

Planning for Process-Based Restoration in Your Watershed

Presented By:

Michael Blazewicz



&

Chelsey Heiden



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Outline

1. Opportunity Evaluation
 - Desktop
 - On-Site
2. Site Specific Goals and Objectives
3. Evaluation and Concept Design
4. Other Limitations and Considerations
5. Construction Ready
6. Monitoring Strategies
7. Adaptive Management
8. Timeline for Key Tasks



The background image is a composite of three scenes. On the left, a river flows through a valley with rolling hills under a cloudy sky. In the center, a person in a blue hoodie and backpack stands in a grassy field, looking towards the right. On the right, a person wearing a wide-brimmed hat and a light-colored shirt sits on a rocky bank, looking at a tablet or map. A large, semi-transparent teal rectangle is overlaid on the center of the image, containing the title text.

Opportunity Evaluation & Concept Design



Further Focusing Restoration Opportunities:

What might you want to know?

Example Questions:

- What was the likely state of the site prior to European occupation?
- What is the condition today and what future possible trajectories might it have?
- Can it self-heal on an acceptable timeline? Is restoration possible? Or perhaps rehabilitation? Or only remediation?
- Would a project be aligned with goals/needs and is it the most effective way to achieve desired outcomes?
- What timescales, costs, expertise and effort might be involved? (e.g., fencing vs. dam removal)

HOW STREAMS WERE → HOW (MANY) STREAMS ARE



7.5 million years ago

Fire/Flood/Flood/Flood/Fire/Flood/Fire/Flood/Flood/Flood/Fire/Flood/Flood/Flood/Flood/Fire/Flood/Flood/Flood/Flood/Fire/Flood

Modern beavers
(*Castor canadensis*) first
arrive in North America

European
fur trade Amazon
Prime

Castorocene

Anthropocene

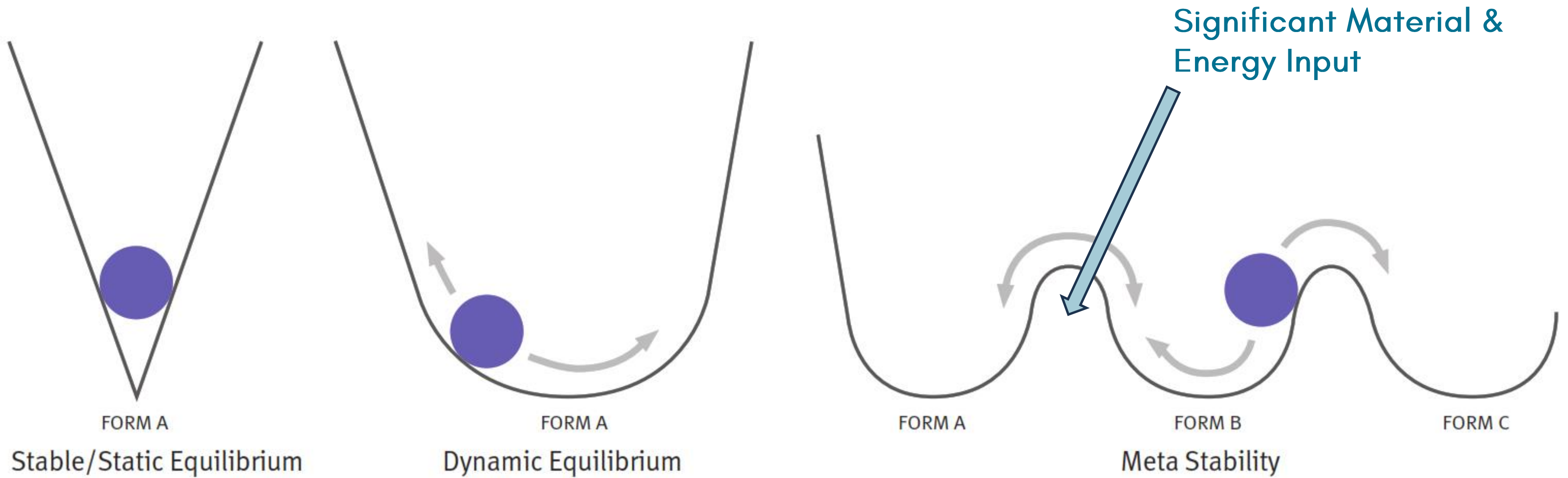
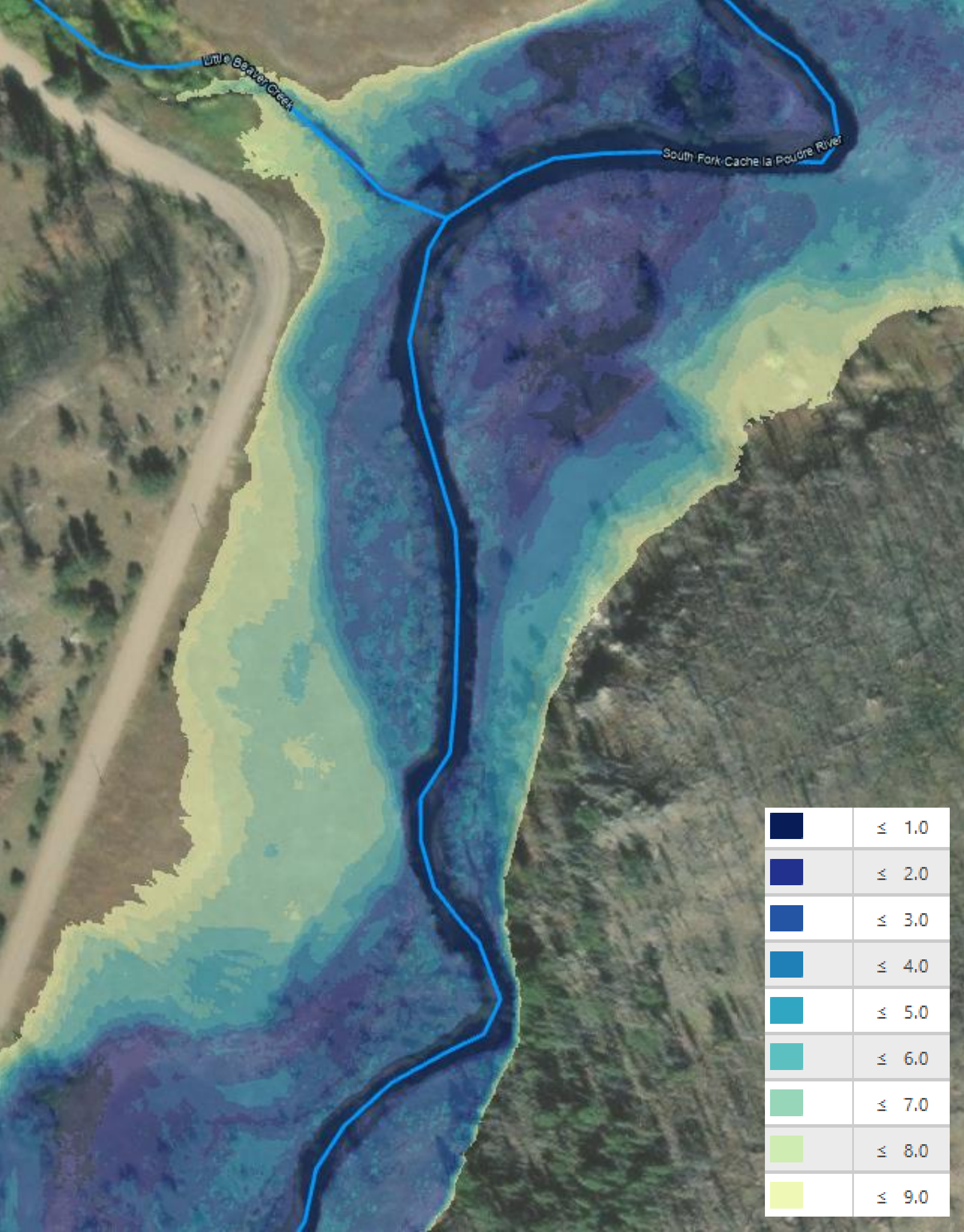


FIGURE 2-4: *Diagram of the varying conceptual models of stability and equilibrium in stream systems.*



Field Preparation: Before You Go

- Historical photos
- Relative Elevation Model
- Geomorphic Grade Line
- Mapped floodplains
- Surficial geology
- Infrastructure
- Land ownership/boundaries

2- Condition Modifiers/Stressors

Natural Factors		Human Factors	
Debris flows	▼	Urban corridor	▼
Recent burnscars	▼	Urbanized watershed	▼
Forest disease	▼	Undersized crossings	▼
Confluence	▼	Altered hydrology	▼
Mobile wood	▼	Off-channel ponds	▼
Ice jams	▼	Fill and development	▼
Active beavers	▼	Diversion structures	▼
Debris jams	▼	Certified levees	▼
Headwaters	▼	Roads/railroads	▼
Avalanche paths	▼	Channelization/ straightening	▼
Fans	▼	Armoring	▼
		D-ASCs	▼

Assessment and interpretation

3- Active River Corridor - Fluvial Signatures

Meander cutoffs	▼	Meander scrolls	▼
Active migration	▼	Side channels	▼
Abandoned channels	▼	Abandoned terraces	▼
Flood chutes	▼	Avulsion zones	▼
Fans in corridor	▼	Avulsion elevation	▼
Fan type	▼	ASC type	▼
Blocking potential	▼		

Notes

Field Preparation: Before You Go (cont.)

- Evidence of fluvial processes?
- Sediment supply?
- Biological inputs and/or connected communities?
- Existing/potential stressors?

Field Assessment

Opportunity:

- Evaluate active processes (planform, widening, incision, aggradation)
- Consider bed and bank materials.
- Sediment mobility and supply?
- Landowner operations.
- Upstream and downstream impacts?
- Confirm remote sensing.
- Concept designing – don't get too attached! Ask the outlandish!



Access?

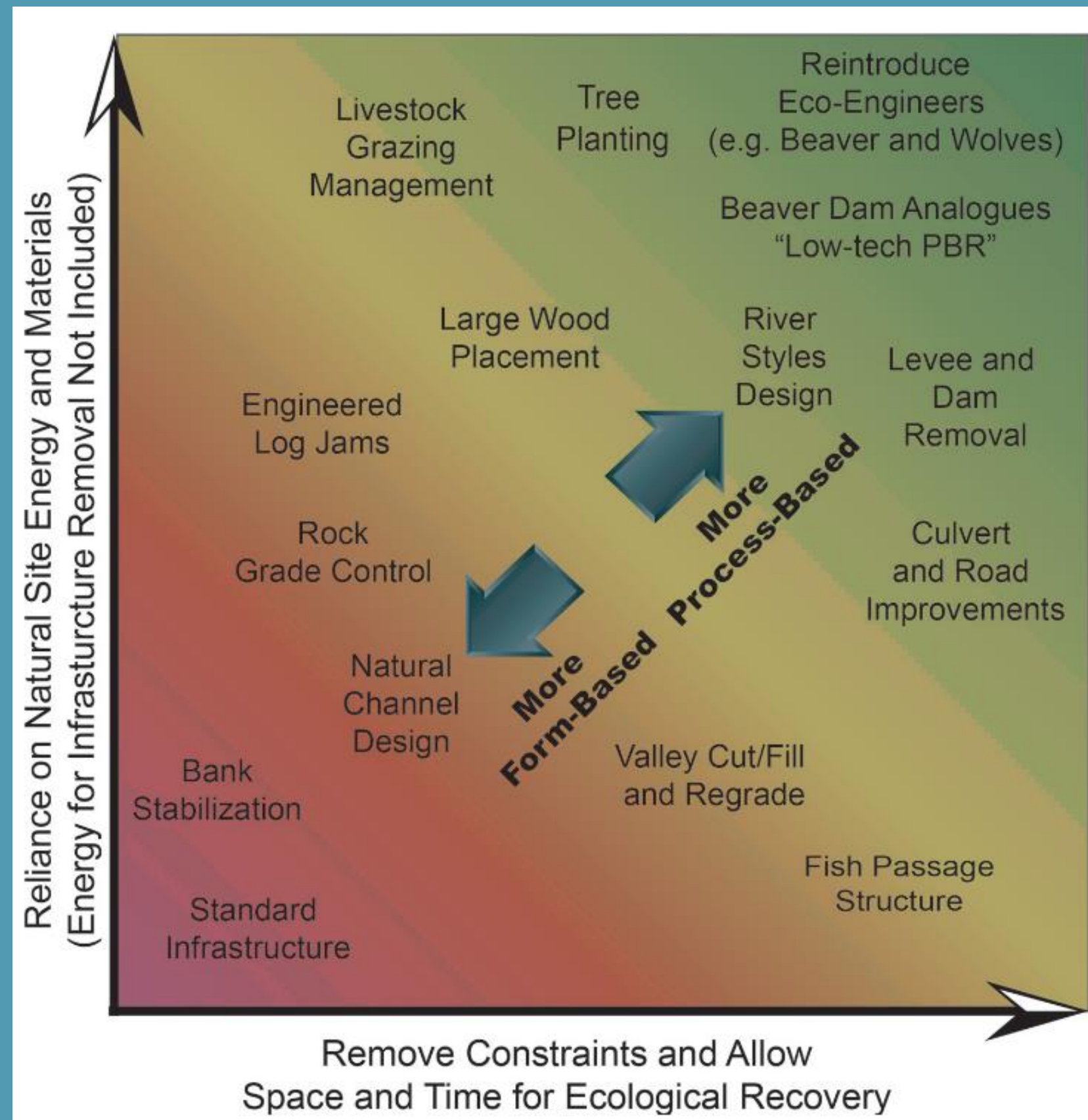
- Hike-in/Remote
- OHV or Standard Vehicles
- Machinery (size & sensitivity)
- Hauling Routes
- Staging Locations

Availability of Materials?

- What materials are appropriate for the project site?
- What materials are available on-site or adjacent to use?
- If none, then are they available within a reasonable distance for import?
- How does that affect your design and decision making? (technical aspects, timing, high or low tech, etc.)



Is PBR Even Right for Me?



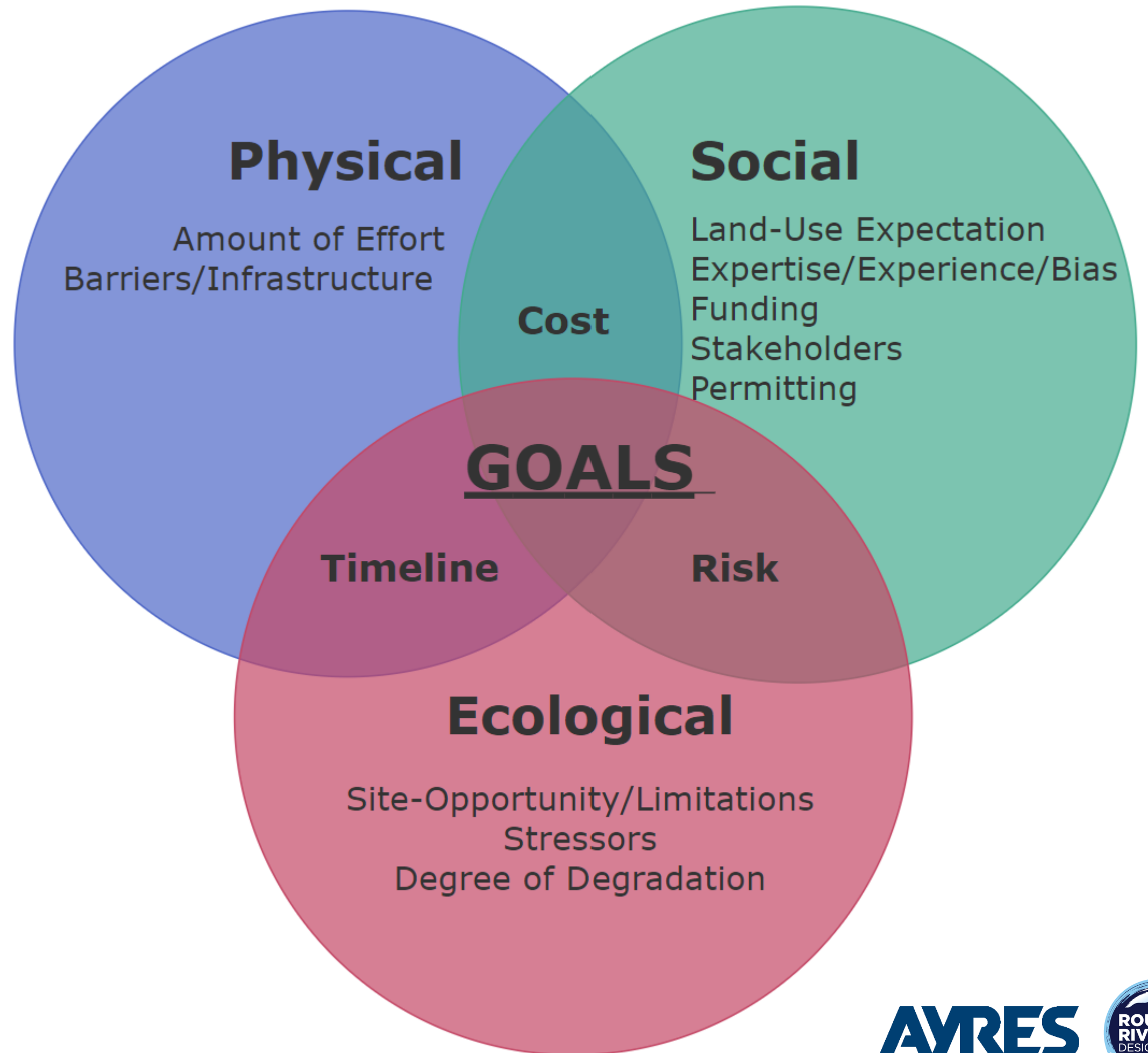
Conceptual diagram evaluating the relative potential for river management actions to meet process-based restoration objectives. Process based actions are those that rely on energy and materials of the site and that achieve high levels of connectivity and allow for sufficient time and space for natural processes to restructure and recover habitat complexity.

Ciotti, et al., 2021. https://www.fs.usda.gov/psw/publications/pope/psw_2021_pope002_ciotti.pdf

What are Your Site Specific Goals and Objectives?

Goal Setting

Setting the vision for the future desired outcome.



Support Project Goals with "SMART" Objectives

S	Specific: The goal must be very specific and grounded in something that's significant to you.
M	Measurable: The goal must have some sort of measurement (days, pounds, miles, etc.).
A	Achievable: The goal must be realistic and reasonable.
R	Relevant: The goal must relate to what you're hoping to accomplish.
T	Time-bound: The goal must have a timeframe and that timeframe must be reasonable.

Very Vague

Very Specific



- Stop erosion
- Stabilize channel
- Reduce floods
- Increase groundwater recharge
- Bed-grain distribution

Which Type of PBR?

EXAMPLES OF TREATMENTS (NOTING OVERLAP ACROSS RESTORATION APPROACH):

PASSIVE RECOVERY (P)

Eliminate grazing (P)

Fence out grazing (P)

Remove invasive weed species (P)

Gravel augmentation (P, LT)

ACTIVE RECOVERY

LOW-TECH (LT)

Leaky beaver dam features (LT)

Wood structures—e.g., BDAs, PALs (LT)

Wood placement without anchoring (LT)

Floodplain reconnection (LT, HT)

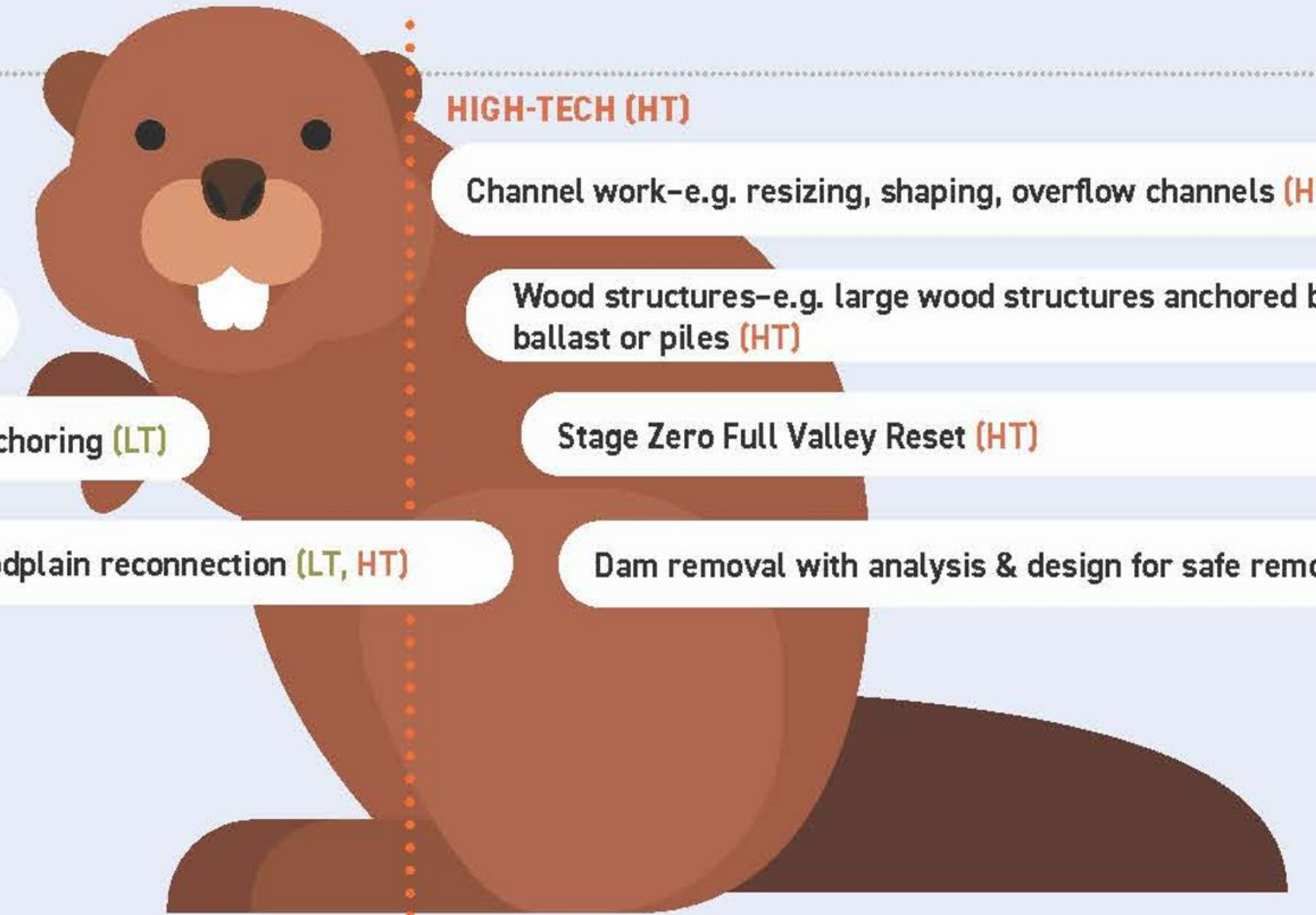
HIGH-TECH (HT)

Channel work—e.g. resizing, shaping, overflow channels (HT)

Wood structures—e.g. large wood structures anchored by ballast or piles (HT)

Stage Zero Full Valley Reset (HT)

Dam removal with analysis & design for safe removal (HT)



Labor-Tech?

Is the location appropriate for hand-built structures?

- Low stream-power (maybe that's the "low" in low-tech) e.g., low slope, low volume.
- Sediment supply (to naturally aggrade structures and channel).
- Too remote or sensitive for machinery (wilderness)
- Does the landowner want to grant access to XX volunteers tramping all over their property?

Do you have?

- A design that calls for materials that can be handled by humans?
- An abundance of volunteer labor and time to train them, care for them, coddle them? OR;
- An available skilled crew to contract?



Machine-Tech?

Does the location or the work necessitate light/heavy machinery?

- High stream power requiring more robust "resistance" to flow
- Private land with already available equipment and/or easy access?
- One-shot access?
- Grading to remove berms or open floodplain channels?

Do you have?

- A design that calls for materials that can not be handled by humans?
- A site that is resilient to appropriate machinery?
- A short timeline and lack of available labor?



Don't Let
"Perfection"
Be the Enemy of
Good!



Tree/slash layer.



As-built looking downstream.

Don't Let "Restoration" Blind You

- PROTECT functioning corridors and processes.
- RECONNECT floodplains and process-drivers (e.g., large wood, sediment, flow, beaver).
- RESTORE degraded sections of river.



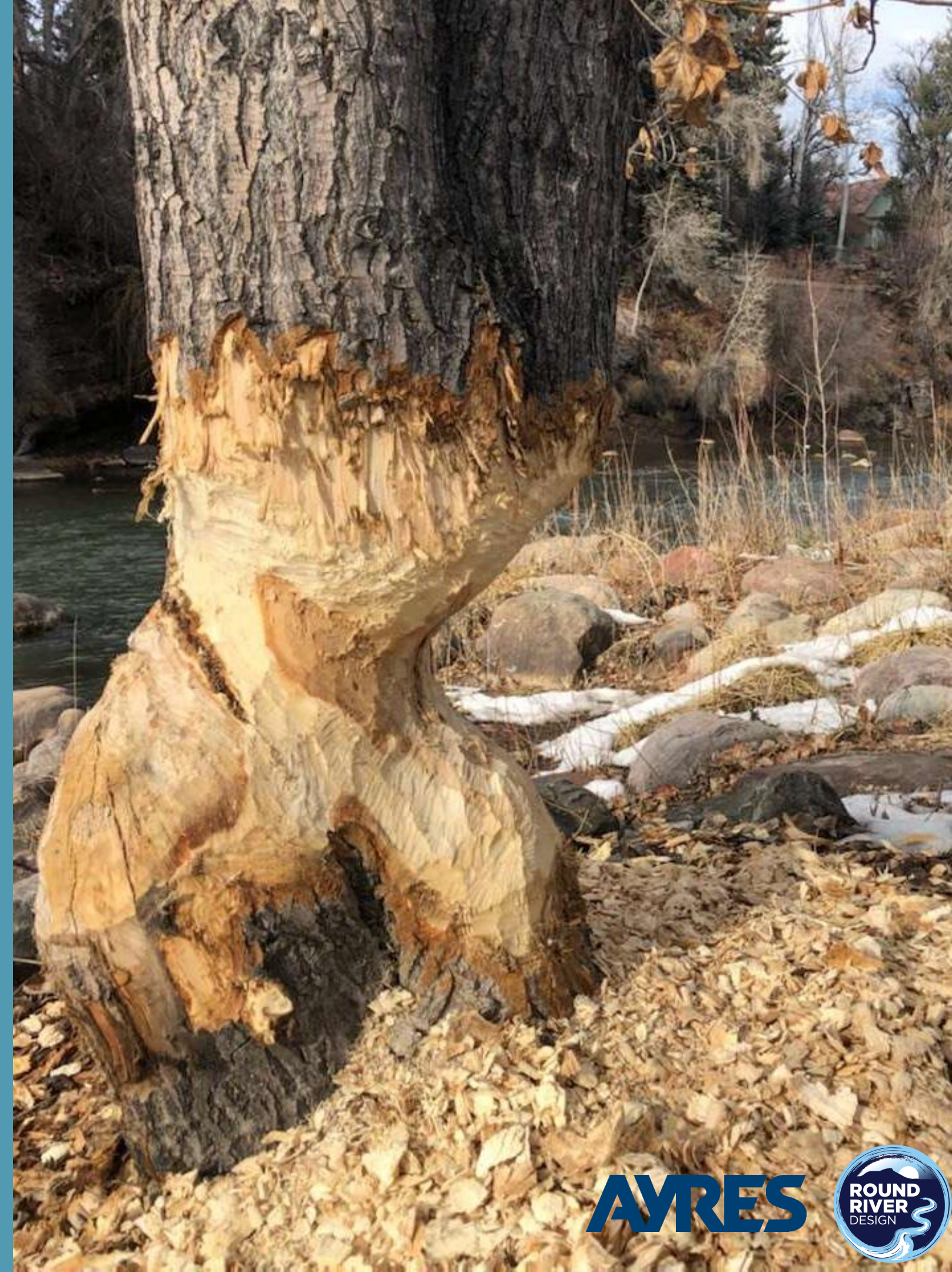
Limitations and Considerations

The less fun part of PBR

Up/Downstream Considerations

Will features impact nearby:

- Recreational Users
 - Boaters
 - Fisher-people
 - Campers (aka wood thieves)
- Infrastructure
 - Roads and Crossings
 - Utilities (overhead/underground)
 - Wells
 - Ranch Access/Operations
- Structures and homes
- Nearby non “beaver believers”



SB23-270

Projects To Restore Natural Stream Systems

Concerning activities that restore the environmental health of natural stream systems without administration.

SESSION: 2023 Regular Session

SUBJECT: Water

BILL SUMMARY

The act states that the following projects within a natural stream system for certain restoration purposes (stream restoration project) do not cause material injury to a vested water right and are not an unnecessary dam or other obstruction:

- A stream restoration project that is limited to certain minor restoration activities; and
- A stream restoration project that has obtained any applicable permits or is under construction or completed by August 1, 2023.

The act prohibits the owner or proponent of a stream restoration project from installing the stream restoration project in a manner that adversely affects water diversion or measurement structures without the permission of the owners of the structures.

APPROVED by Governor June 5, 2023

EFFECTIVE August 7, 2023

Water Rights

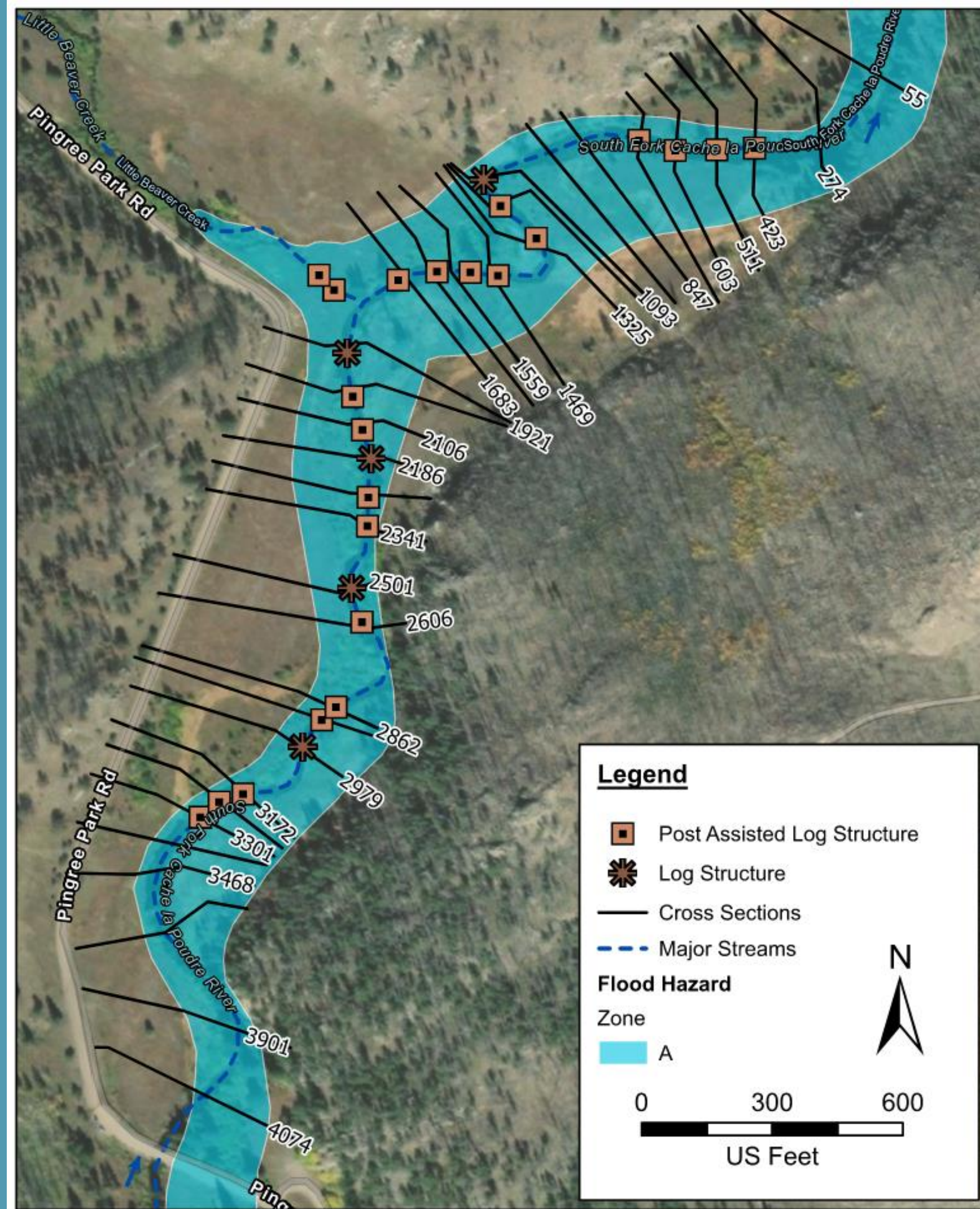
- Is your project a “Minor Stream Restoration Activity”?
- Are you working in a “Natural Stream System”?
- Do you cause a rise above the OHW mark in a perennial stream without a flood or fire?

AYRES



Permitting

- NEPA
- USACE Nationwide
- FEMA Floodplain
- USFS Wild and Scenic
- Others?

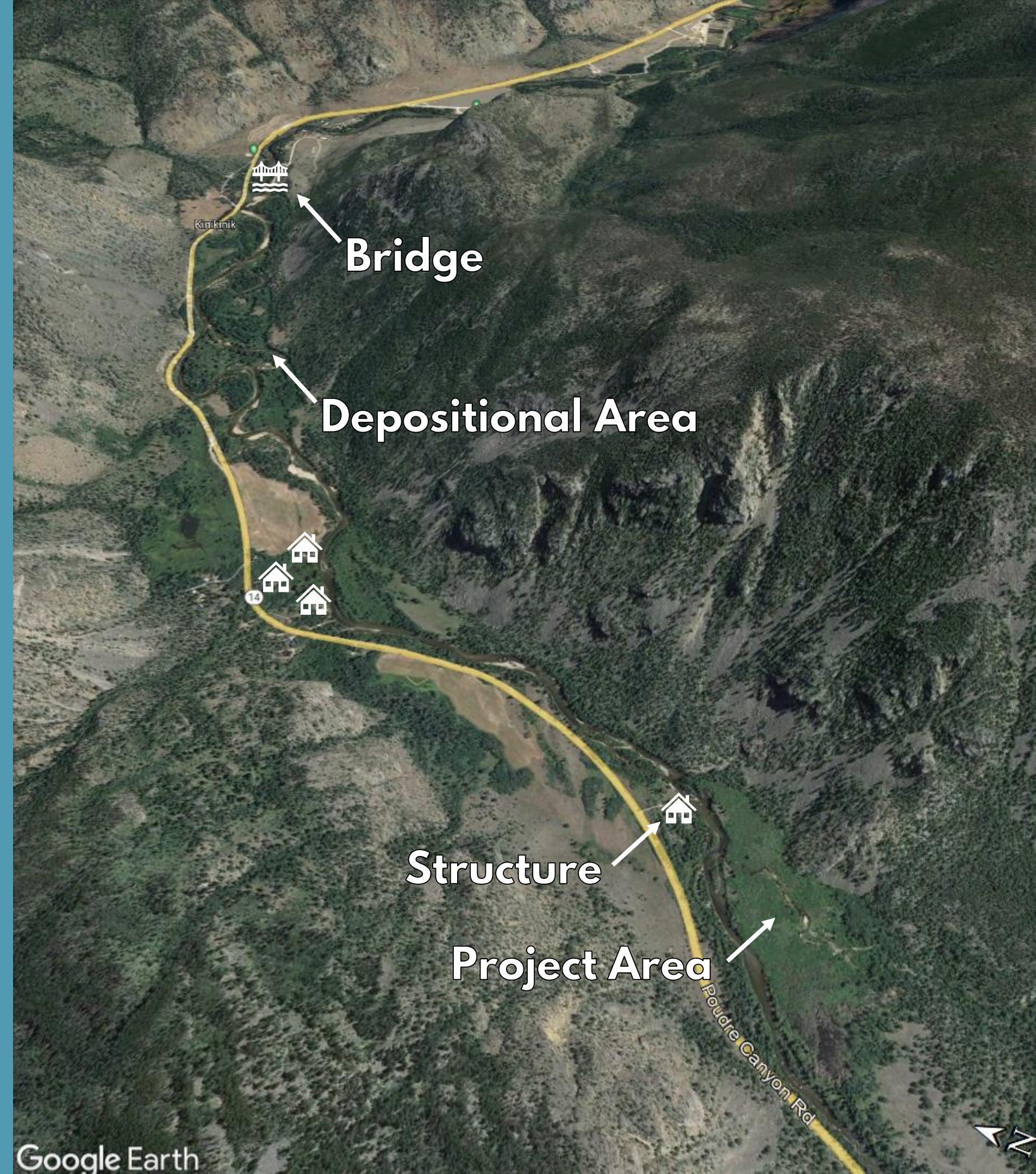


Example



Up/Downstream Impacts

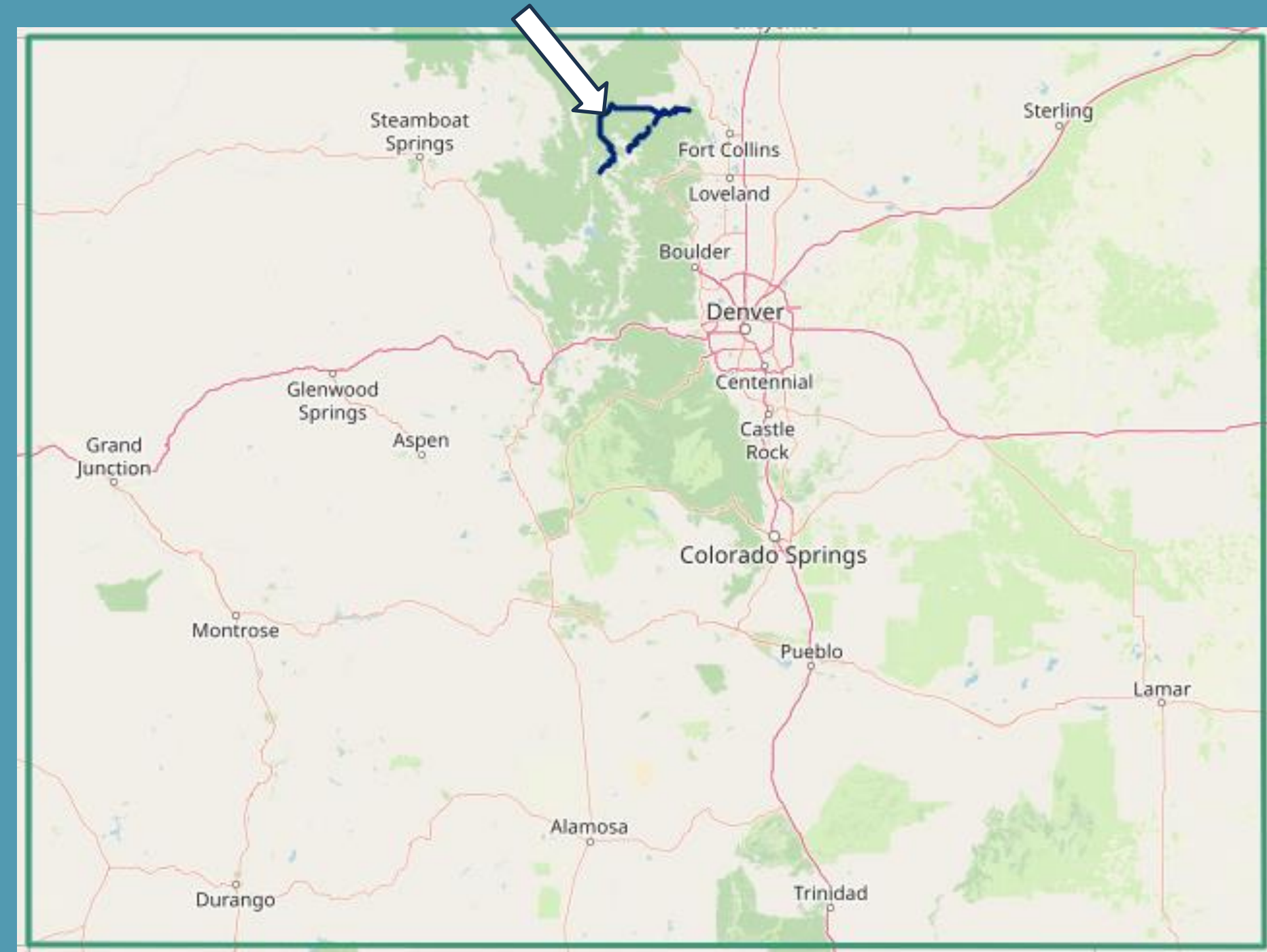
- Recreational Users – Few
- Infrastructure
 - Downstream bridge
- Structures across
- Nearby concerned “beaver believers”



Google Earth

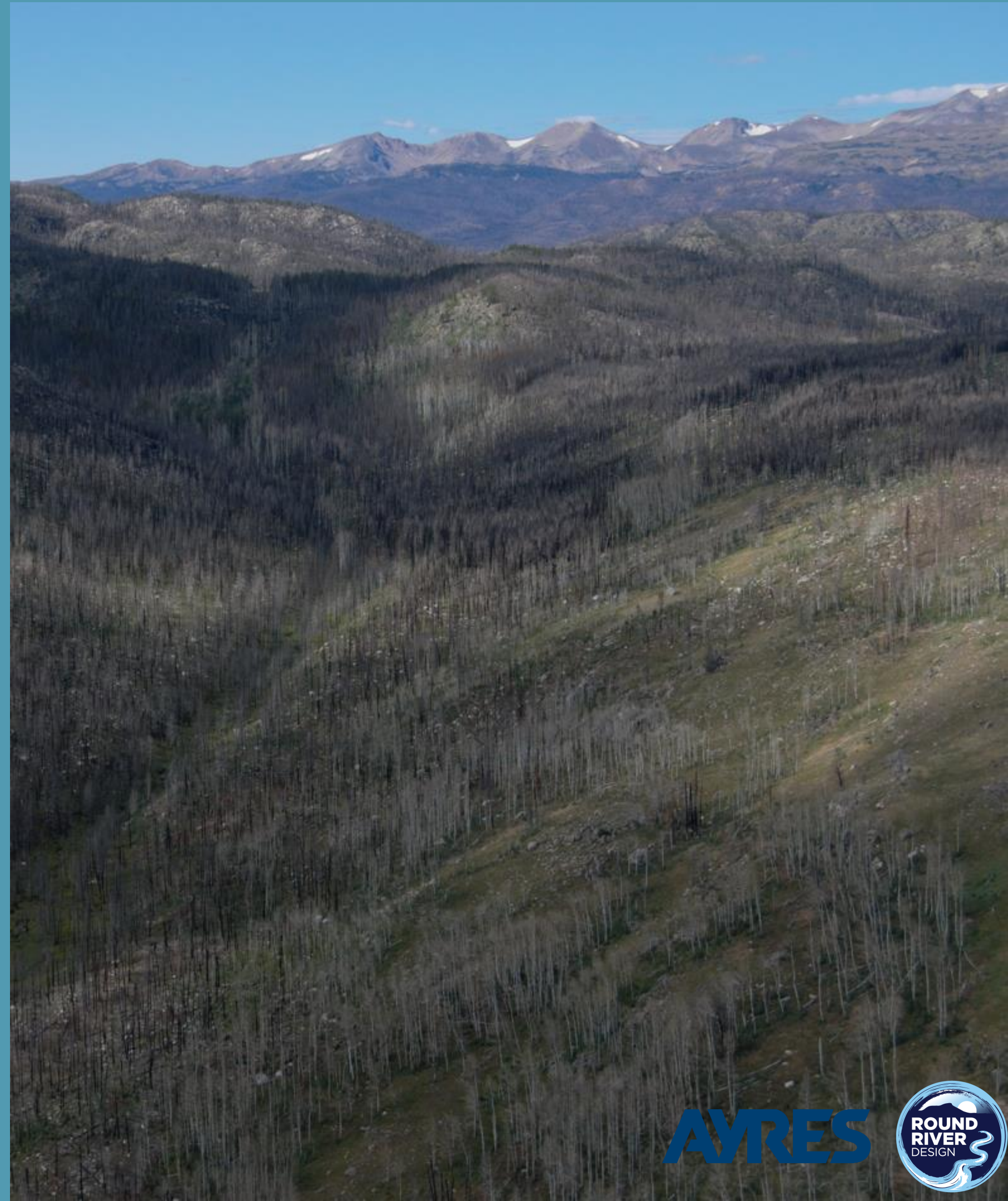
Permitting

- FEMA Floodplain Development
- USFS Section 7 Wild and Scenic
- USACE Nationwide



Water Rights

- Minor Stream Restoration Activity in a Natural System
- Planning to go above the OHW mark
- BUT post-fire!



Know when to ask for help...

AYRES





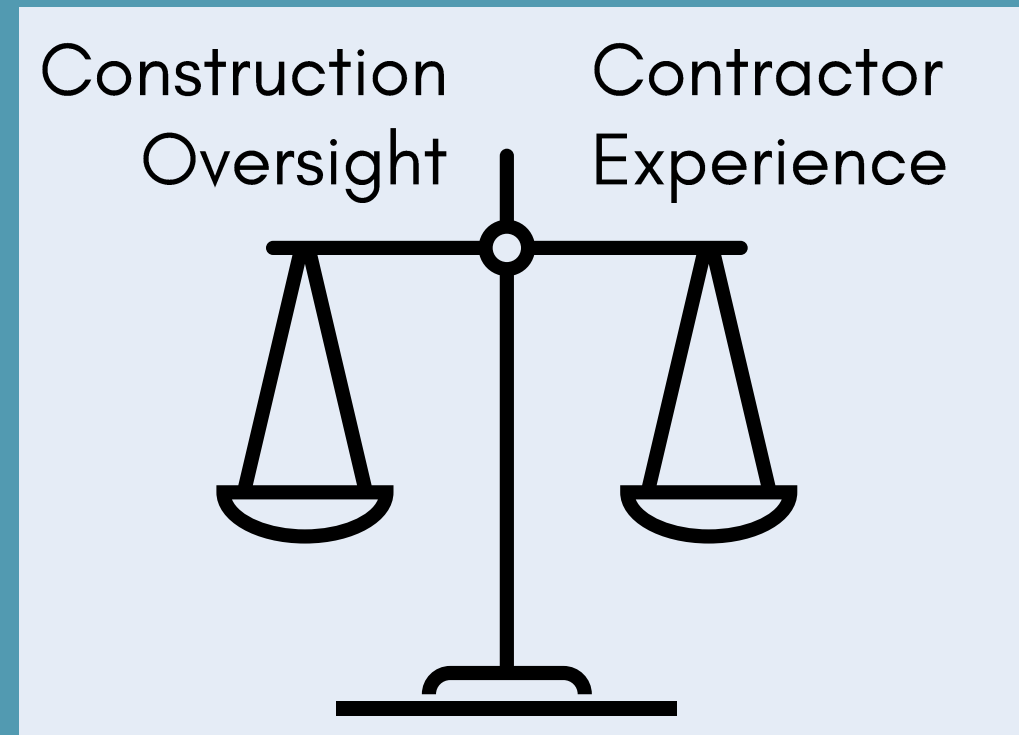
Construction Ready

Timing, Contractors, oh my...



Contractor Selection

- Volunteers vs Contractor
 - LTPBR
 - HTPBR
- Construction Oversight
 - Field Fit
 - \$\$\$



Timing

- As Soon As Possible
- Summer is likely booked by March/April

	J	F	M	A	M	J	J	A	S	O	N	D
2024	Design/Permitting	Design/Permitting	Design/Permitting	Design/Permitting	Design/Permitting	Design/Permitting	Design/Permitting	Design/Permitting	Design/Permitting	Design/Permitting	Contractor Selection	Contractor Selection
2025	Construction	Construction	Construction	Construction	Construction	Construction	Construction	Construction	Construction	Construction	Construction	Construction

Design/Permitting
Contractor Selection
Construction

From a real contractor:

We really wish people could work with us to get their contracts done by February at the latest so that we could sign our contracts and then go out on the open market and hire the extra people we need to fill those contracts.

If you want good contractors, get them on board early!

Monitoring Strategies

What's the point?

- Are you meeting your goals/objectives?
 - Improve Water Quality
 - Increase Floodplain Connectivity
 - Fish Habitat Improvement
 - Boost Ecologic Function
- Do you need to do adaptive management?
- Budget for it!
- Tell a story



Courtesy of CSU

Getting Started

- Qualitative vs Quantitative
 - Meeting grant requirements
 - “Research Grade” monitoring
- Partners
 - Universities
 - Citizen Science Programs

Monitoring Strategies

- Repeat Photo Points
- Qualitative Ecology Survey
- Game Cameras/Beaver Assessments
- Floodplain Inundation Mapping
- Repeat Drone (orthophotos)
- Repeat Lidar/DEM differencing
- Quantitative Ecology Survey
- Grain Size/Sed retention volume
- Groundwater Wells
- Stream Gaging

Min
Grant
Req

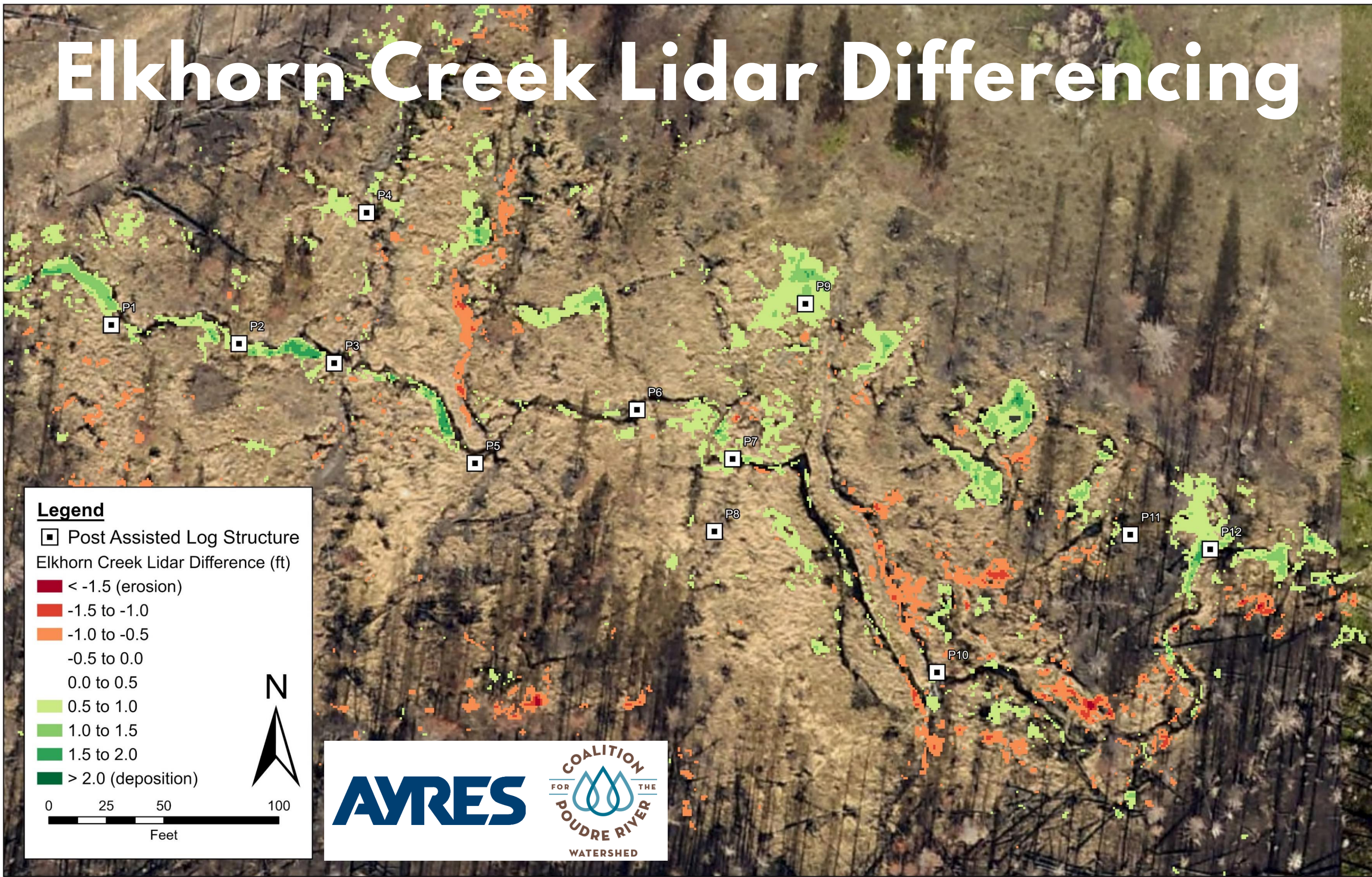
Research
Grade



AVRES



Elkhorn Creek Lidar Differencing



Legend

□ Post Assisted Log Structure

Elkhorn Creek Lidar Difference (ft)

■ < -1.5 (erosion)

■ -1.5 to -1.0

■ -1.0 to -0.5

■ -0.5 to 0.0

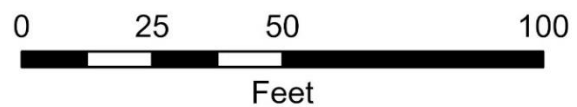
■ 0.0 to 0.5

■ 0.5 to 1.0

■ 1.0 to 1.5

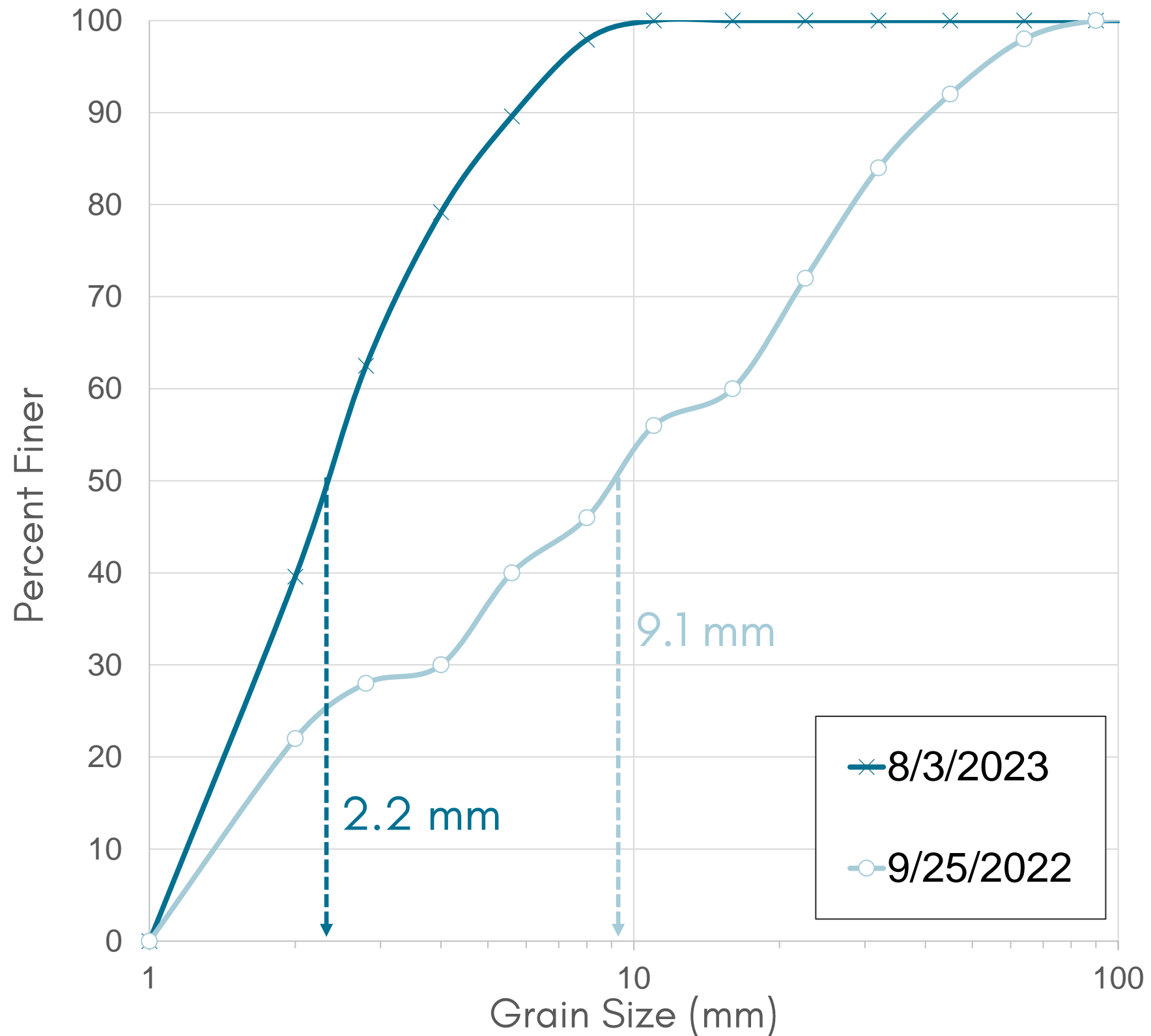
■ 1.5 to 2.0

■ > 2.0 (deposition)

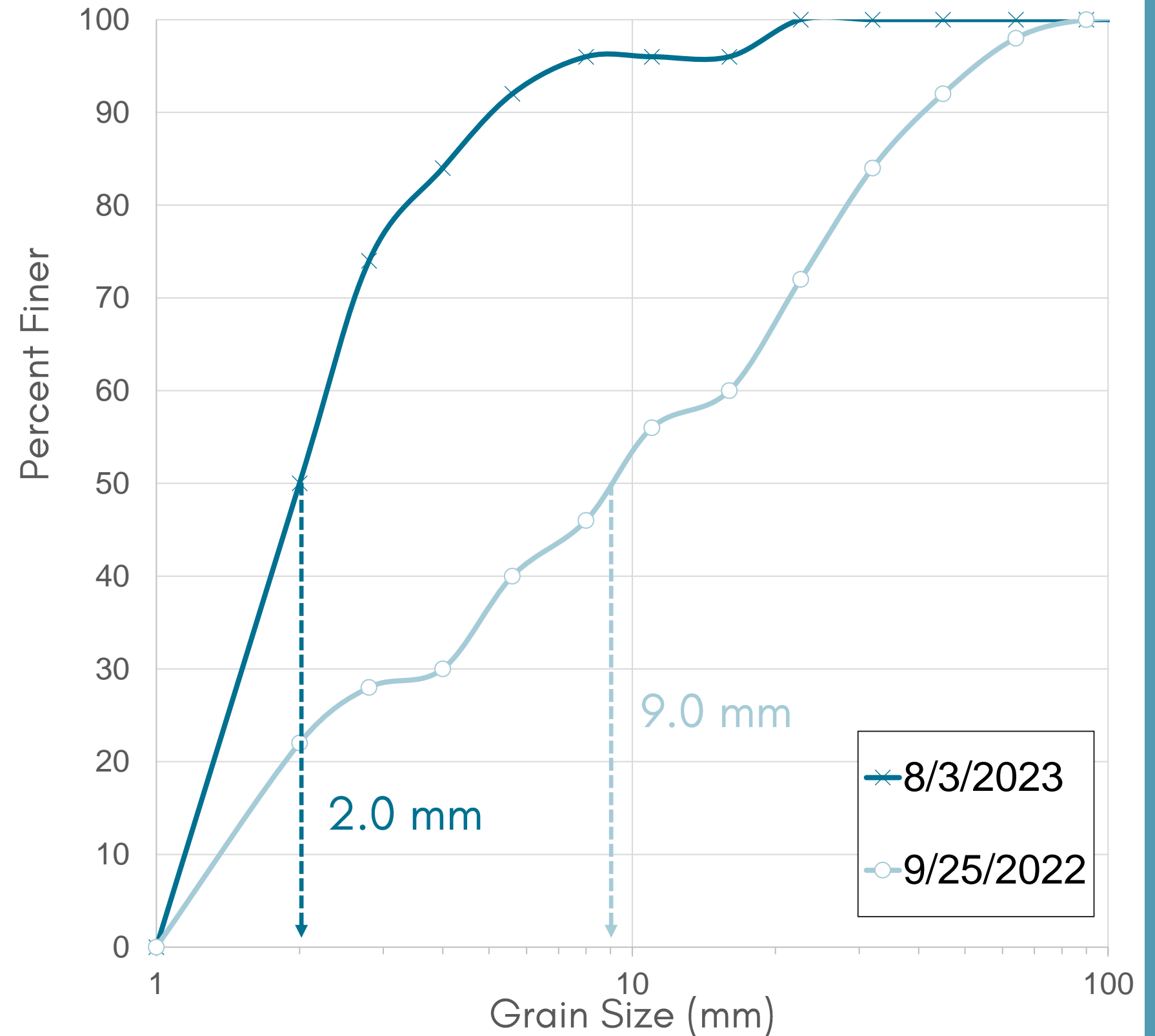


Elkhorn Creek Bed Grain Sampling

PALS 1 (UPSTREAM)



PALS 1 (DOWNSTREAM)



Adaptive Management

Are you ready for a long-term relationship?

Need for Adaptive Management

- The PBR “catch”
- Shifting logs
- Puncture holes
- Poor revegetation success



Adaptive Management Planning

- Feature Design Intent (Description and Goals)
- Performance Standard
- Management Trigger
- Suggested Action

Feature Name	Description & Goal	Performance Standard	Management Trigger	Suggested Action
Post-Assisted Log Structure	On-site woody material of various sizes is pinned together with untreated posts driven into the streambed to initiate and simulate natural wood accumulation. PALS provide opportunity for sediment storage behind the structures while promoting floodplain connectivity, additional wood recruitment, and riparian health.	Water is being slowed through the structure and shallow flooding is being added to the overbank areas. Some sediment deposition is evident on the overbanks and in the channel. The key log is still in place and stable. Wood is likely to added and removed overtime and should not impact the overall function of the structure.	The key log has move significantly down channel and is no longer positioned to recruit other debris. The structure has been flanked or undercut.	<ul style="list-style-type: none"> •Reposition the key log to be more stable at its current location. Add more material to the structure. •If the key log has moved to a location that could harm infrastructure or other mitigation features, consider removing from the channel.

Adaptive Management Take Aways

1. Don't overcomplicate
2. Allow for flexibility
3. Plan for it

Timeline for Key Tasks

Timeline for Key Tasks

	Year 1				Year 2				Year 3				Year 4+				
Planning	█	█															
Design		█	█														
Permitting			█														
Contractor Selection				█	█												
Implementation						█	█										
Monitoring								█	█	█	█	█	█	█	█	█	
Adaptative Management														█			

Thank you!



Michael Blazewicz (Round River Design)
Michael@RoundRiverDesign.com



Chelsey Heiden
HeidenC@AyresAssociates.com