



Lessons from the Cache La Poudre:  
Using Drones and GIS to Advance River  
Restoration Monitoring

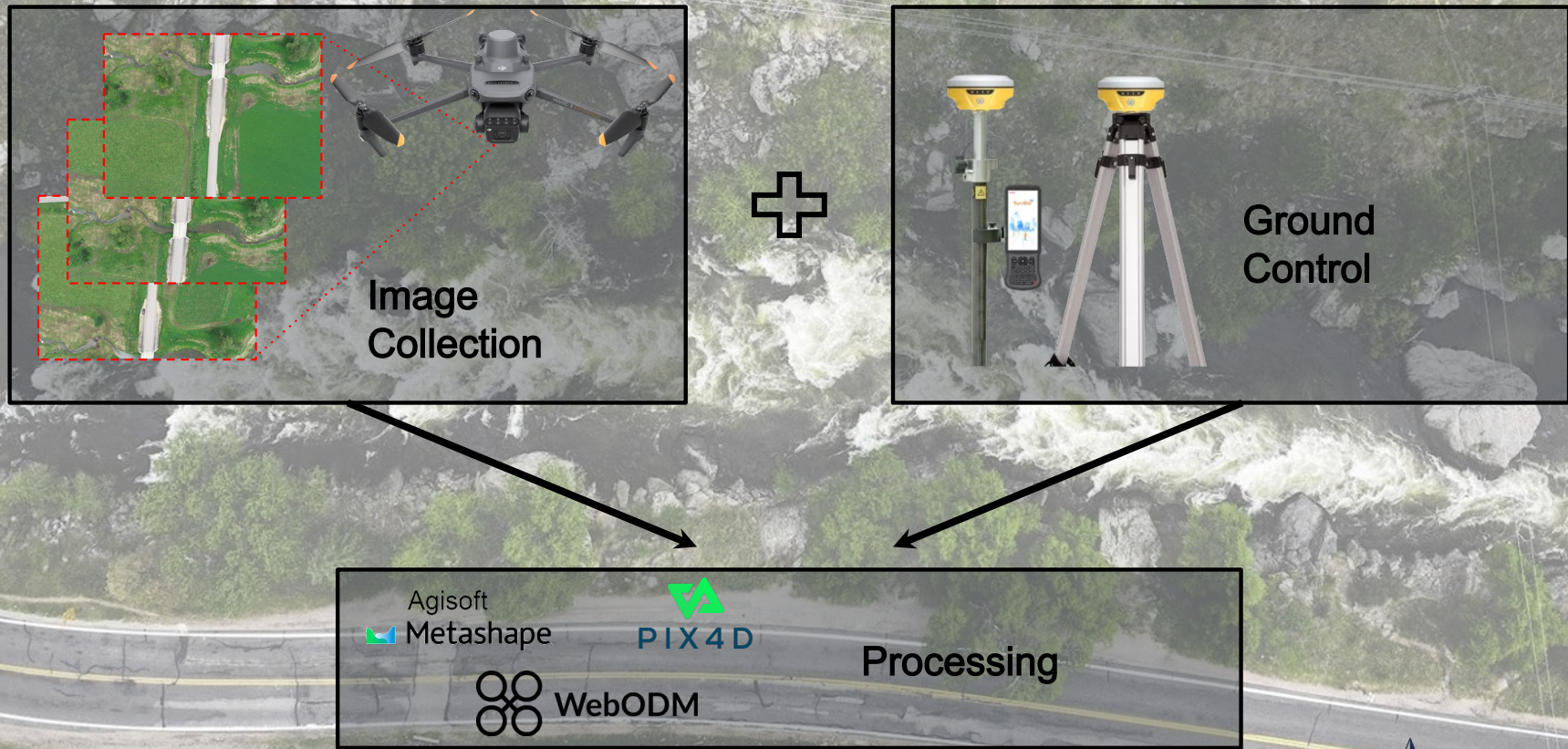
By: Ben Sellers

CG Mapping

# Overview

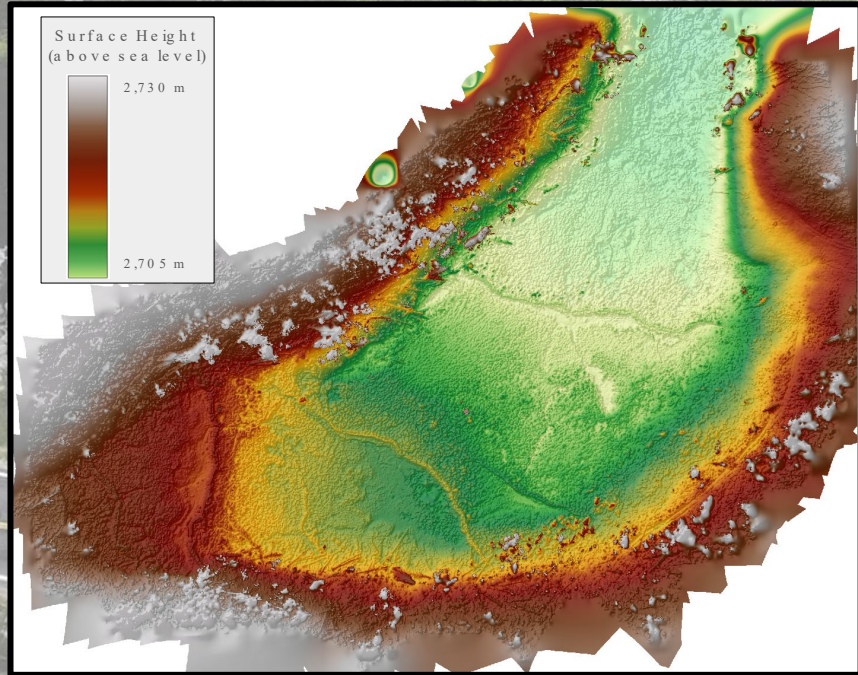
- Introduction to drone mapping products and their value to river restoration monitoring
- Highlight applications of drone mapping for planning, monitoring and adaptive management of restoration projects in the Poudre Watershed
- Discuss opportunities and limitations of incorporating drone mapping into restoration monitoring

# What is Drone Mapping? How does it work?

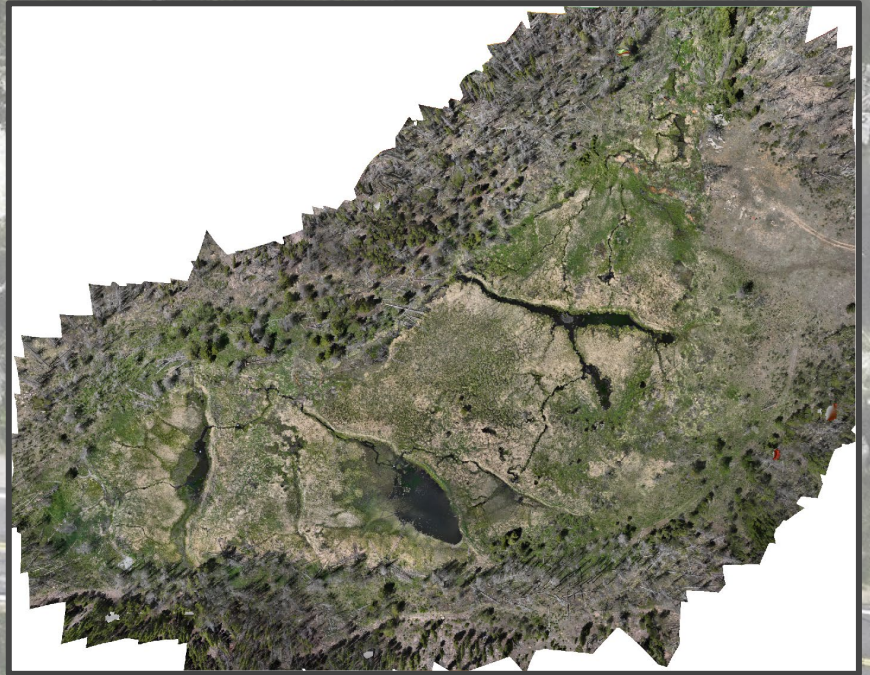


# What is Drone Mapping? How does it work?

Surface Model

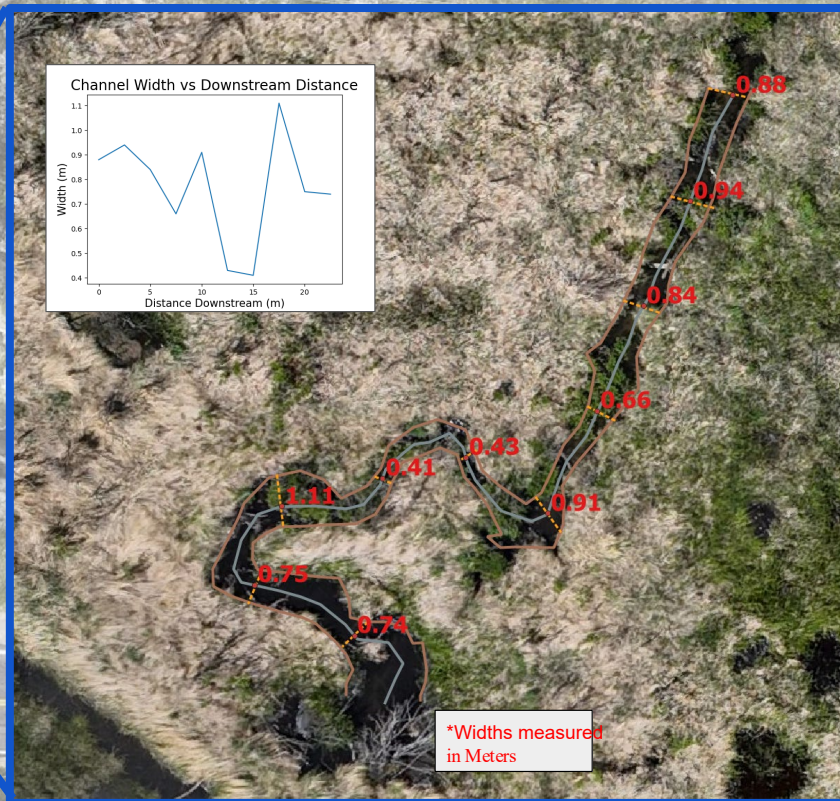
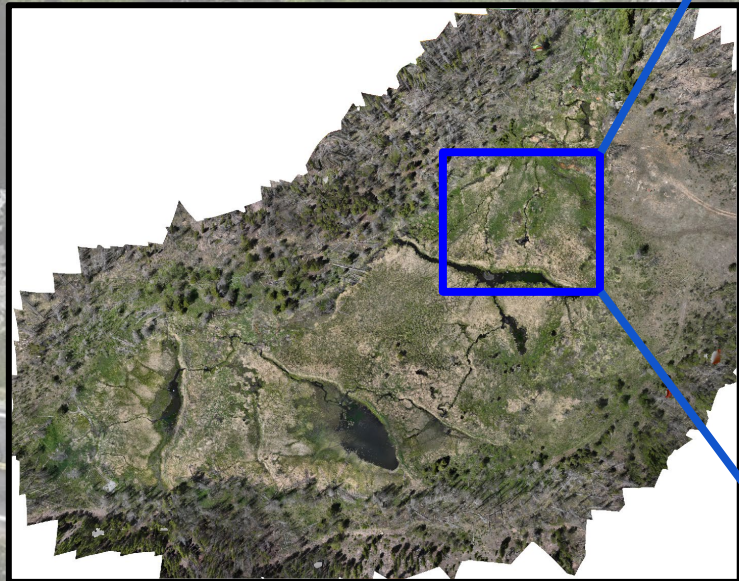


Orthomosaic



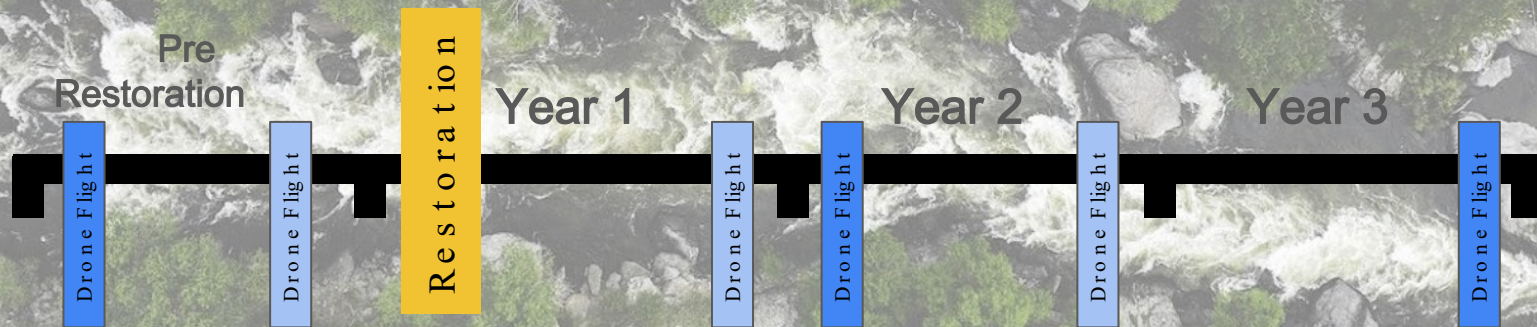
# Why not use Google Earth?

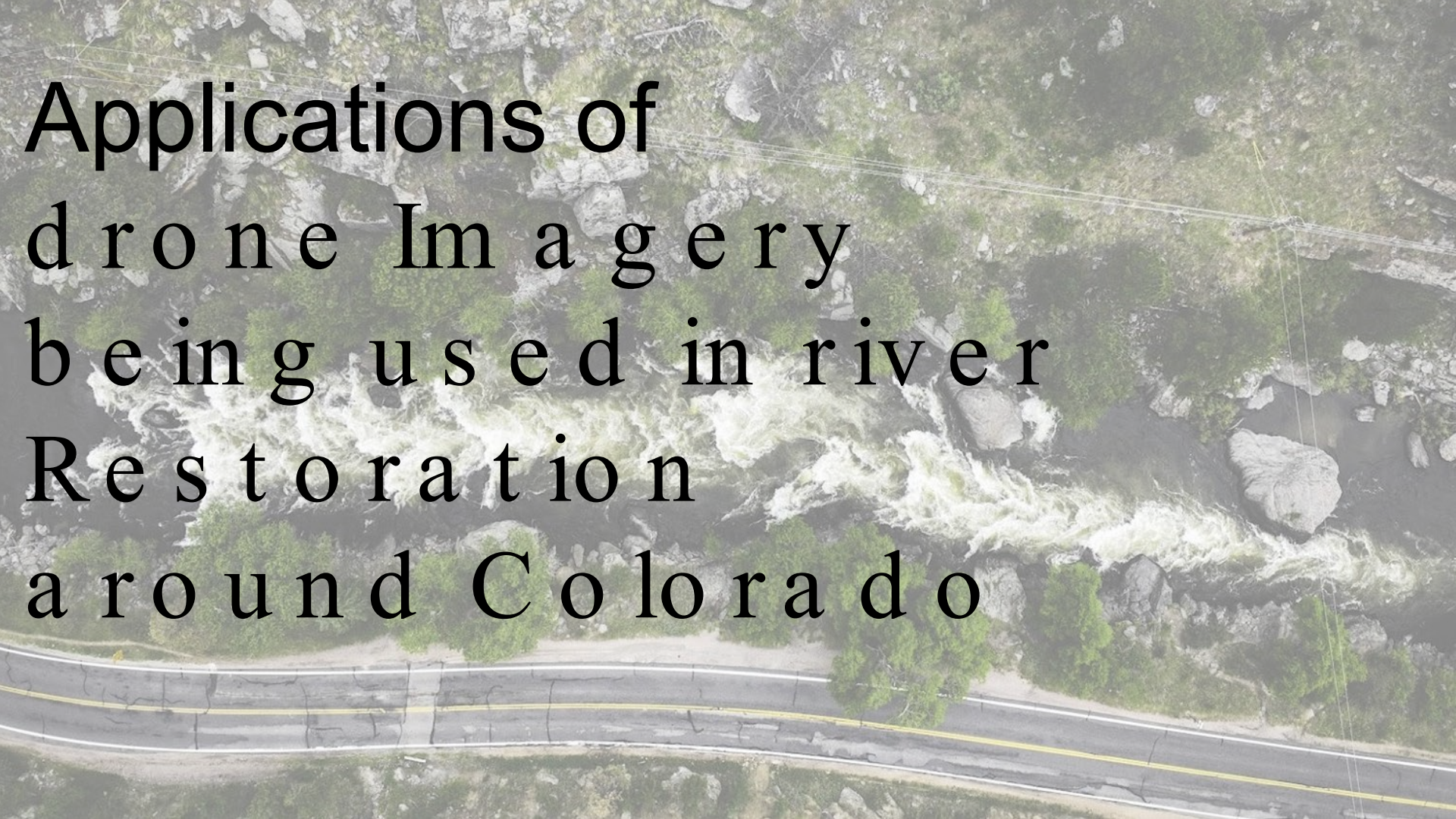
## Resolution



# Why not use Google Earth?

## A: Timing



An aerial photograph of a river with rapids, surrounded by rocky terrain and green vegetation. A paved road with yellow and white markings runs along the bottom of the frame. The text is overlaid on the image in a black, serif font.

Applications of  
d r o n e I m a g e r y  
b e i n g u s e d i n r i v e r  
R e s t o r a t i o n  
a r o u n d C o l o r a d o

# Cameron Peak Post Fire LT-PBR Restoration

## Goals :

- Improve water quality and ecological functioning
- Increasing roughness, reducing flow velocities, and promote sediment deposition

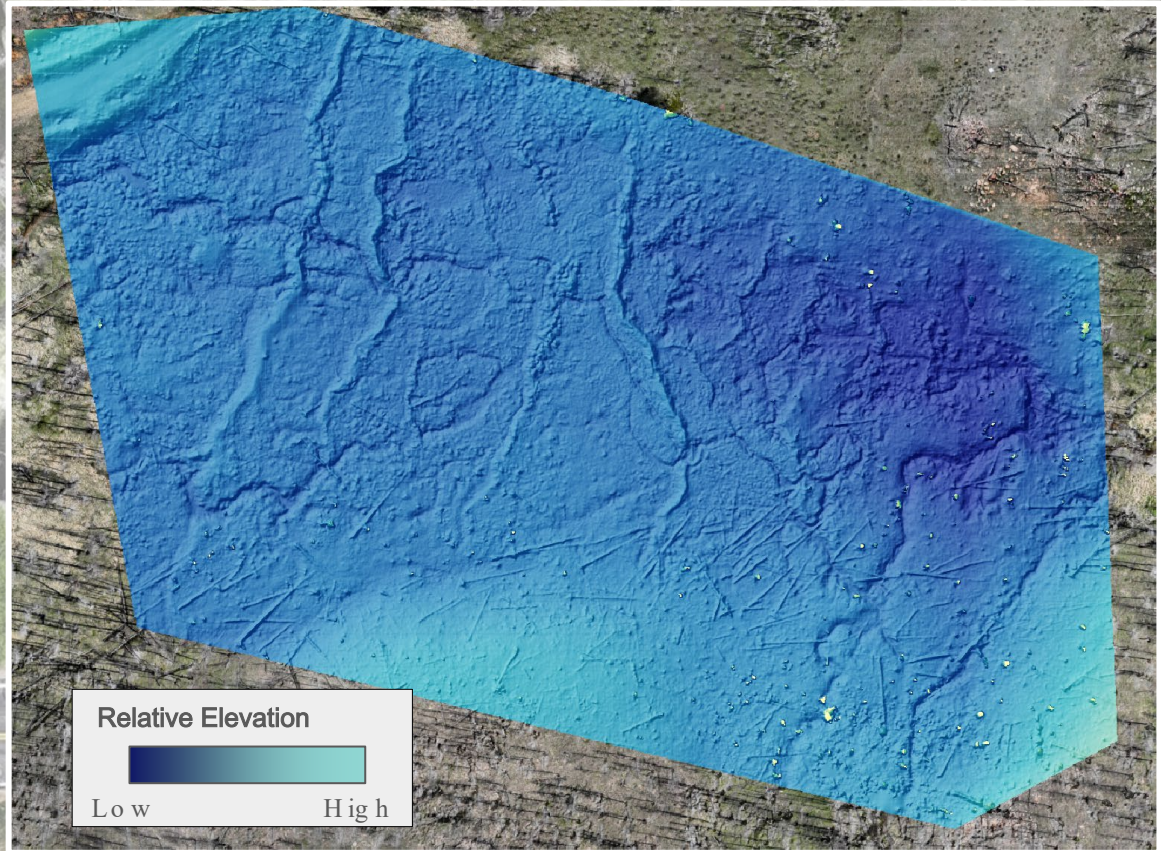
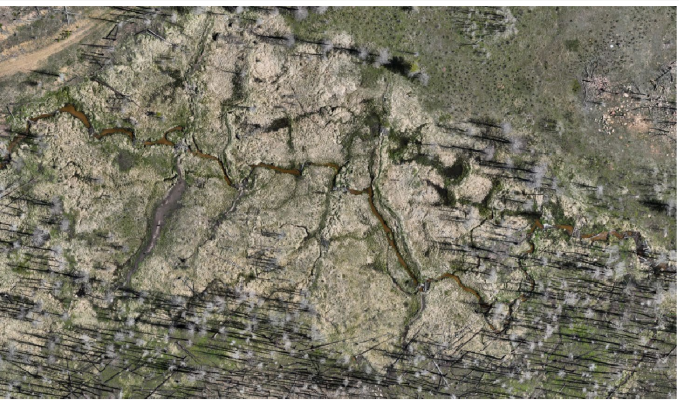


# Low Tech PBR Monitoring: Project Implementation



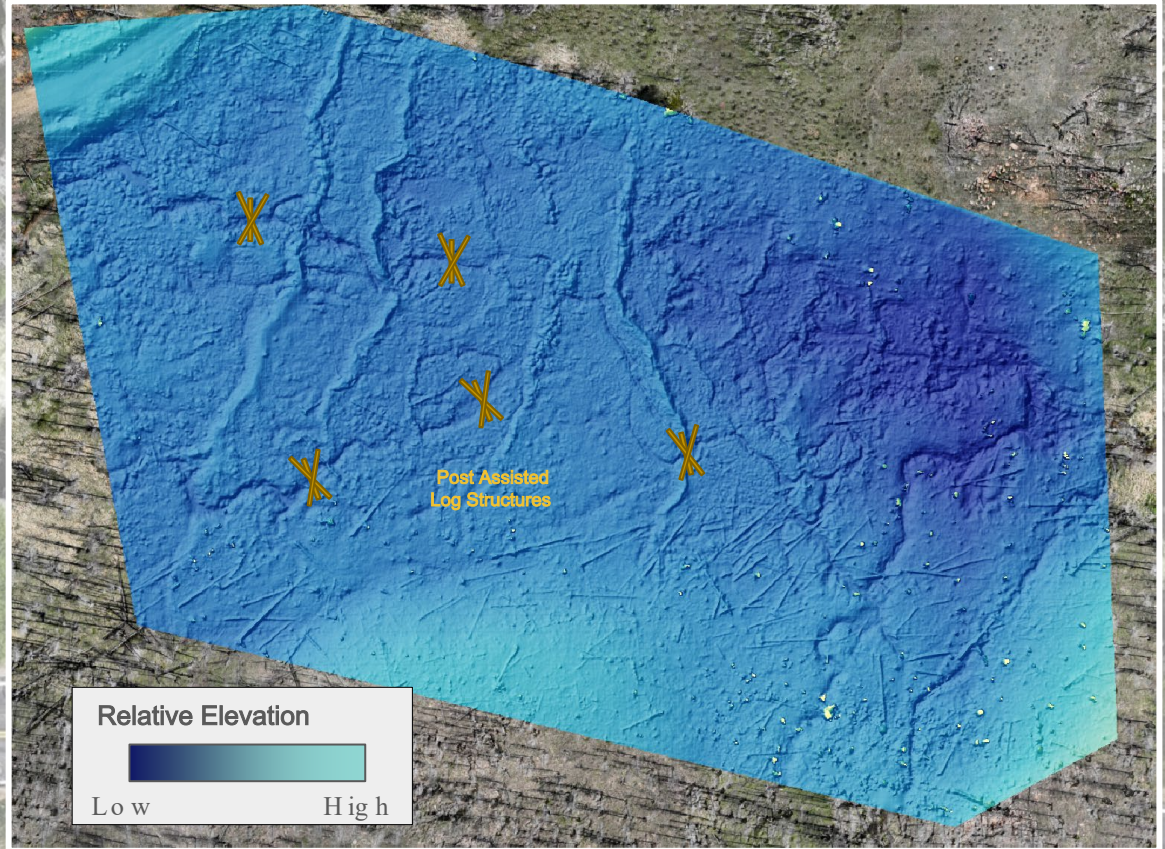
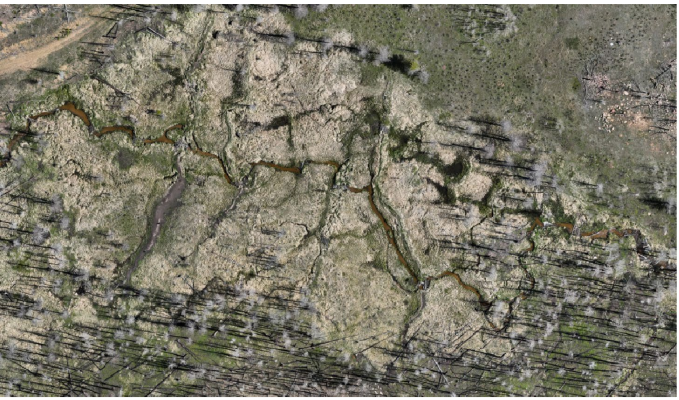
# Pre -Project Monitoring

## Relative Elevation Models



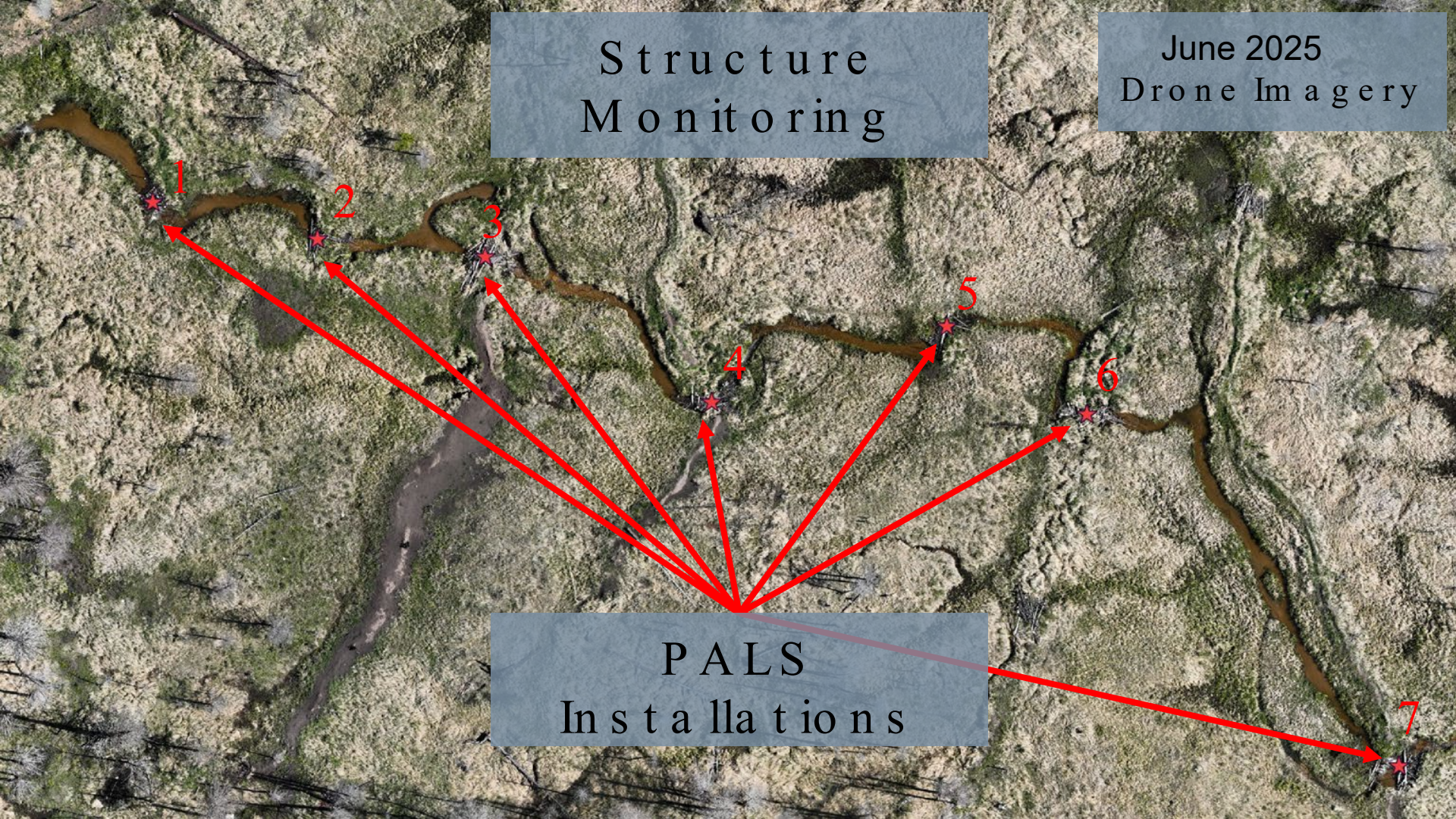
# Pre -Project Monitoring

## Relative Elevation Models



Structure  
Monitoring

June 2025  
Drone Imagery



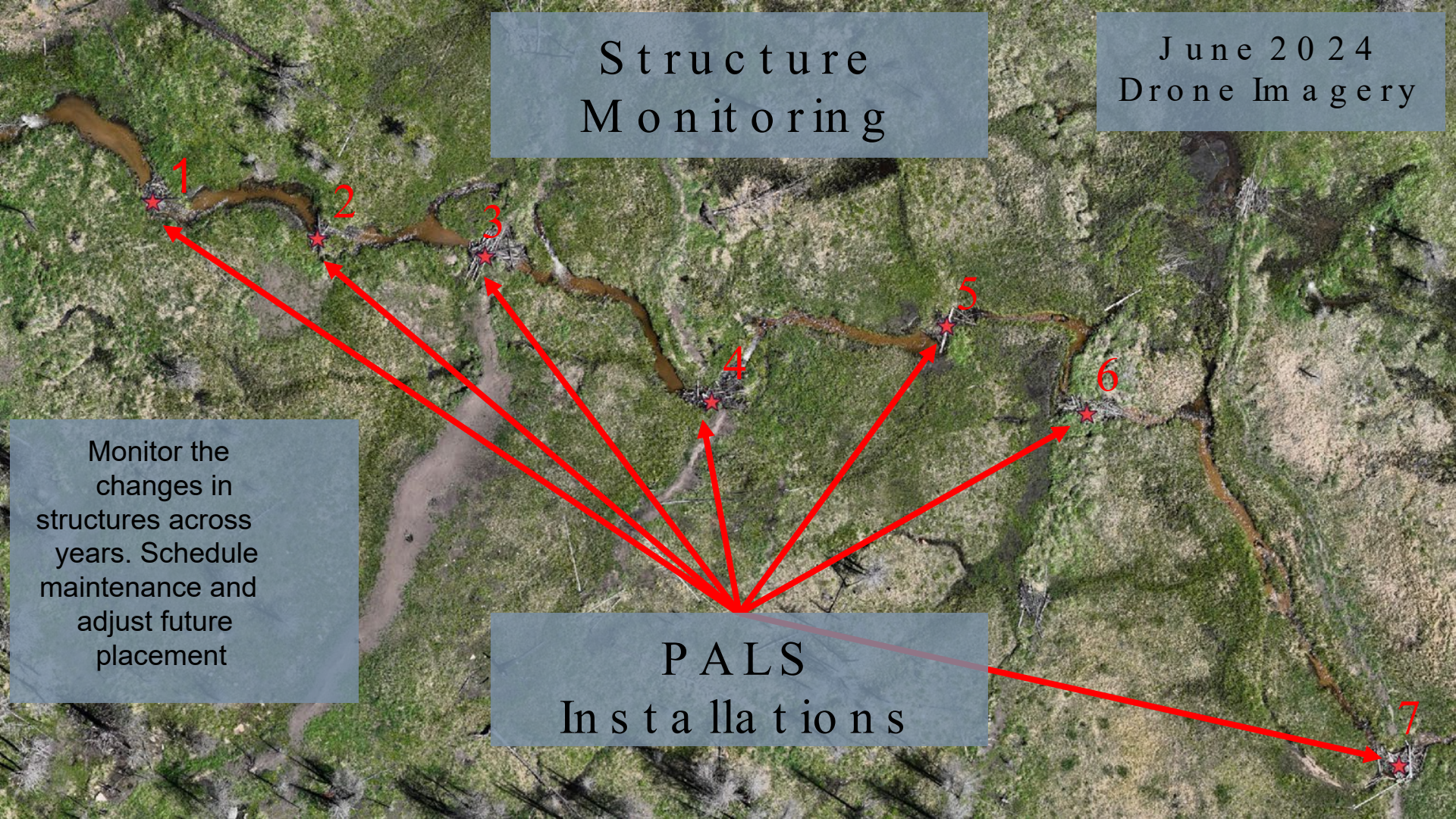
PALS  
Installations


# Structure Monitoring

June 2024  
Drone Imagery

Monitor the changes in structures across years. Schedule maintenance and adjust future placement


PALS  
Installations



An aerial photograph of a stream flowing through a grassy area. A large pile of sticks and debris is situated in the middle of the stream. The surrounding vegetation is green and dense.

Structure  
Monitoring

June 2024

An aerial photograph of the same stream and debris pile as in 2024. The surrounding vegetation is now sparse and yellowish, indicating a change in the environment.

June 2025

An aerial photograph of a river winding through a lush green forest. The river is dark and appears to be carrying sediment. Several log weirs, constructed from stacked logs, are placed across the river at various points. The surrounding forest is dense with green trees and some yellowish-green shrubs. The overall scene is a natural, somewhat rugged landscape.

Low Tech PBR  
Monitoring:  
Tracking Physical  
Metrics

# Measuring Ecological Characteristics in LT-PBR Sites



- Channel Length
- Total Wetted Area
- Sinuosity
- Habitat Type (Lotic, Lentic, Vegetated)

Before



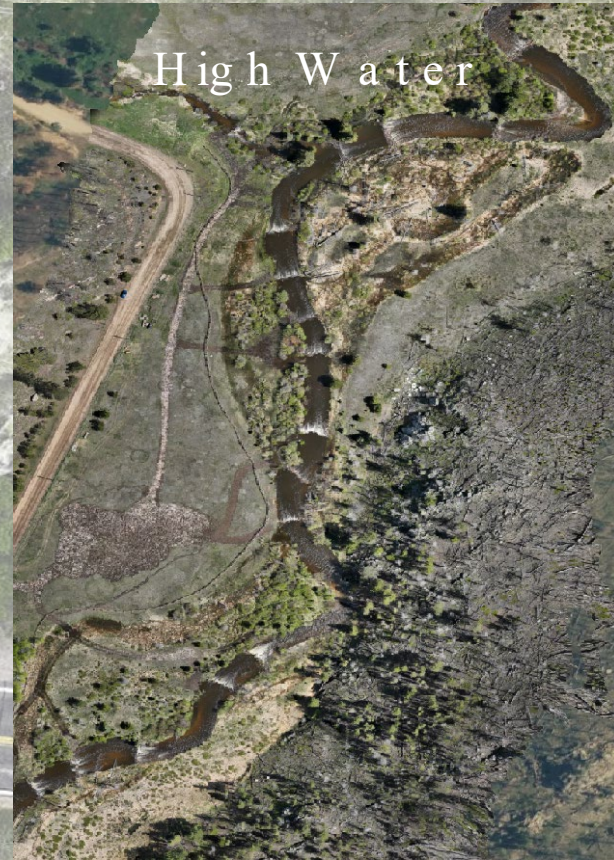
After



Control



# Wetted Area: Pre & Post Project Channel Changes



# Wetted Area: Pre & Post Project Channel Changes



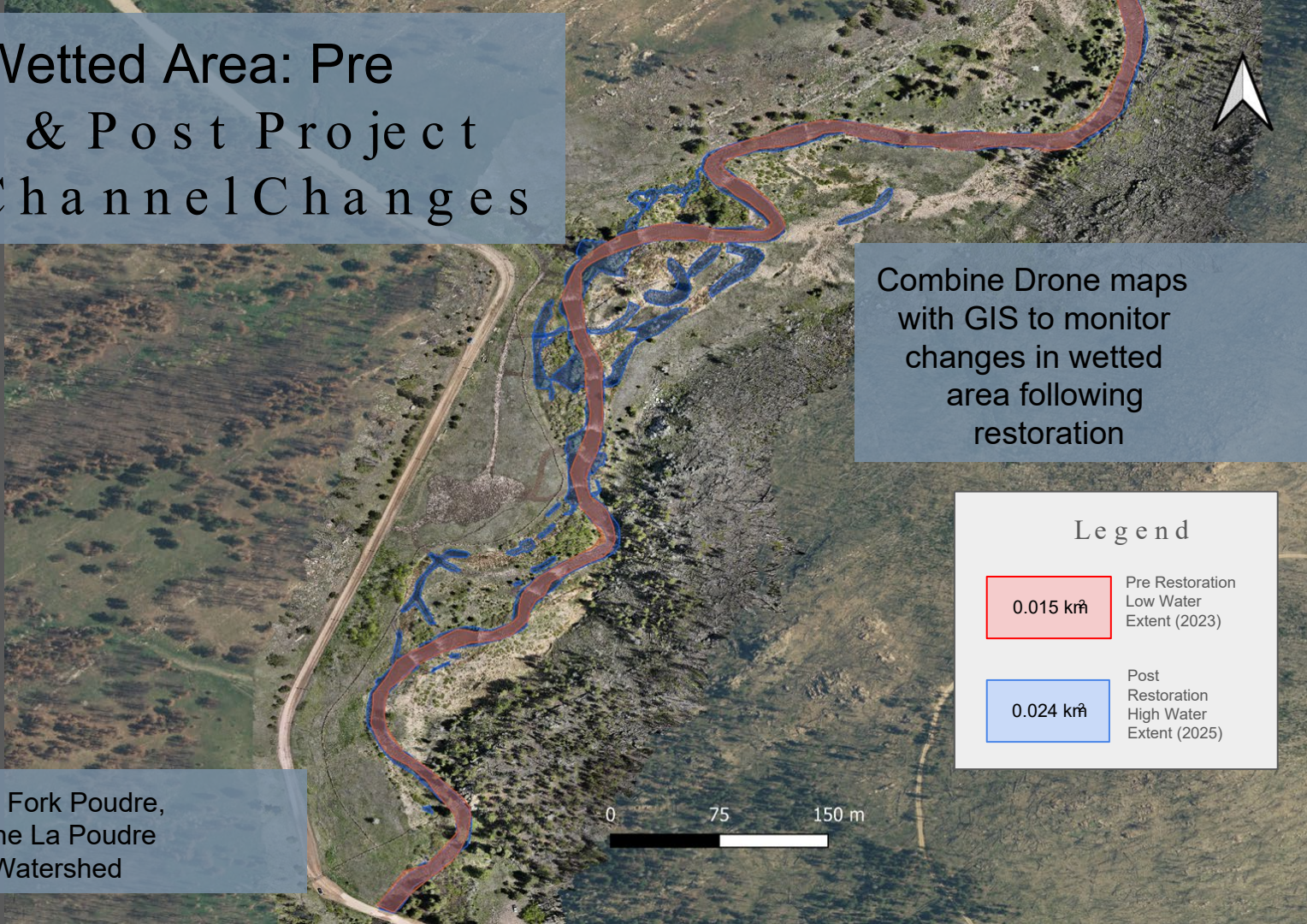
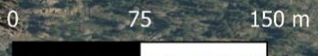
# Wetted Area: Pre & Post Project Channel Changes

Combine Drone maps  
with GIS to monitor  
changes in wetted  
area following  
restoration

Legend

0.015 $\text{kr}^2$	Pre Restoration Low Water Extent (2023)
0.024 $\text{kr}^2$	Post Restoration High Water Extent (2025)

South Fork Poudre,  
Cache La Poudre  
Watershed



# Vegetation Monitoring

## Riparian Vegetation Inventory



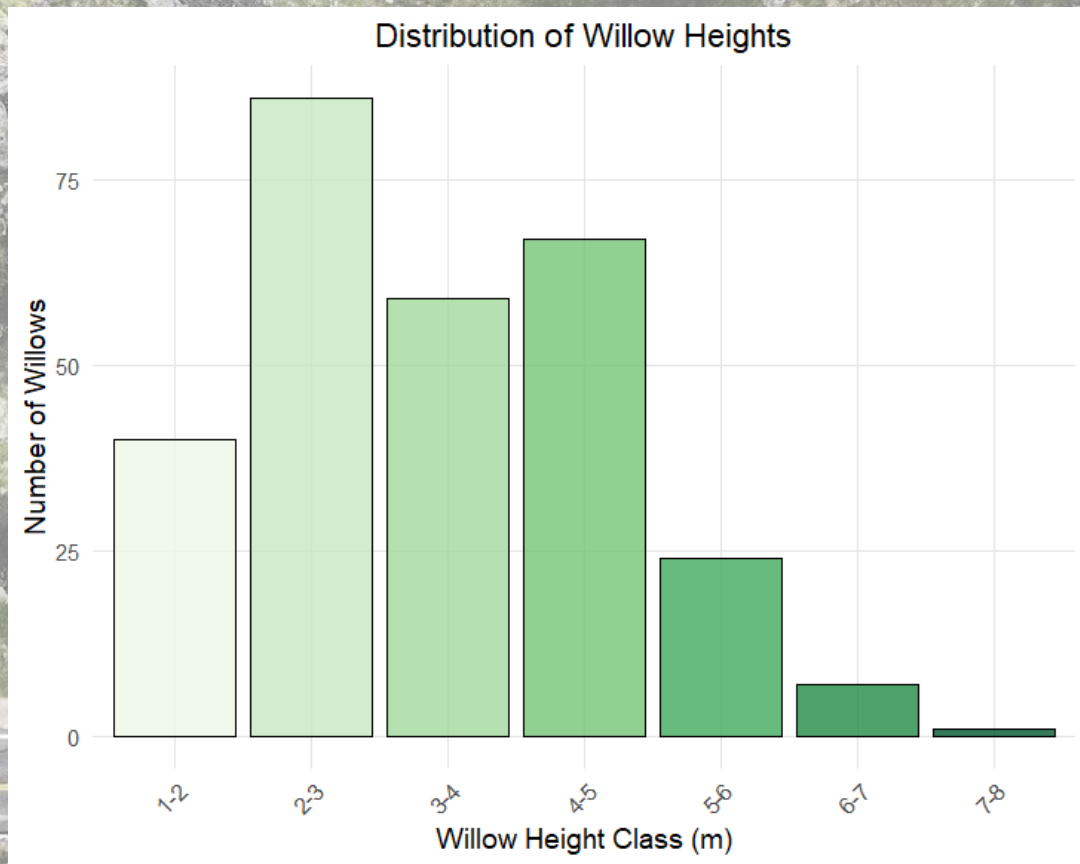
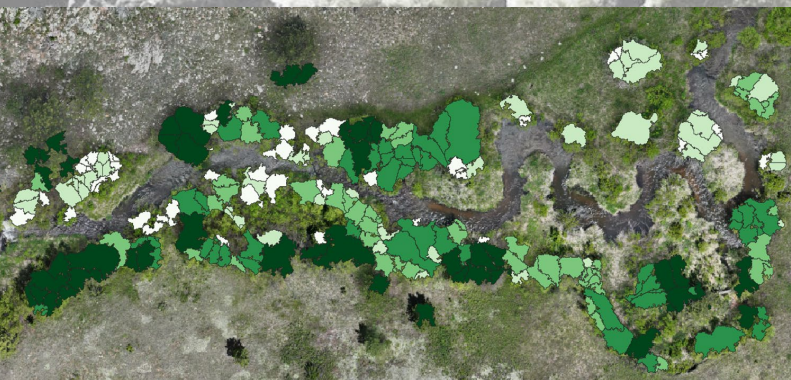
# Vegetation Monitoring

## Riparian Vegetation Inventory



# Vegetation Monitoring

Riparian Vegetation  
Inventory



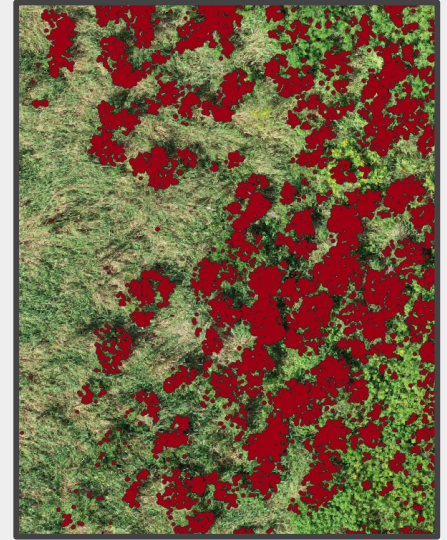
# Invasive Species

## Invasive Species Monitoring

- Drones enable targeting species specific phenology
- Multispectral sensors, and 3D information can be combined to improve detection.



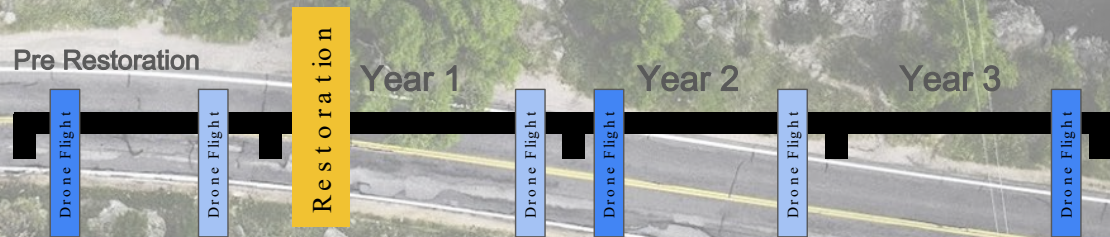
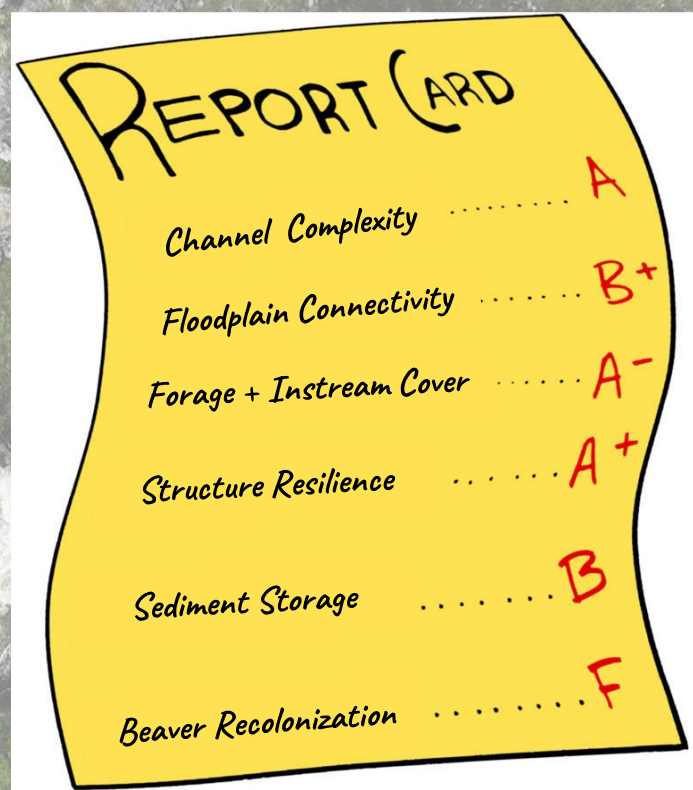
RGB Orthomosaic  
(2 m resolution)




Purple Loosestrife  
Extent

# Informing Adaptive Management

- Supports field monitoring with spatial record of site conditions
- Measurements provide basis for tracking progress
- More information for decision making, informing future restoration efforts



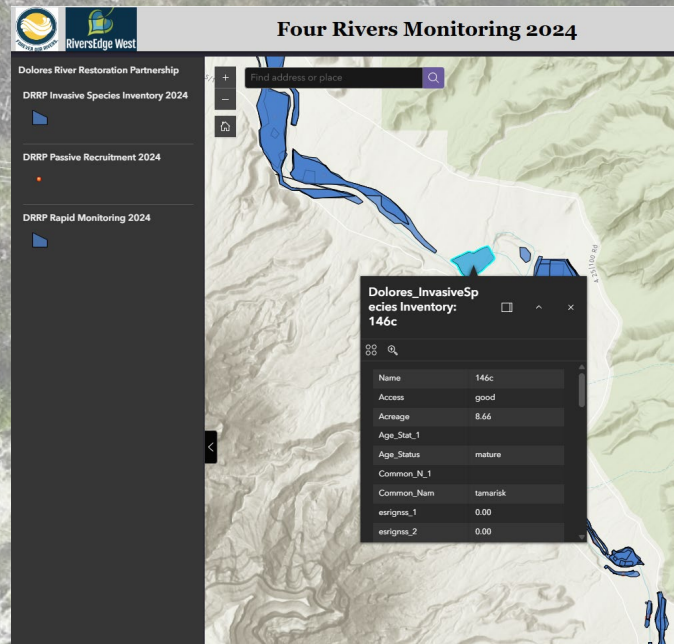
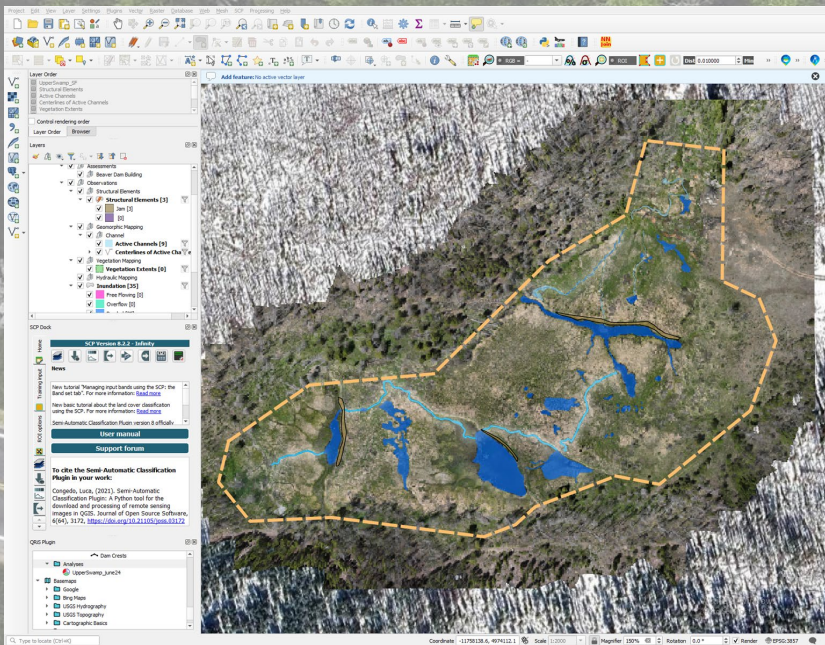
An aerial photograph of a mountain valley. A dark river flows through the center, bordered by a winding asphalt road. Several small buildings with red roofs are situated near the road. The surrounding hills are covered in a mix of green grass, yellowish-brown patches, and dense evergreen forests. The sky is filled with heavy, grey clouds, suggesting an overcast day.

# Collaboration and Public Engagement

# Collaboration Across Watersheds



Riverscapes Studio



HYDROSHARE

# Visual Storytelling



Pineview Falls,  
Cache La Poudre  
Watershed

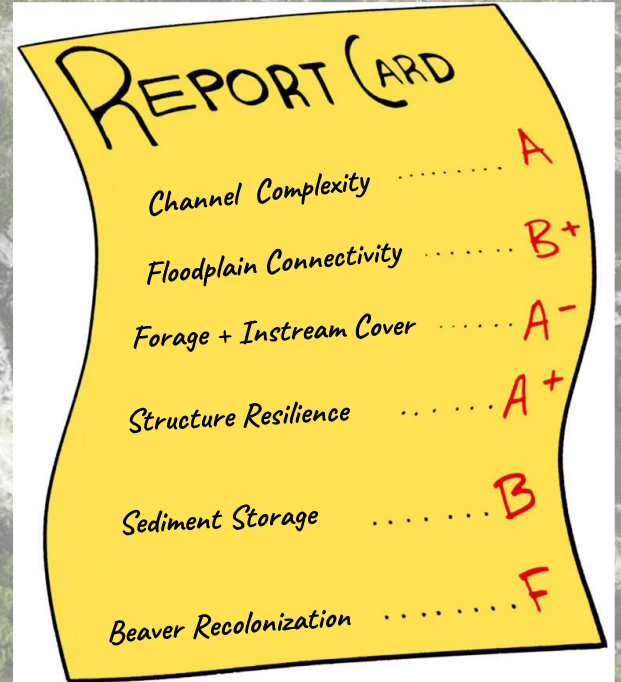


# Limitations

- Some sites more suitable than others, depending on size, vegetation cover, elevation, WIND
- non-standardized data collection protocols across organizations.
- Limited by airspace and landowner permissions

# Takeaways

- Drone imagery provides visual evidence supporting ongoing adaptive management
- Combined with GIS analysis, a platform for quantifying physical metrics closely linked to stream health
- Fosters collaboration between organizations, engages the public



# CG Mapping is happy to help!

Contact: [ben.sellers@cgmapping.com](mailto:ben.sellers@cgmapping.com)

