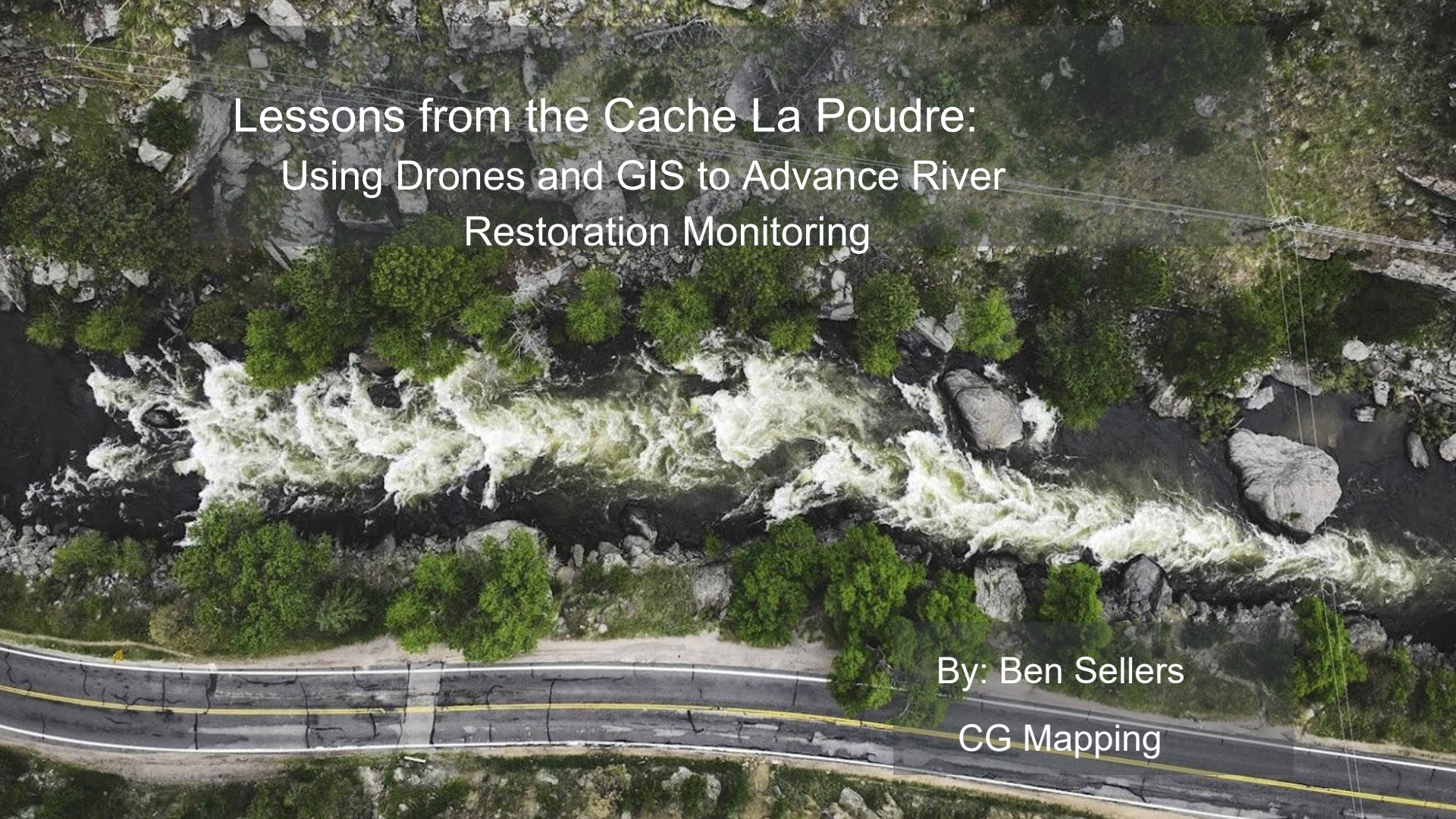


Lessons from the Cache La Poudre:

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?

Image Collection

Ground Control

Agisoft Metashape

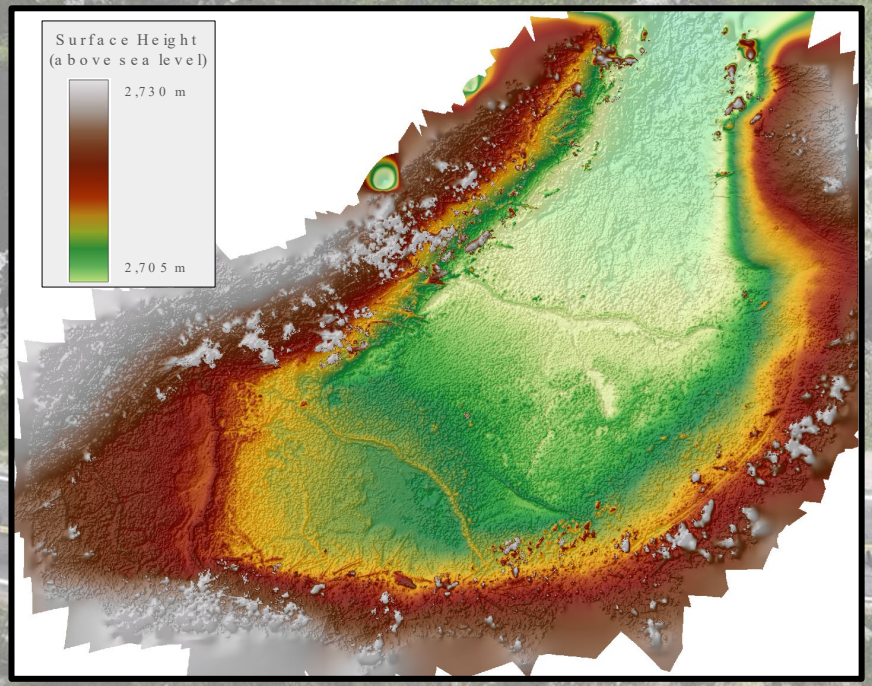
PIX4D

WebODM

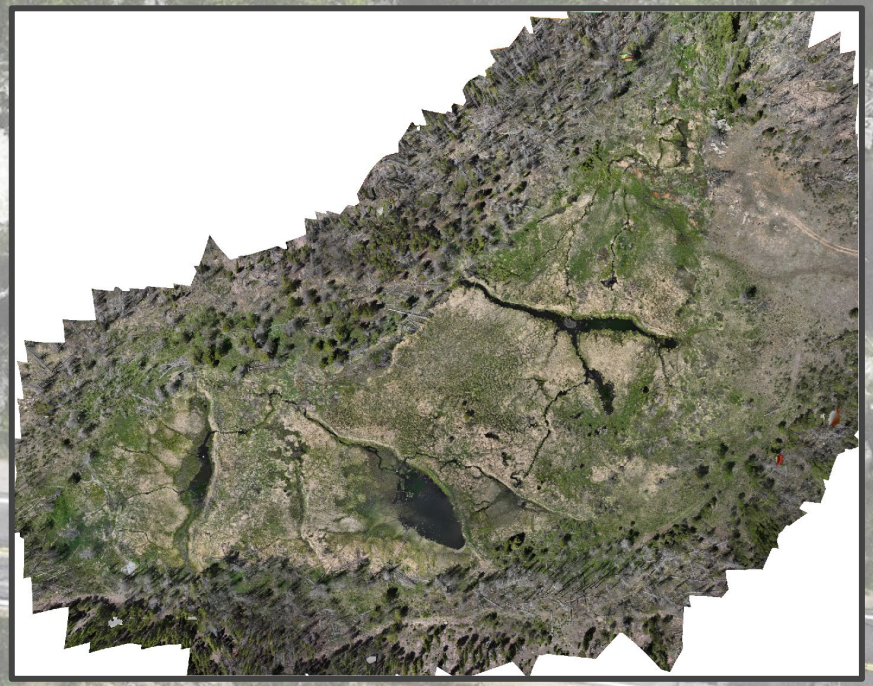
Processing

What is Drone Mapping? How does it work?

Surface Model

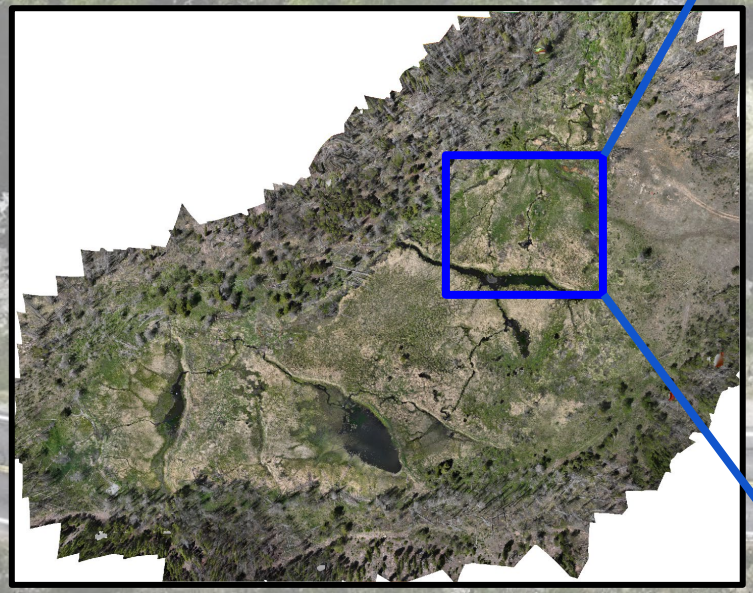


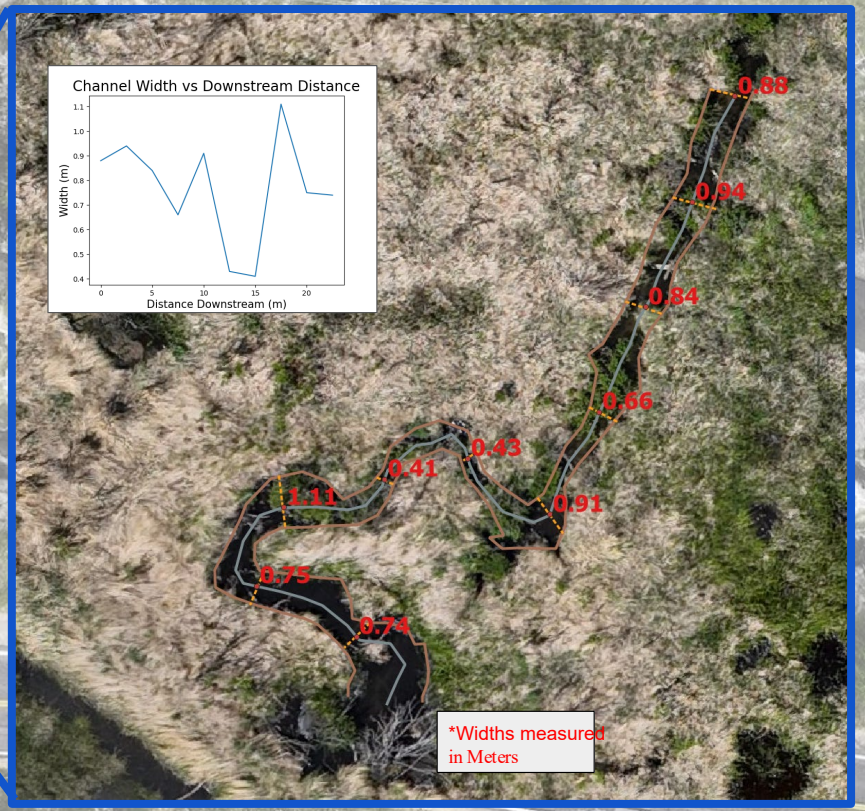
Orthomosaic



Why not use Google Earth?

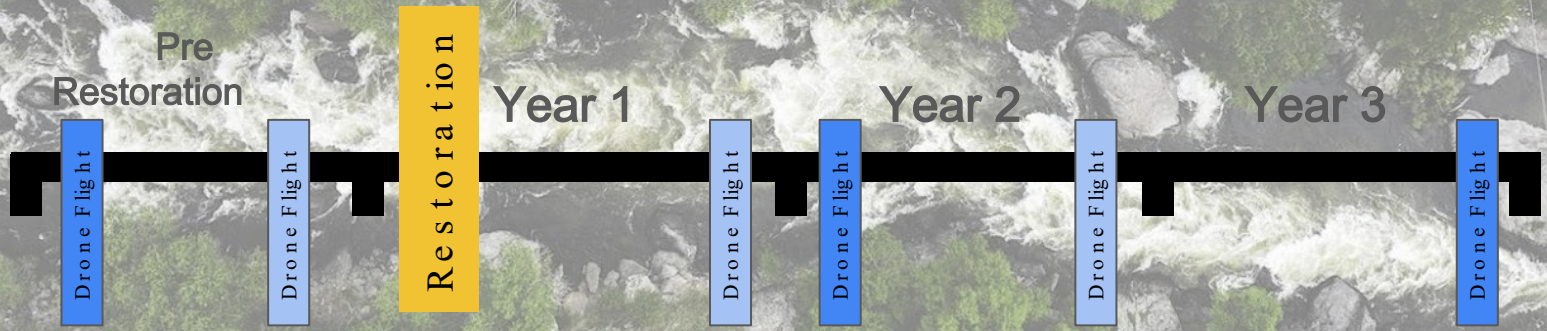
Resolution

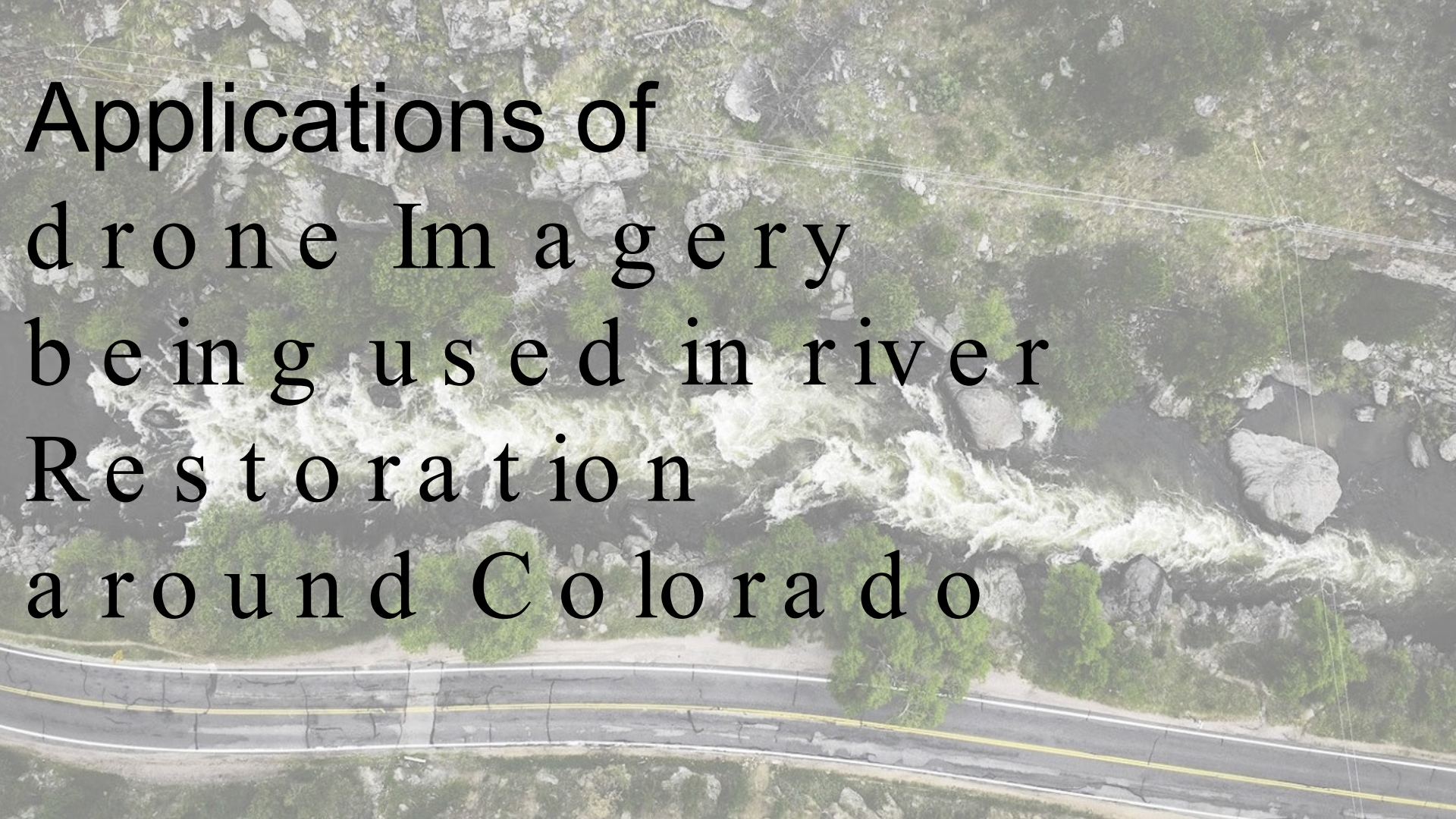




Why not use Google Earth?

A: Timing





Applications of drone Imagery being used in river Restoration around Colorado

Cameron Peak Post Fire
LT-PBR Restoration

Goals:

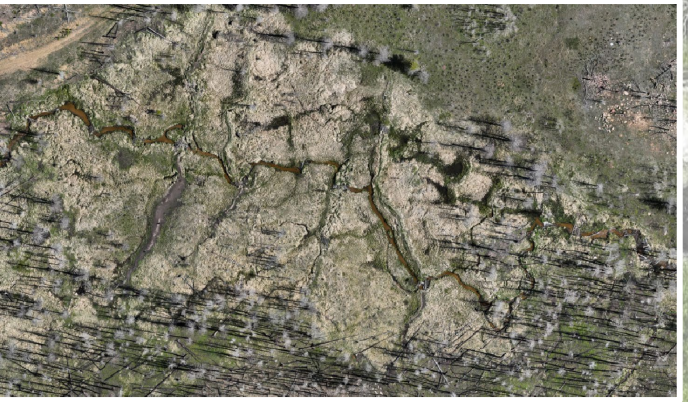
- Improve water quality and ecological functioning

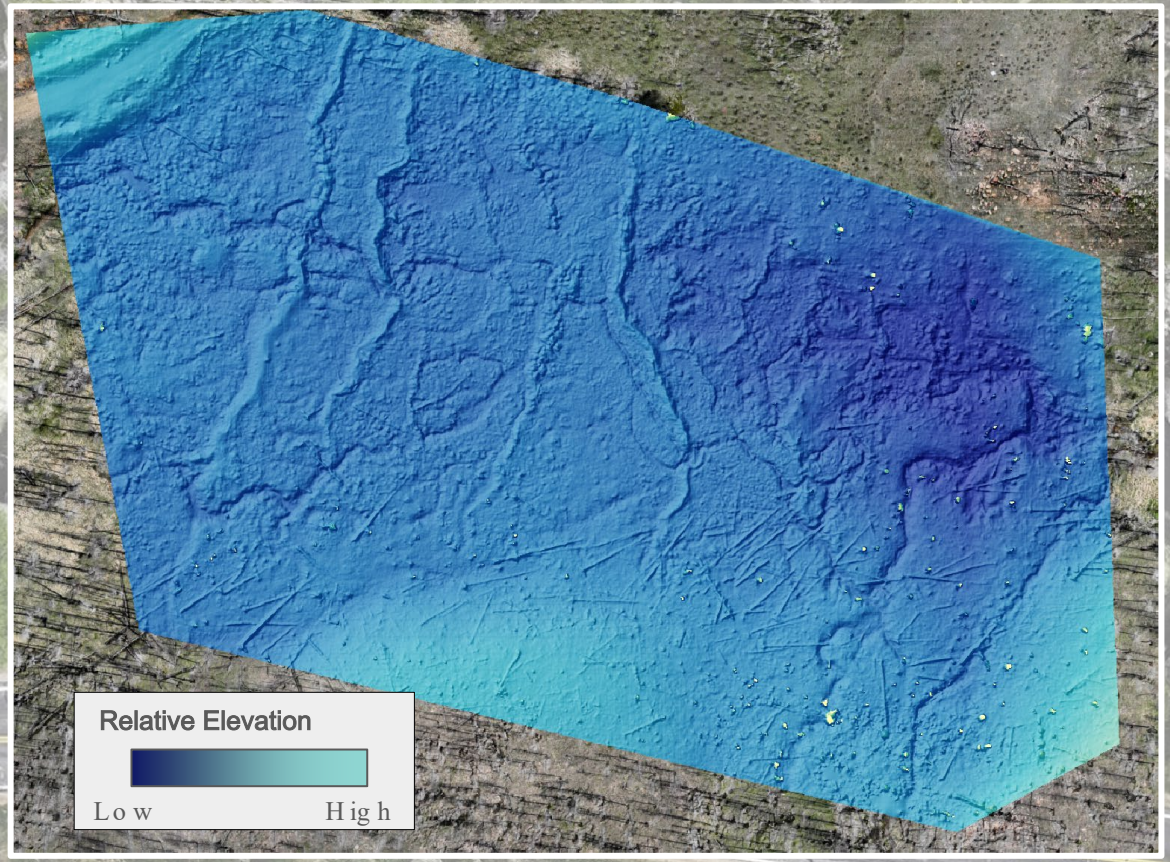
- Increasing roughness, reducing flow velocities, and promote sediment deposition

Low Tech PBR Monitoring: Project Implementation

Pre -Project Monitoring

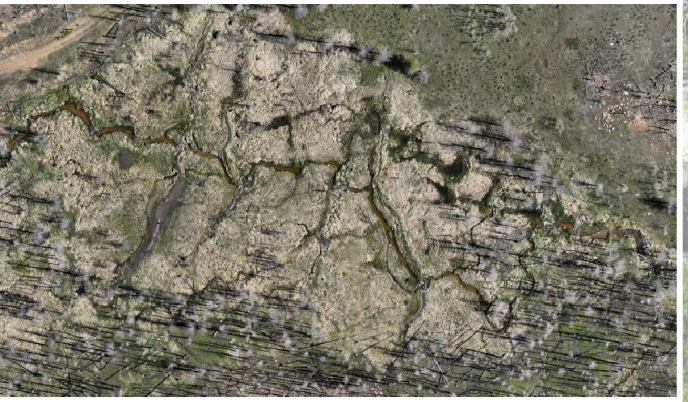
Relative Elevation Models

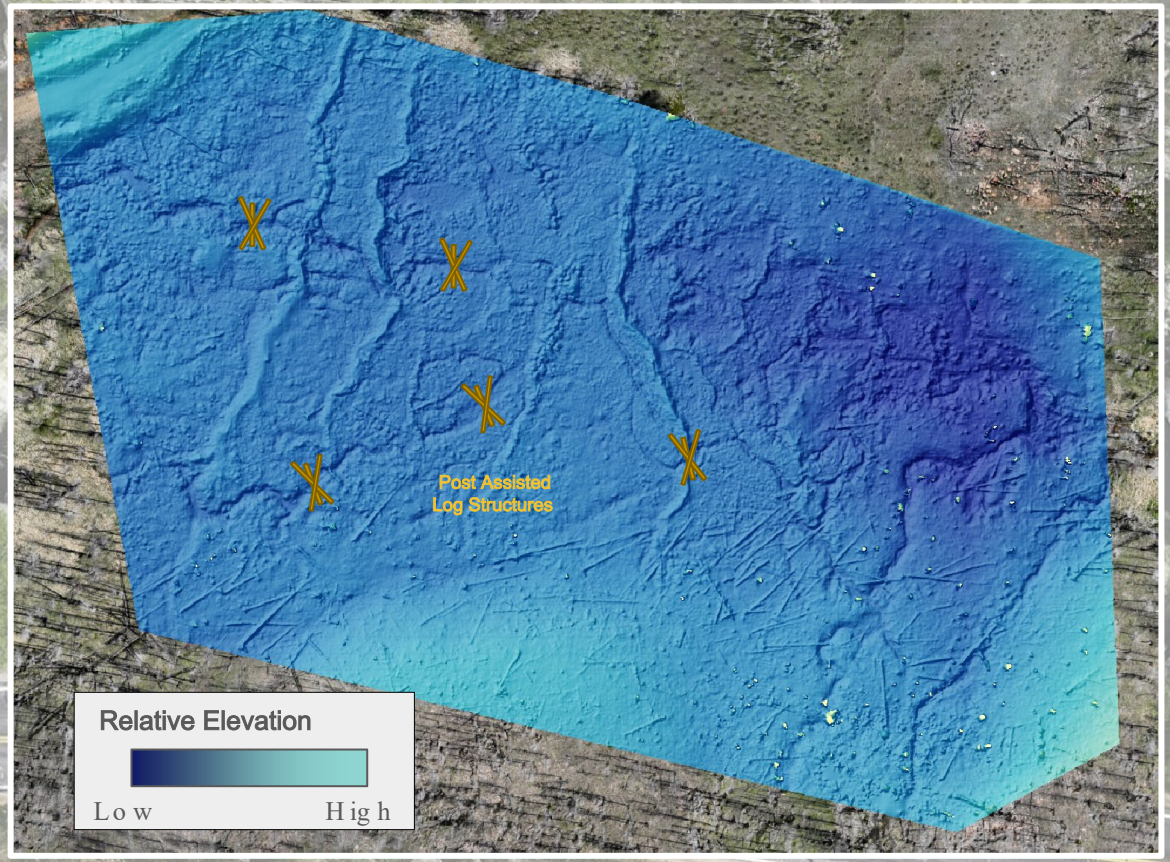


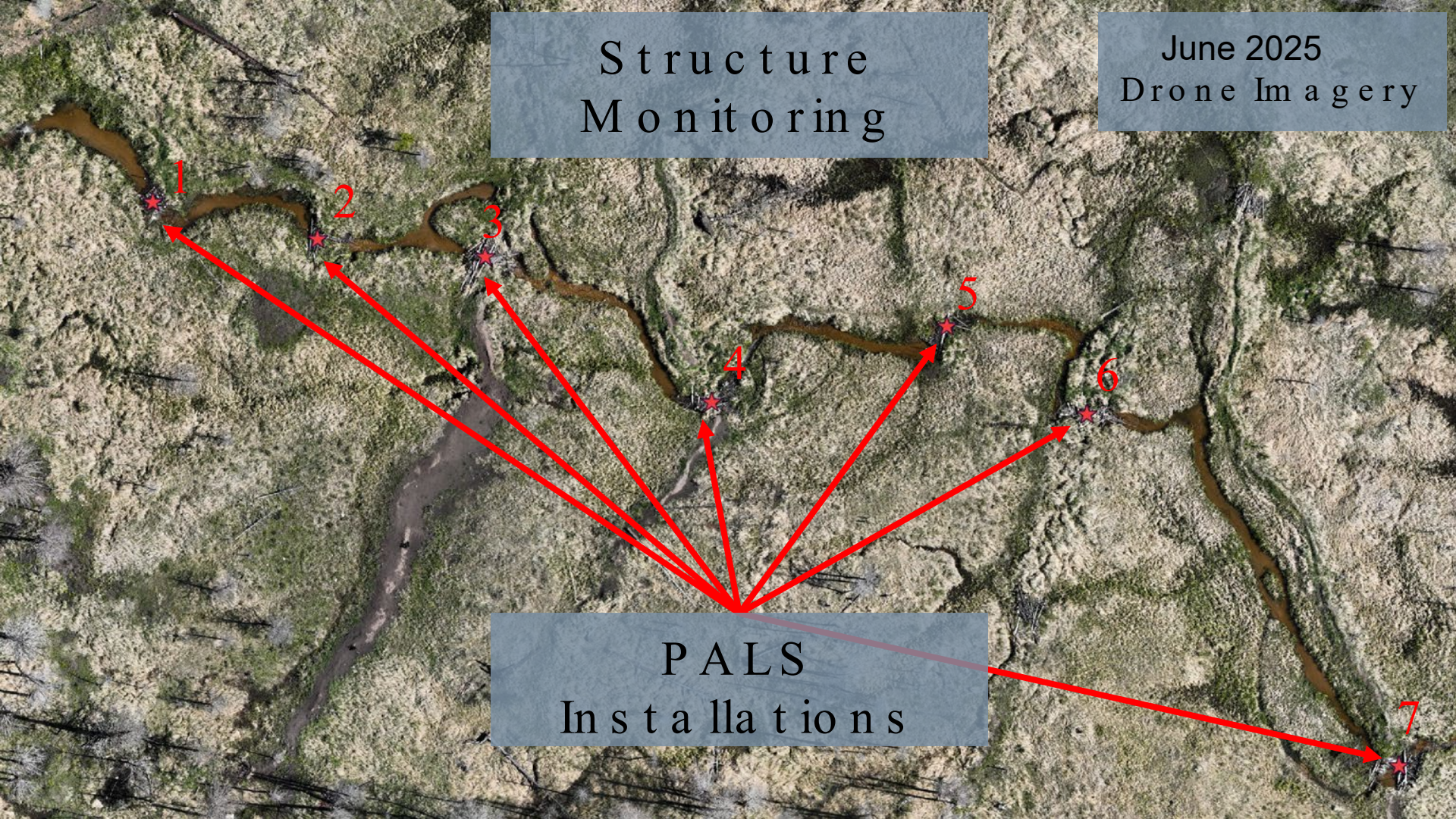


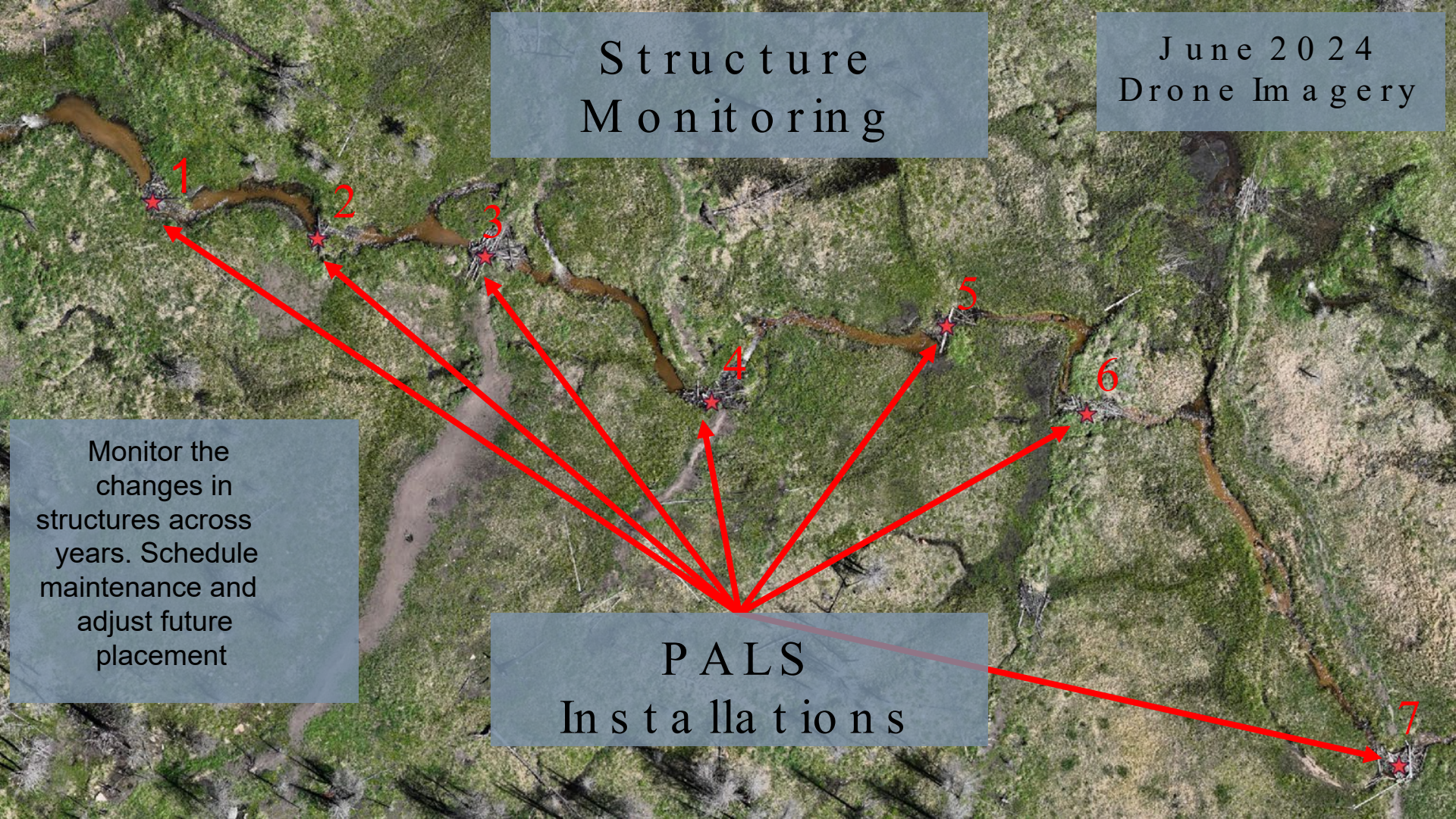
Pre -Project Monitoring

Relative Elevation Models

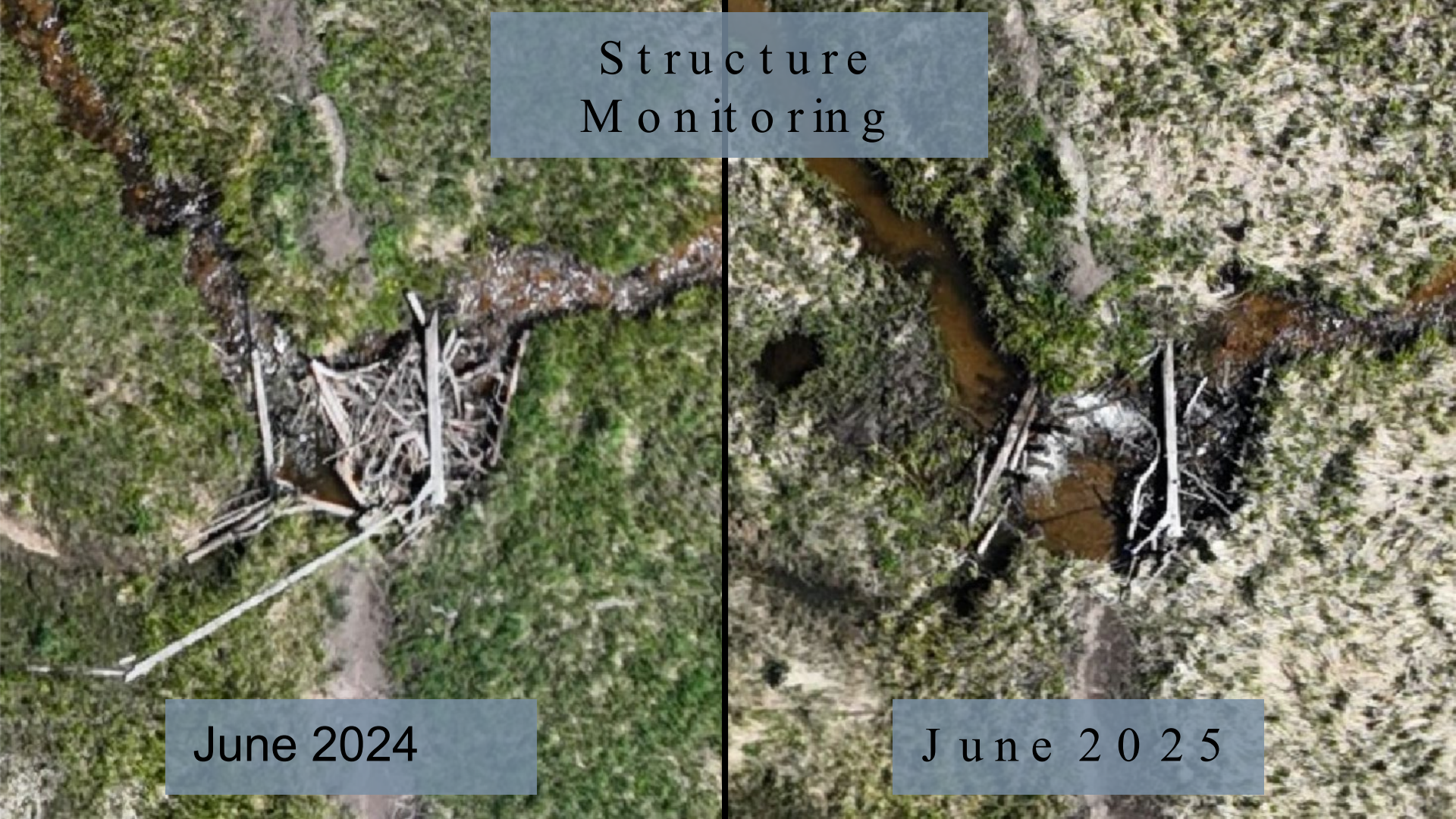





Structure Monitoring
June 2025 Drone Imagery
1
2
3
4
5
6
7
PALS Installations


Structure Monitoring
June 2024 Drone Imagery
1
2
3
4
5
6
7
Monitor the changes in structures across years. Schedule maintenance and adjust future placement
PALS Installations

Structure Monitoring




Low Tech PBR
Monitoring:
Tracking Physical
Metrics

Measuring Ecological Characteristics in LT-PBR Sites

- ChannelLength
- TotalWetted Area
- Sinuosity
- Habitat Type (Lotic, Lentic, Vegetated)

River Research and Applications

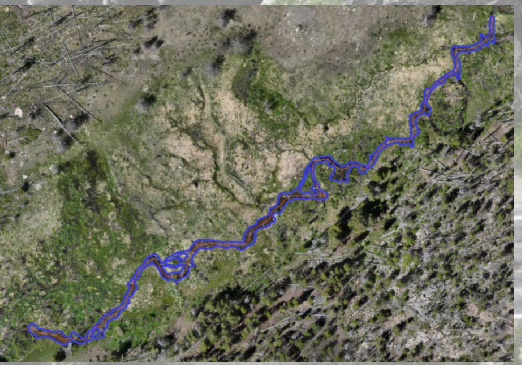
RESEARCH ARTICLE | Open Access

Ecological Characteristics of Stream Reaches With and Without Low-Tech Process-Based Restoration in a Wildfire-Affected Catchment

Kimberly A. Nichter, Travis Gilmore, Cole Carbone, Ben Sellers, Matthew P. Fairchild, Daniel L. Preston

First published: 18 February 2026 | https://doi.org/10.1002/rra.70119 | VIEW METRICS

Before



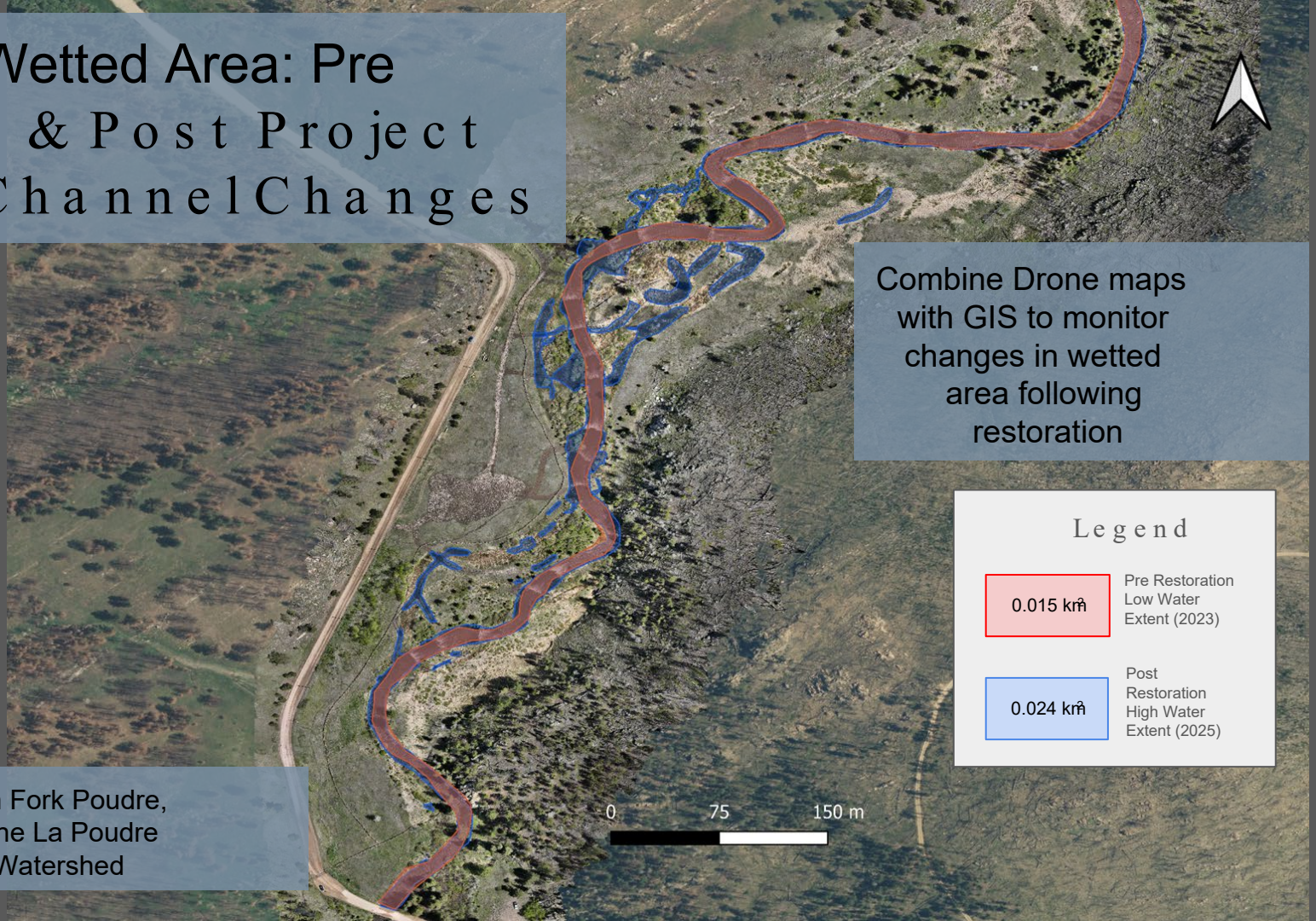
After

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

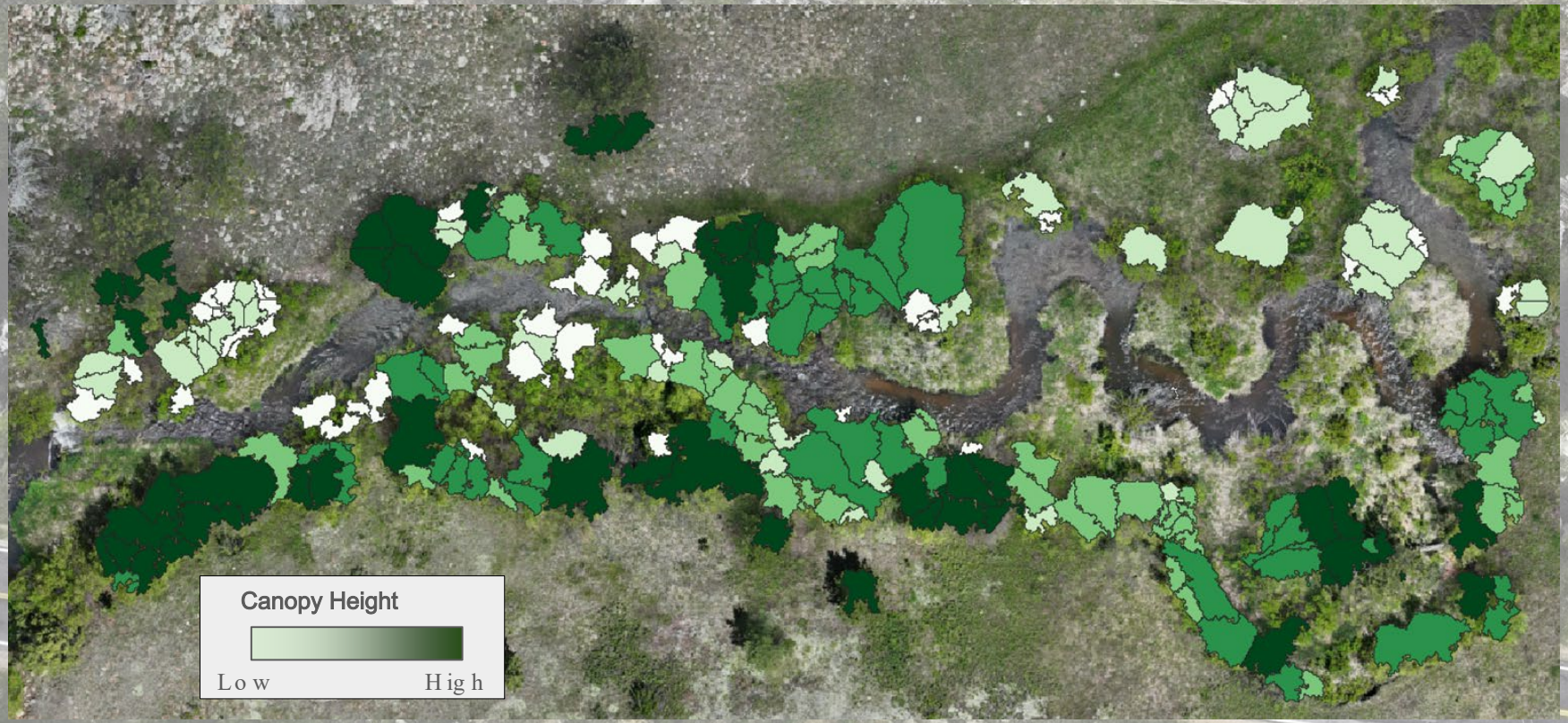
South Fork Poudre, Cache La Poudre Watershed

Vegetation Monitoring

Riparian Vegetation Inventory

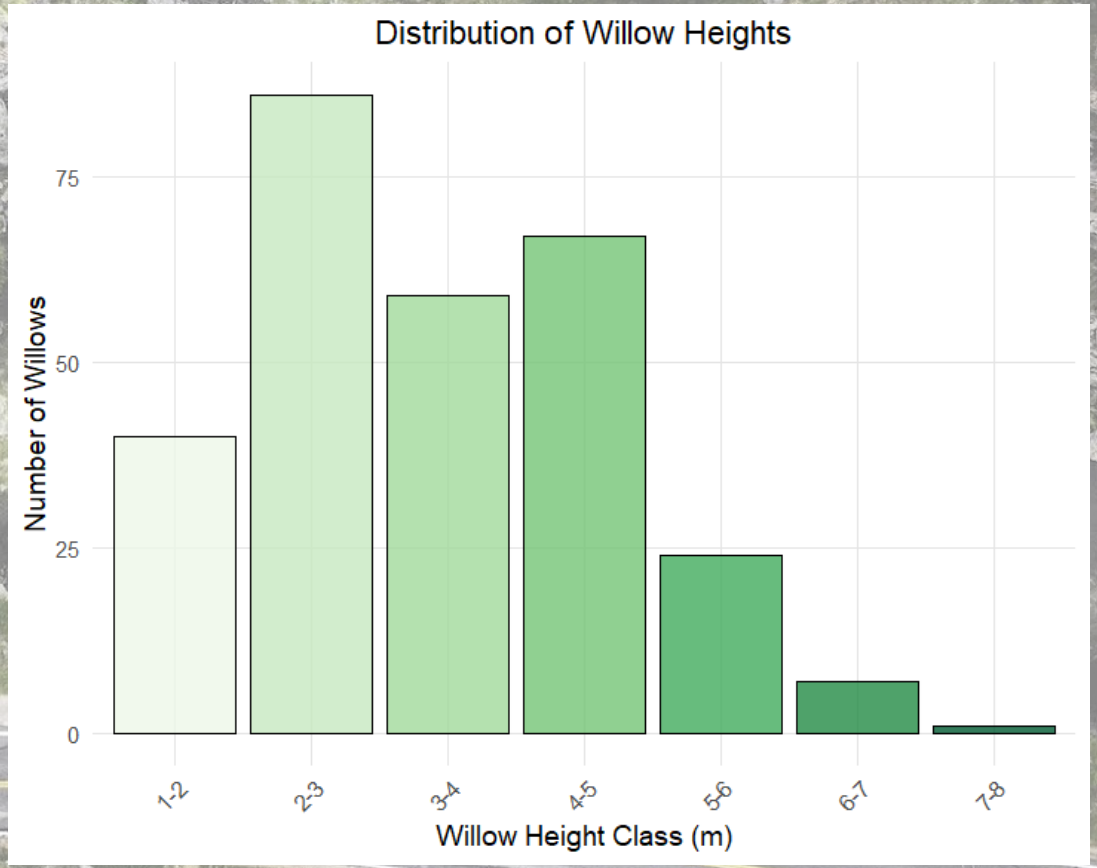
Vegetation Monitoring

Riparian Vegetation Inventory



Vegetation Monitoring

Riparian Vegetation Inventory

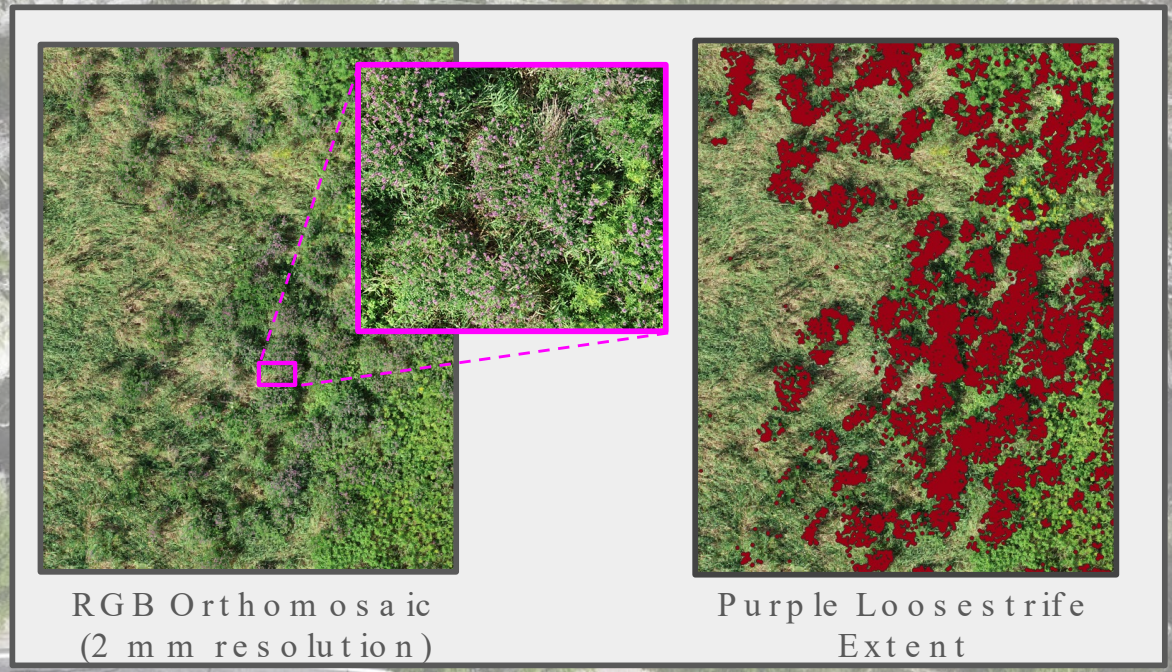


Invasive Species

Invasive Species Monitoring

- Drones enable targeting species specific phenology

- Multispectral sensors, and 3D information can be combined to improve detection.

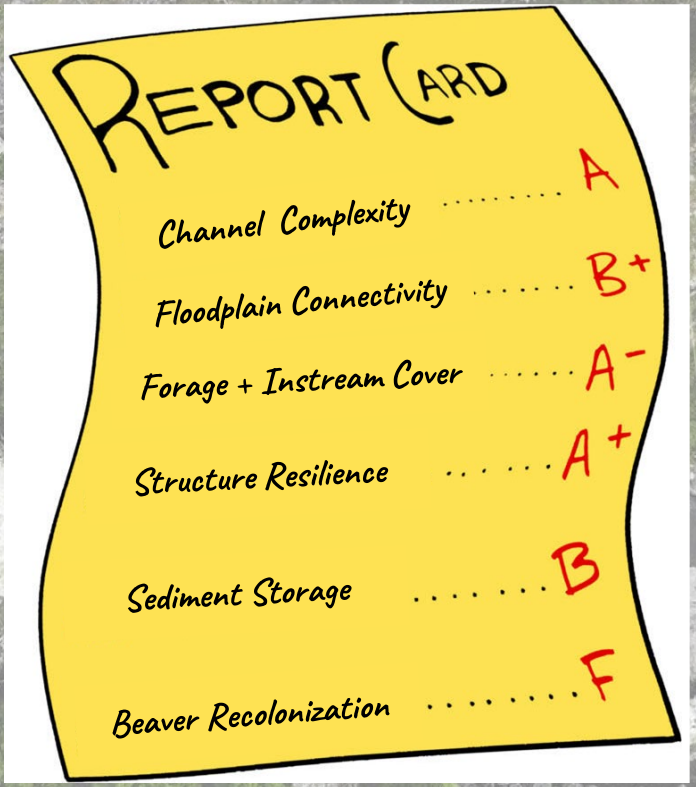


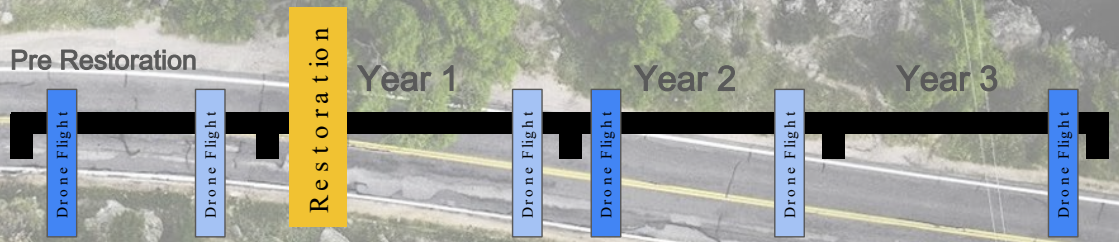
RGB Orthomosaic (2 mm resolution)

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

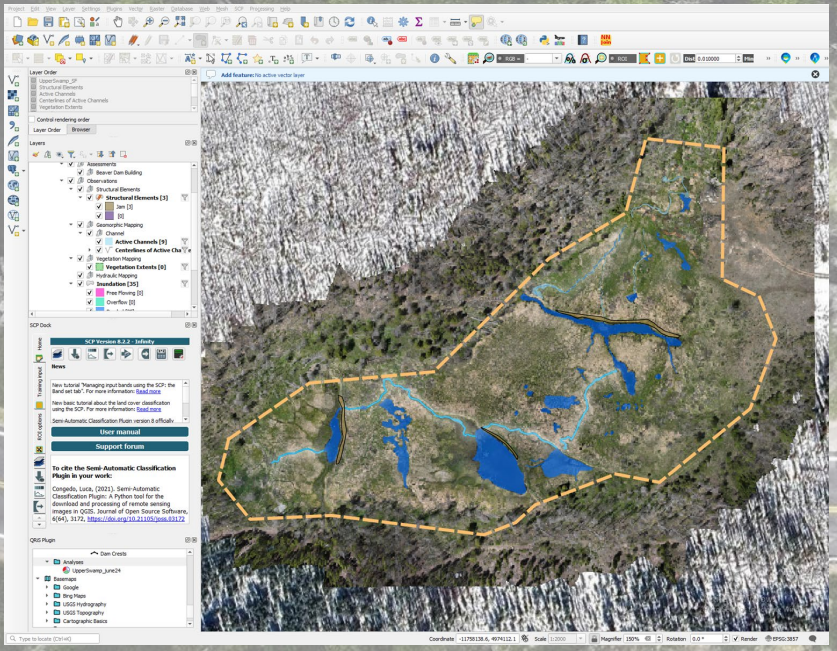


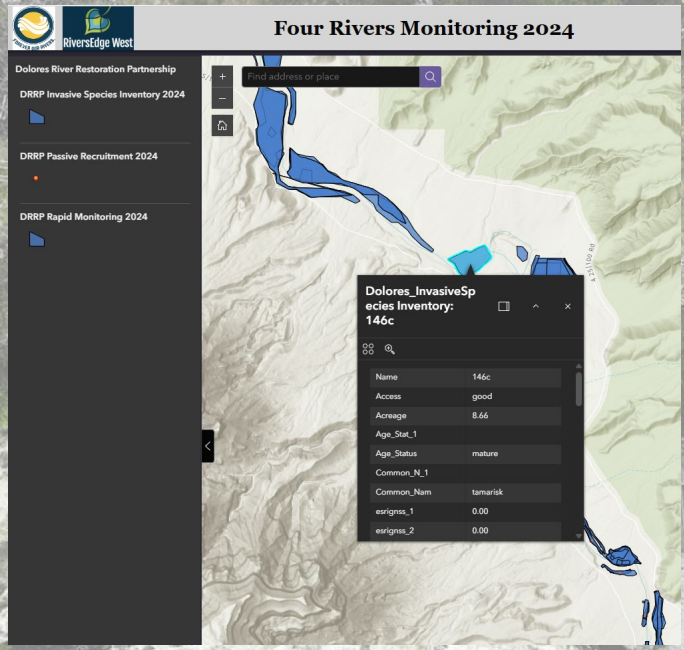


Collaboration and Public Engagement

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