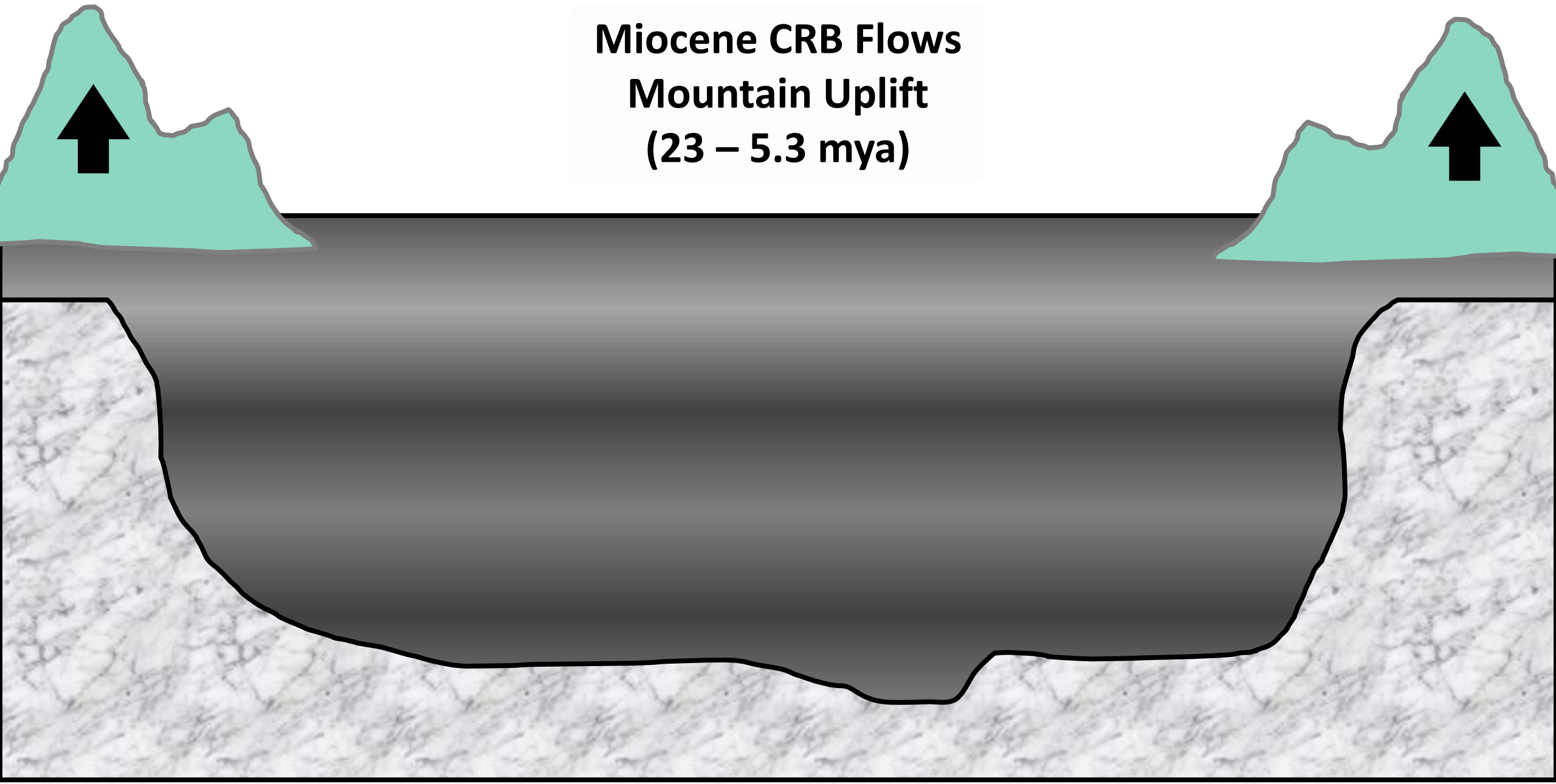
- **Fluvial Autopsy:** Use lines of evidence to reconstruct the river's past structure and processes



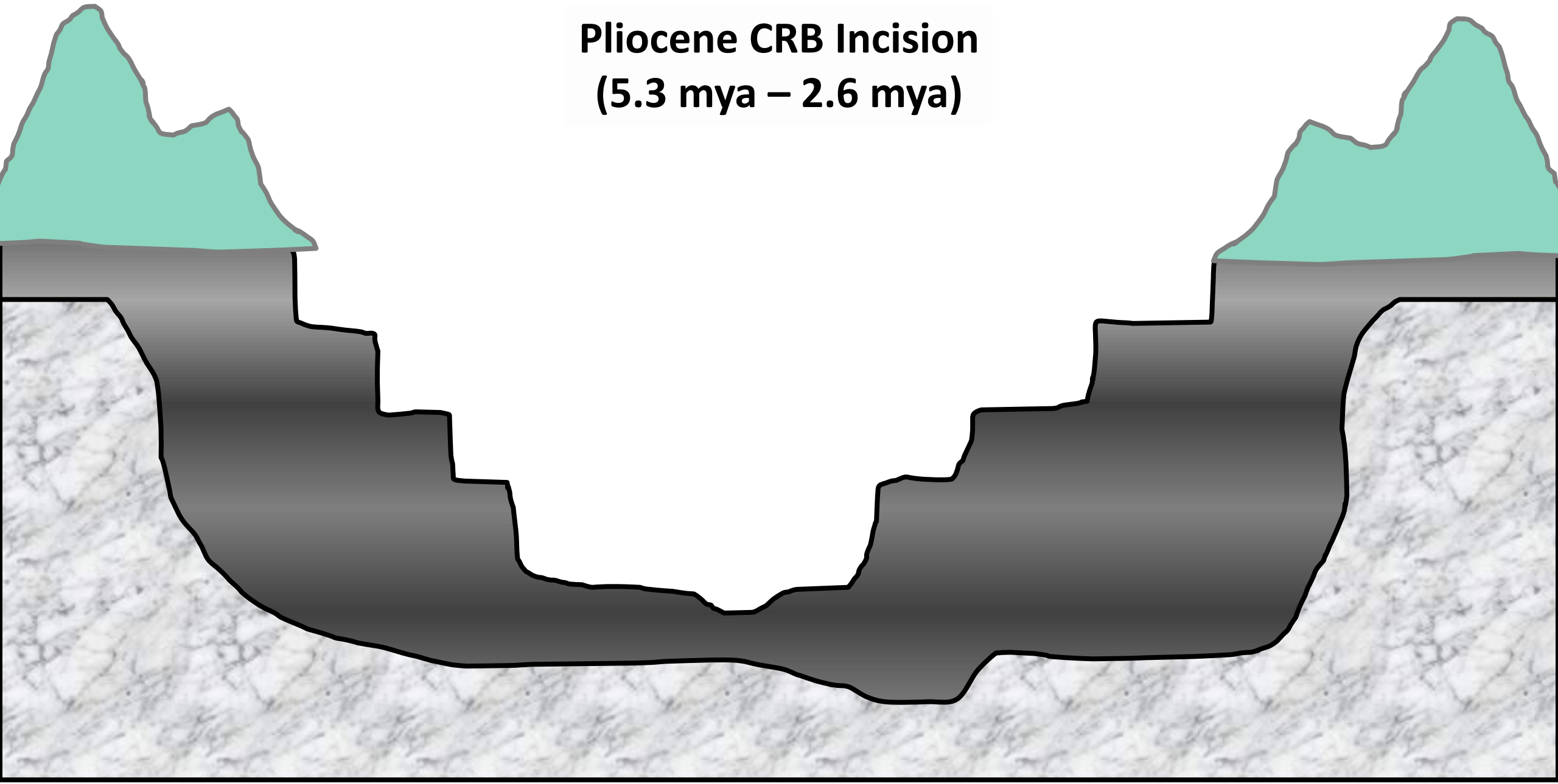
Pre-Miocene River Valley
(>23 mya)



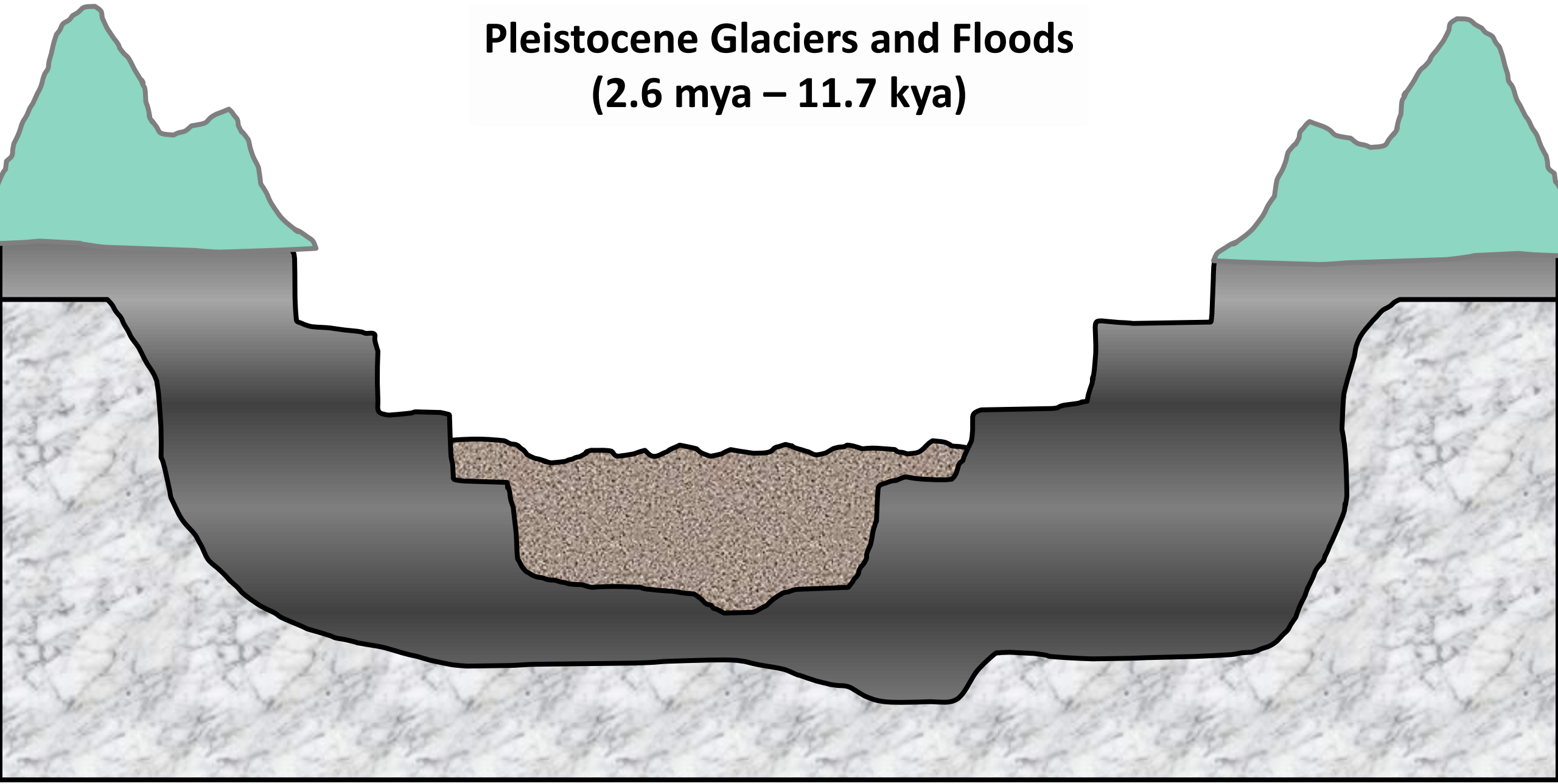
Miocene CRB Flows
Mountain Uplift
(23 – 5.3 mya)



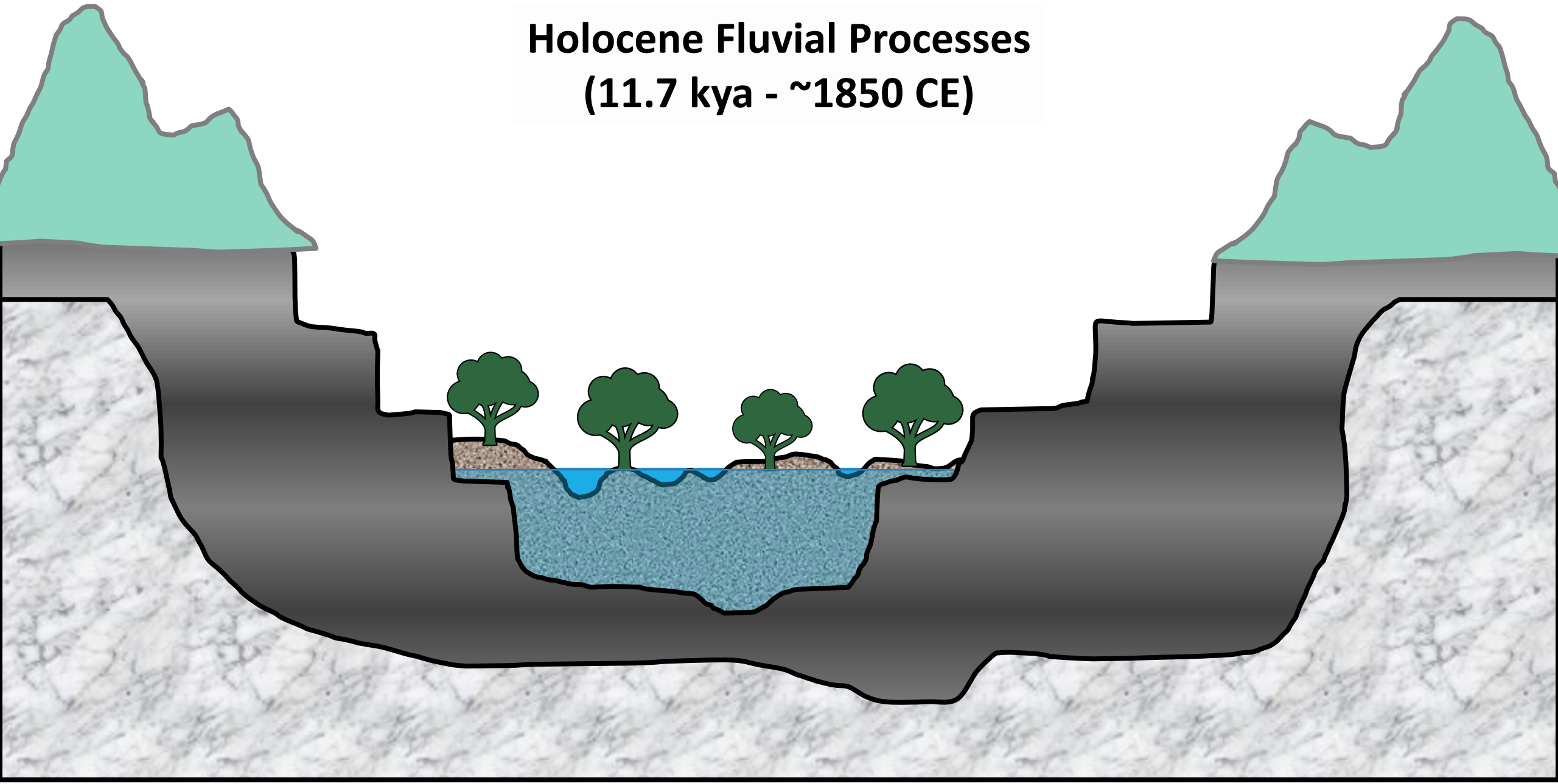
Pliocene CRB Incision
(5.3 mya – 2.6 mya)



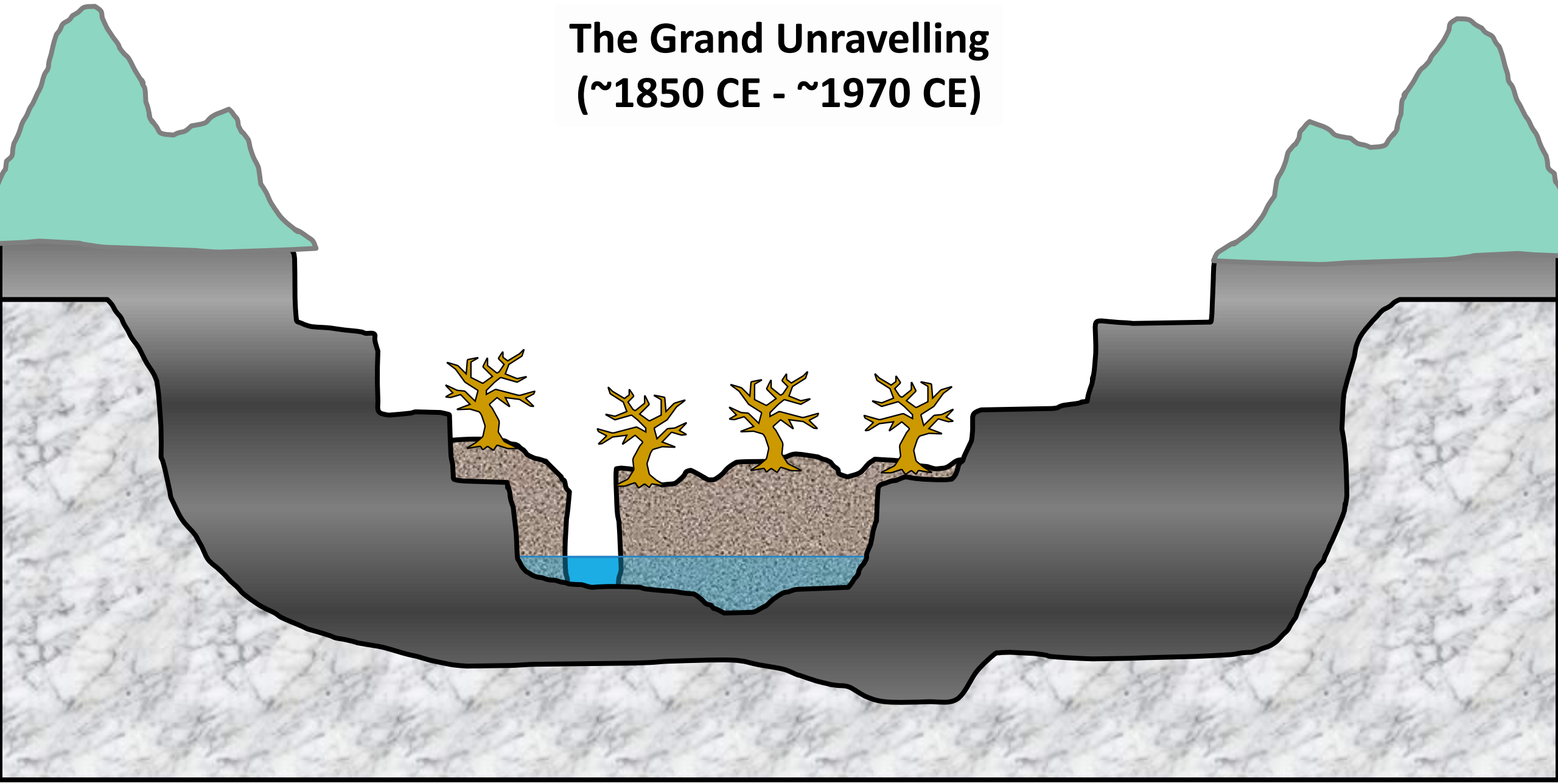
Pleistocene Glaciers and Floods
(2.6 mya – 11.7 kya)



Holocene Fluvial Processes
(11.7 kya - ~1850 CE)



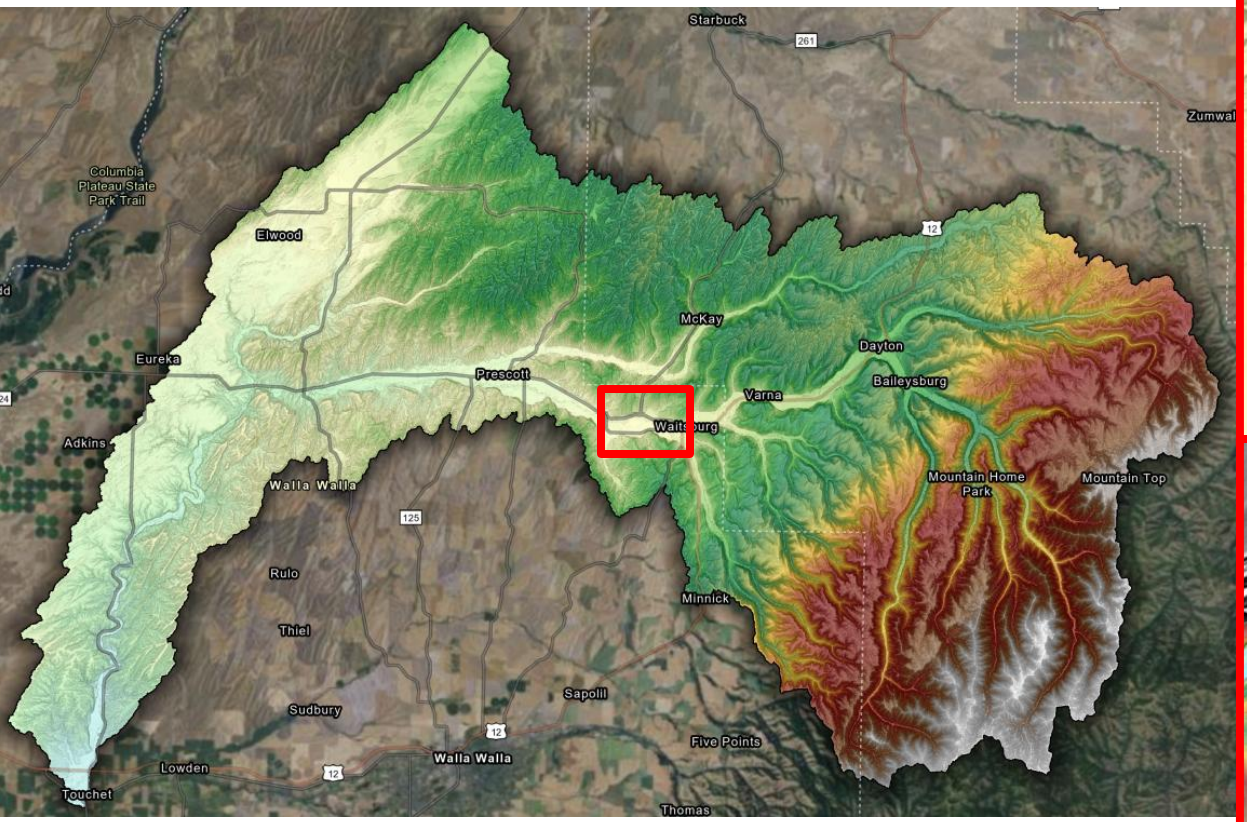
The Grand Unravelling
(~1850 CE - ~1970 CE)

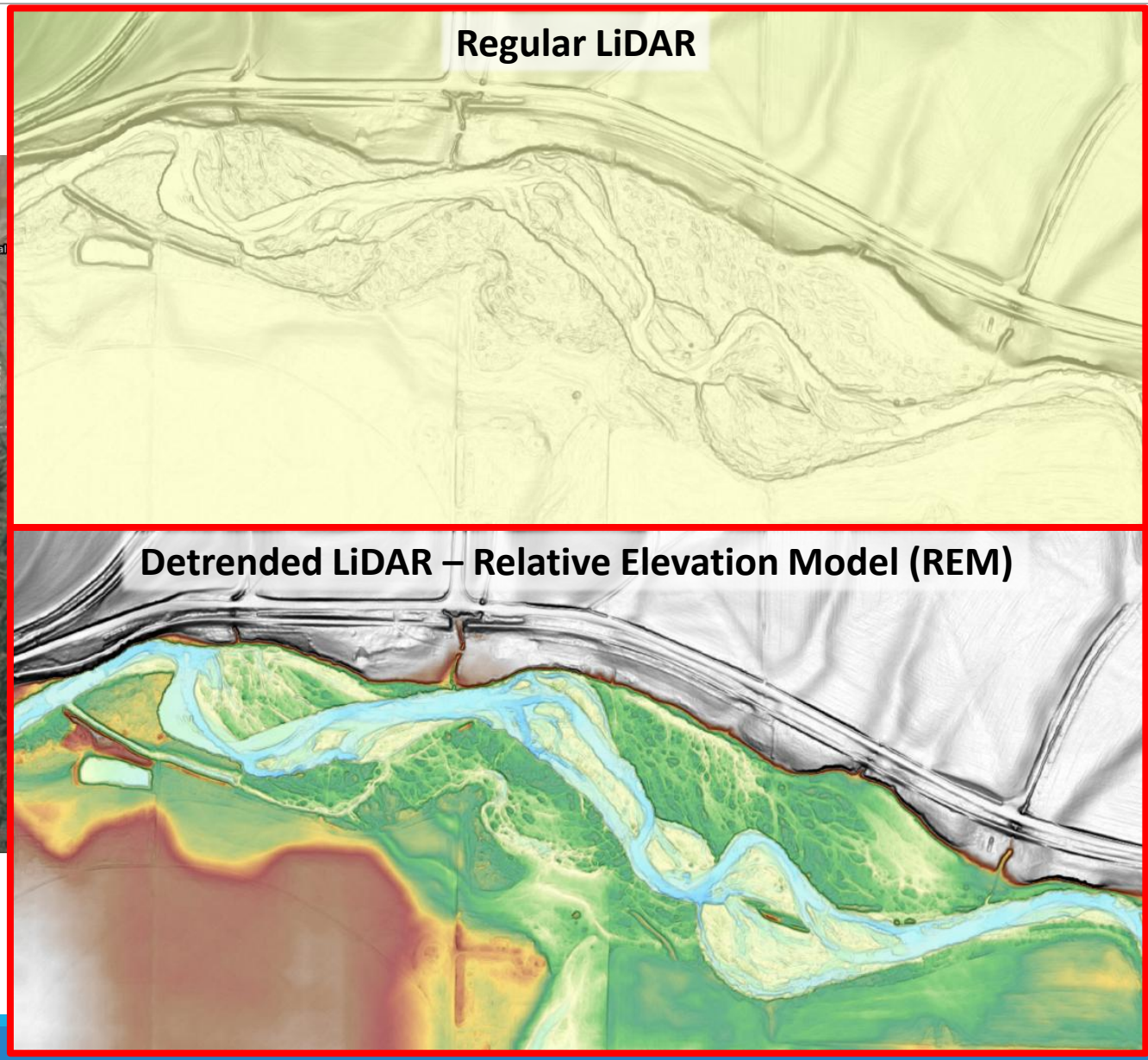


Uncovering Lost Rivers with an REM

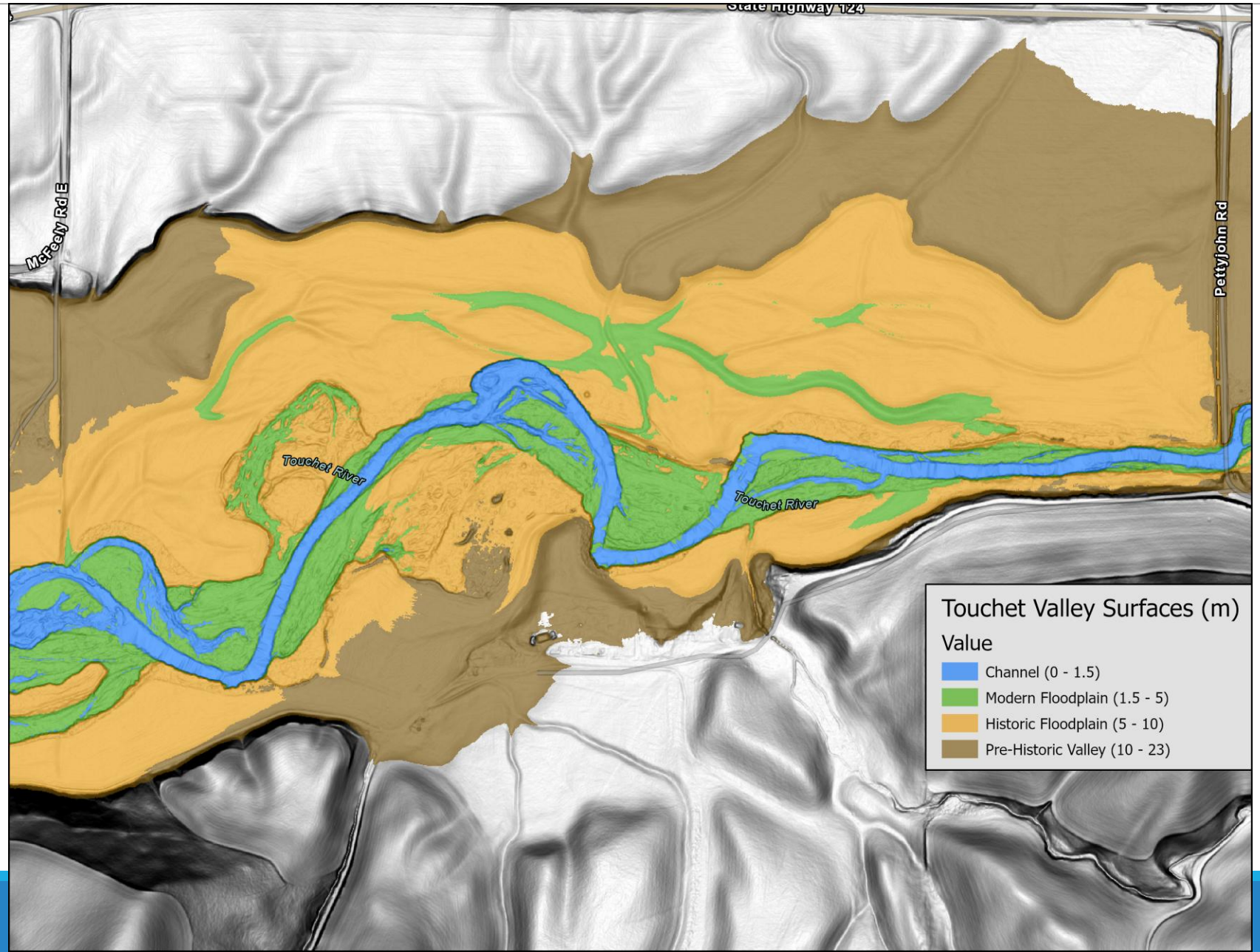
Case Study: Touchet River Reconstruction

- LiDAR = Continuous elevation data

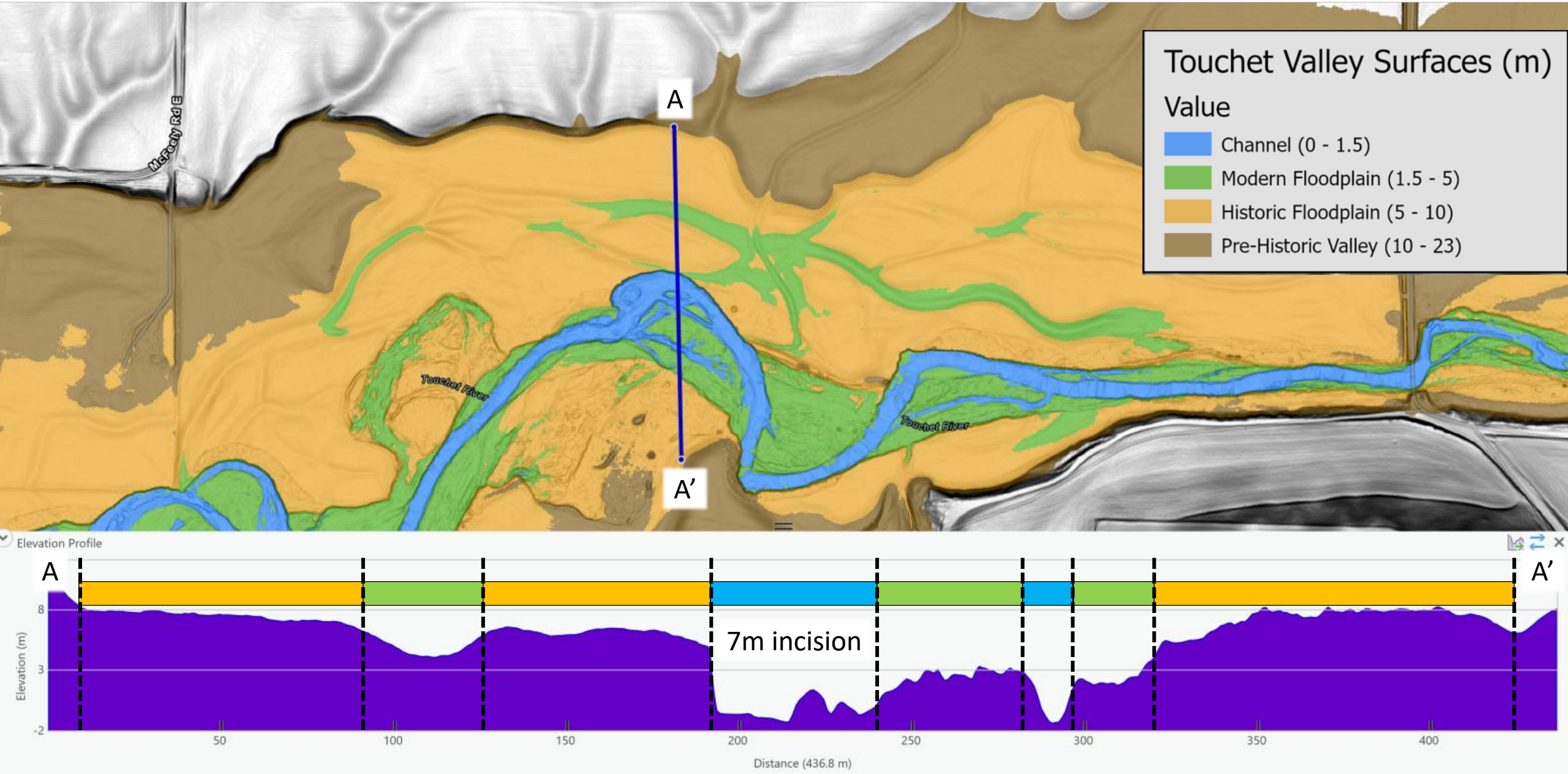




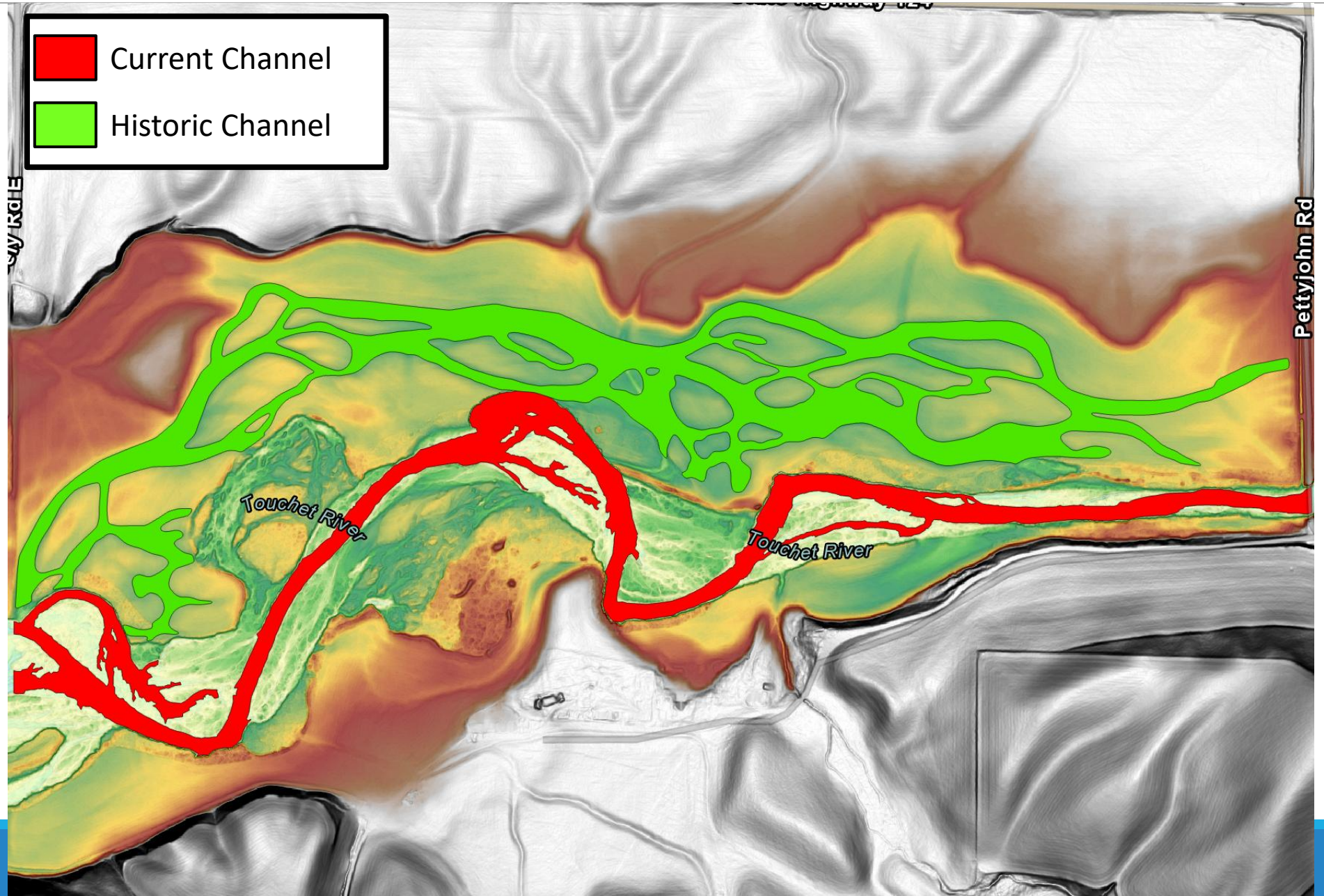
Case Study: Touchet River Fluvial Autopsy



Case Study: Touchet River Fluvial Autopsy



Case Study: Touchet River Reconstruction



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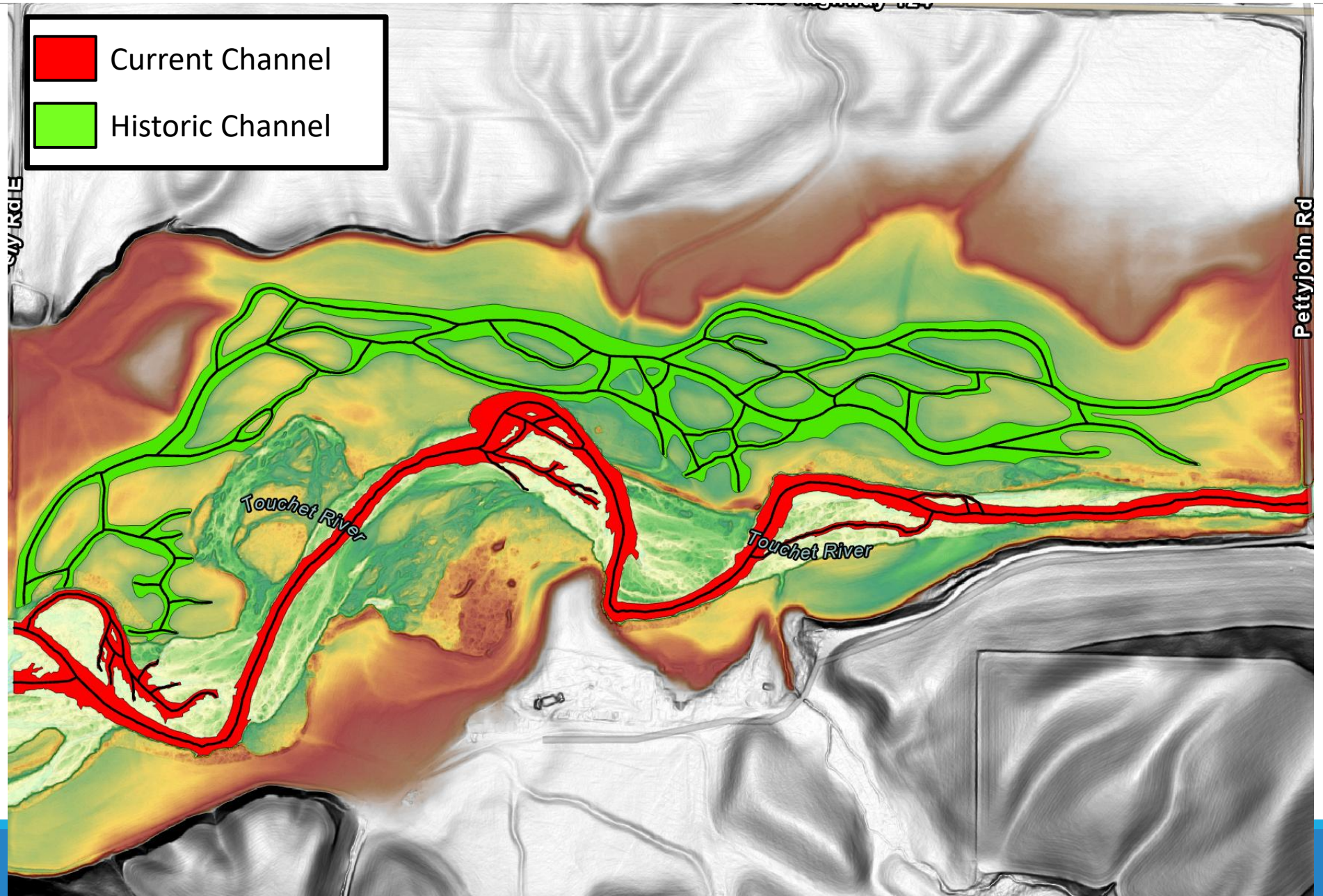

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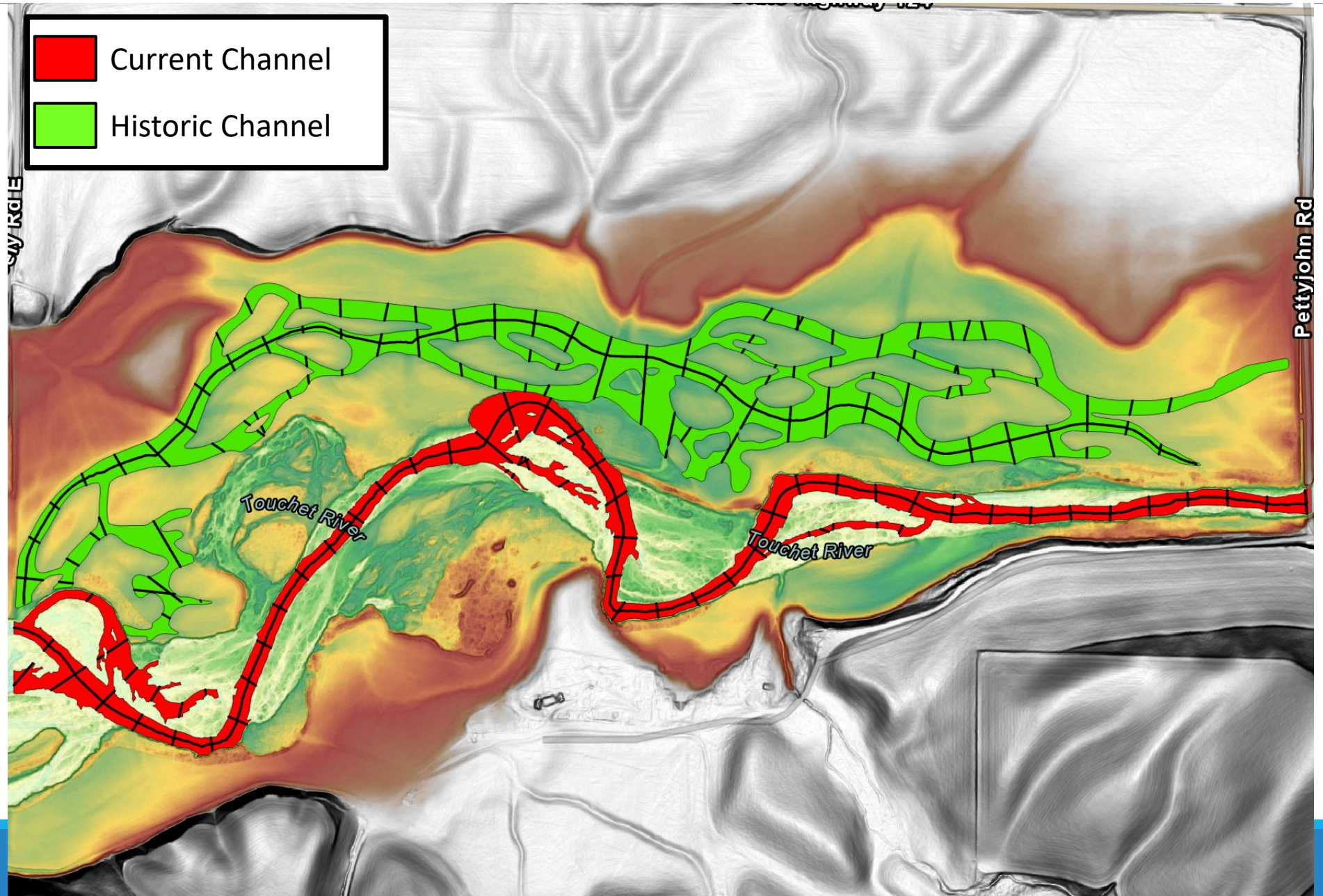
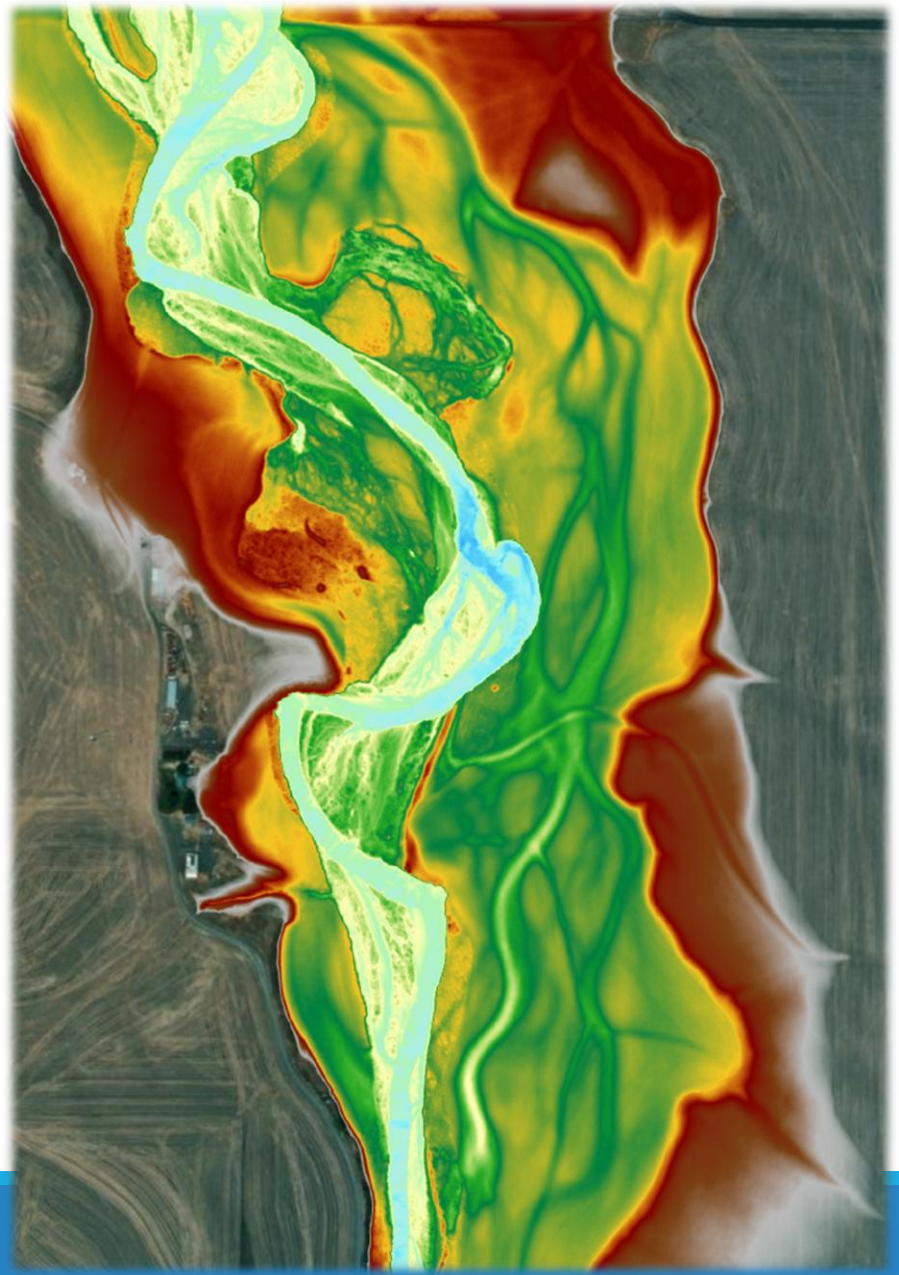


Case Study: Touchet River Reconstruction

Target Acquired!

Metric	Historic	Current
Total Channel Length (m)	6433	3791
Total Channel Area (acres)	26.3	16.1
Total Mainstem Length (m)	1732	2202
Total Secondary Channel Length (m)	4701	1589
Mainstem Sinuosity	1.17	1.36
River Complexity Index (RCI)	3.33	1.42
Mean Width (m)	67.5	31.2
Min Width (m)	31.2	16.8
Max Width (m)	118.3	91.5



Case Study: Touchet River Reconstruction

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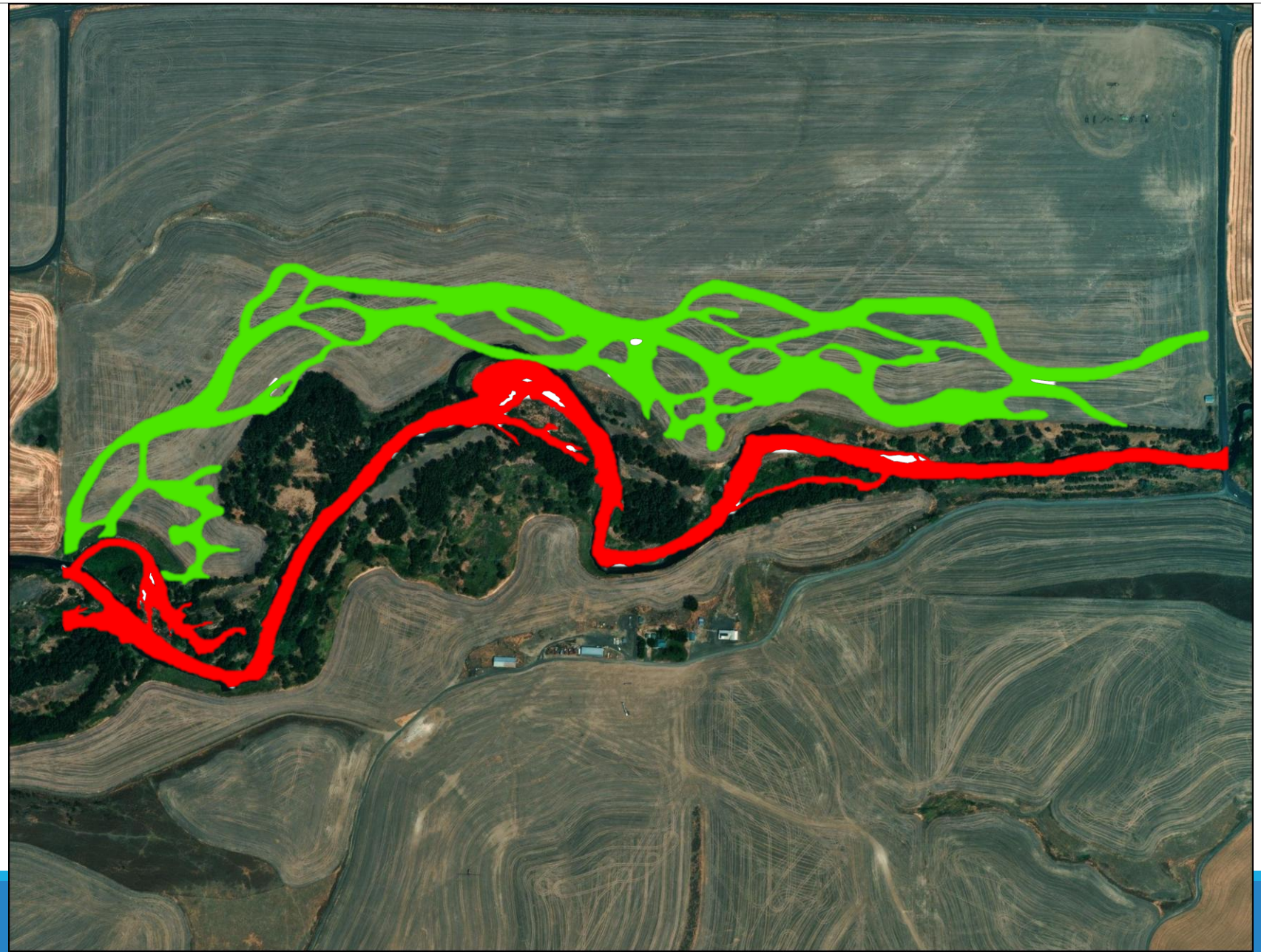


Case Study: Touchet River Reconstruction

Case Study: Touchet River Reconstruction

Case Study: Touchet River Reconstruction

"the branch forked in several places"

"more timber than usual on this creek"

"a great many beaver signs on this branch"

"much appearance of beaver and otter"

"it is deep and has a bold current"

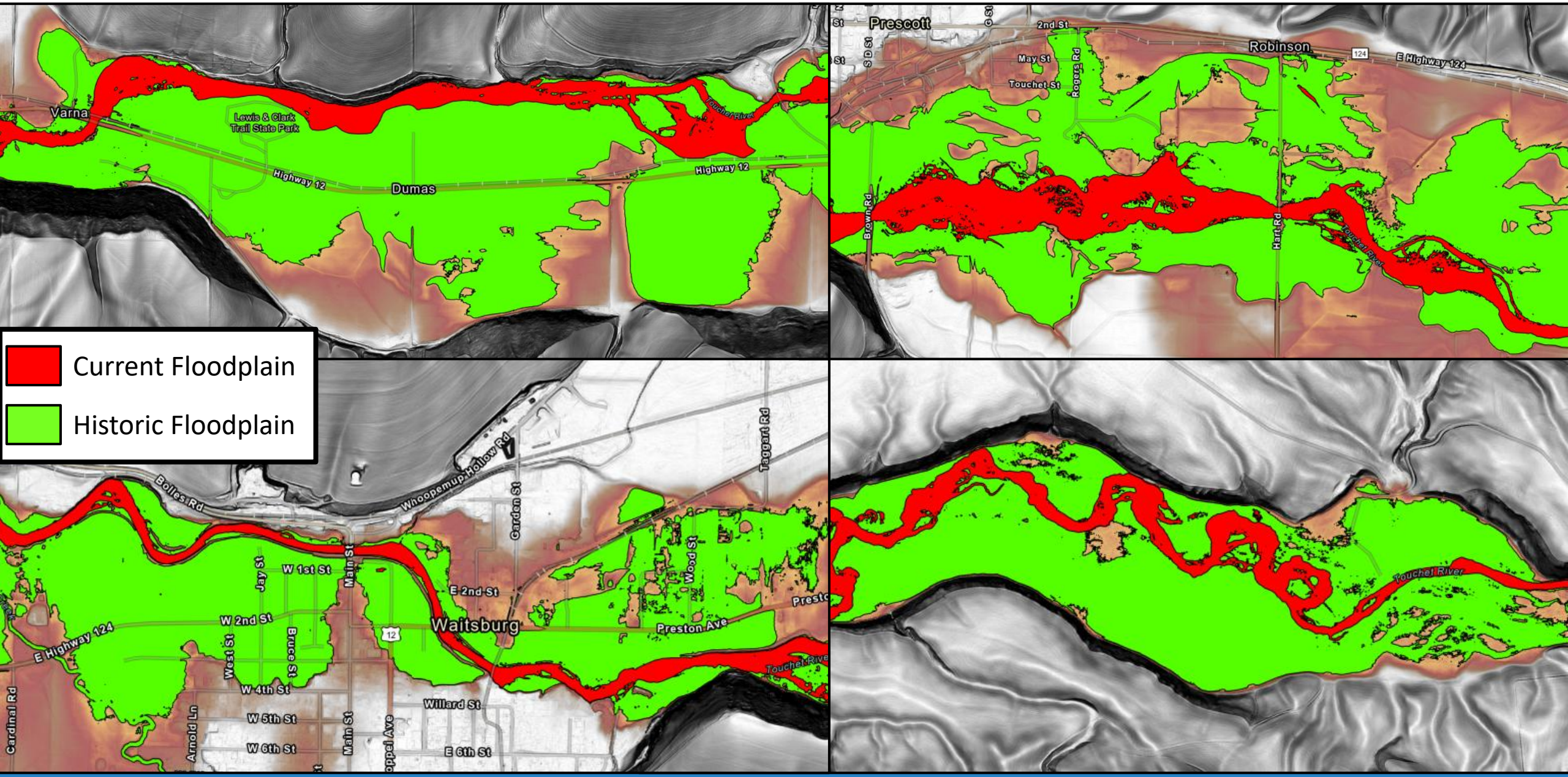
"the bottom of this creek is very fertile"

"at least 20 fold more [timber] than on the Columbia River"

"[The valley bottom] consists of:

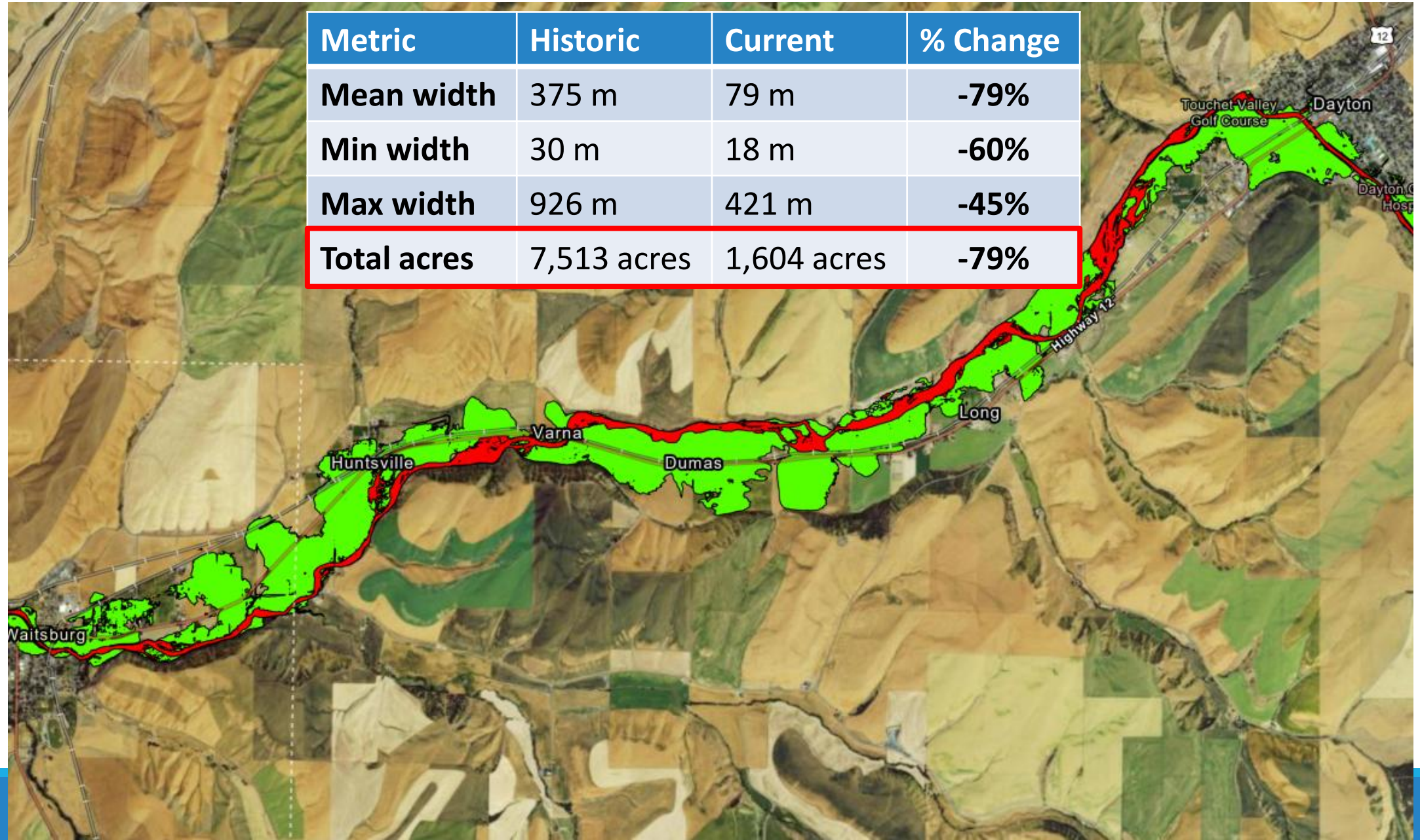
- Cottonwood
- Birch
- Crimson haw
- Red-willow
- Sweetwillow
- Chokecherry
- Yellow currants
- Gooseberry
- White-berried honeysuckle
- Rose bushes
- Seven bark
- Shoemate
- Corngrass
- Rushes"

Case Study: Touchet River Floodplain



Case Study: Touchet River Floodplain

Metric	Historic	Current	% Change
Mean width	375 m	79 m	**-79%**
Min width	30 m	18 m	**-60%**
Max width	926 m	421 m	**-45%**
Total acres	7,513 acres	1,604 acres	**-79%**

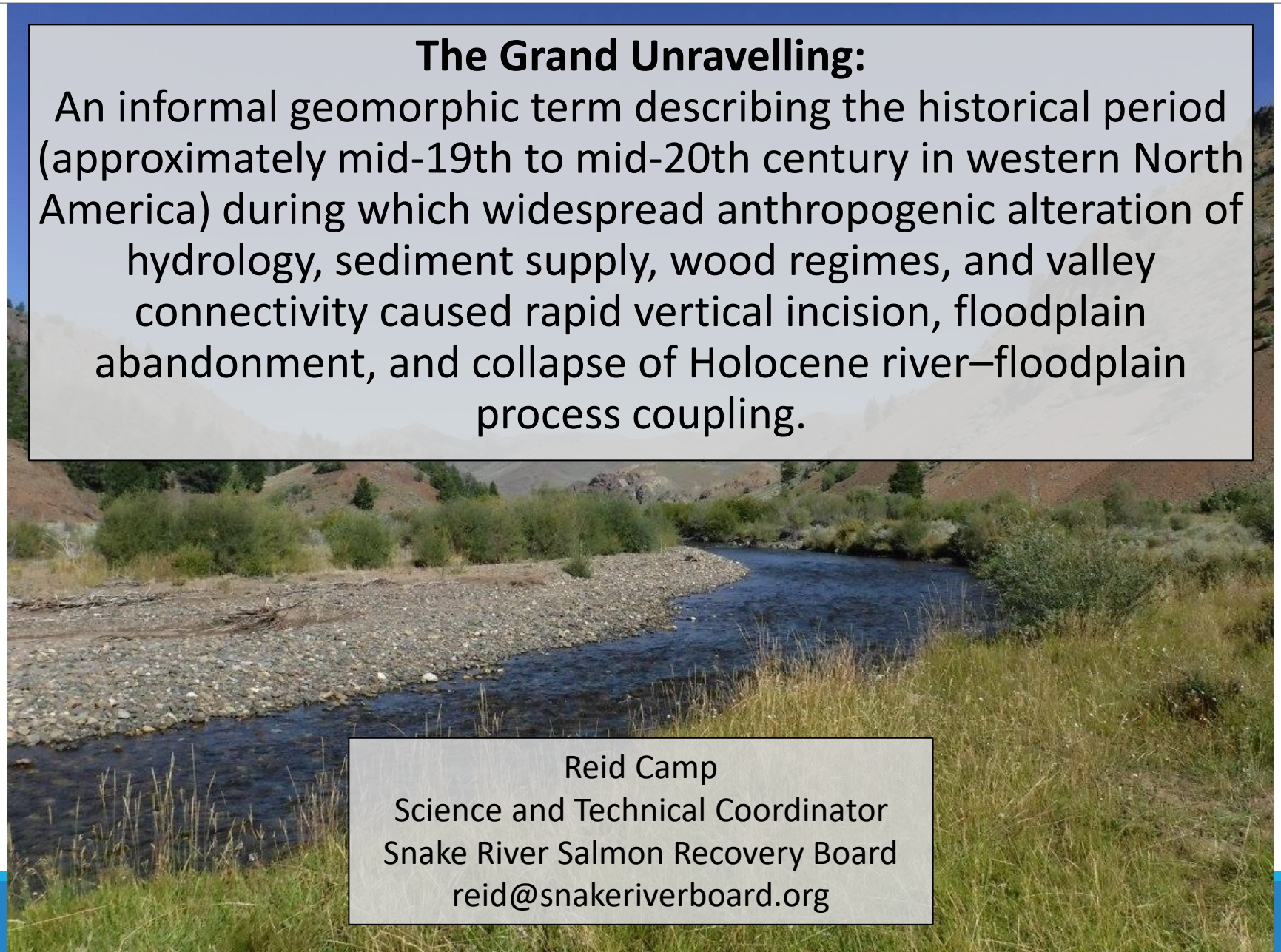


What's the point?

- The goal of "restoration" is to return to a previous condition
- Recreate site-specific concepts using local evidence instead of reference sites
- Directly quantify restoration goals and target conditions
- **The Grand Unravelling:** Acknowledge the tremendous loss of alluvium, water storage, and habitat
- Document how far we must go to achieve true restoration (i.e., "to move the needle")

Thank you!

The Grand Unravelling:
An informal geomorphic term describing the historical period (approximately mid-19th to mid-20th century in western North America) during which widespread anthropogenic alteration of hydrology, sediment supply, wood regimes, and valley connectivity caused rapid vertical incision, floodplain abandonment, and collapse of Holocene river–floodplain process coupling.



Reid Camp
Science and Technical Coordinator
Snake River Salmon Recovery Board
reid@snakeriverboard.org