SITE SELECTION AS A DRIVER OF PROJECT SUCCESS FOR PARTNERING WITH BEAVER IN COLORADO

Allison Vitello | Arable Earth
6.17.2024


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GOALS AND EXPECTED OUTCOMES

- How beaver-based restoration fits into the bigger picture of PBR and LTPBR
- The importance of site selection and looking through the “beaver lens”
- Why conflict mitigation is important and how to approach it

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WHAT IS PROCESS-BASED RESTORATION IN RIVER ECOSYSTEMS?

Process-based restoration is a form of ecological restoration that aims to aid rivers and floodplains return to their natural condition by helping to reestablish important natural processes (physical, chemical, and biological) that create and sustain river and floodplain ecosystems.

Adapted from Beechie *et al* (2010) "Process-based principles for restoring river ecosystems"

PROCESS-BASED RESTORATION PRINCIPLES

1. TARGET ROOT CAUSES OF HABITAT AND ECOSYSTEM CHANGE
2. TAILOR RESTORATION ACTIONS TO LOCAL POTENTIAL
3. MATCH THE SCALE OF RESTORATION TO THE SCALE OF THE PROBLEM
4. BE EXPLICIT ABOUT EXPECTED OUTCOMES

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Beaver influence and support physical, chemical, and biological ecosystem processes that create and sustain river and floodplain ecosystems.

Adapted from Beechie *et al* (2010) "Process-based principles for restoring river ecosystems"

BEAVER BASICS

BEAVER BASICS

- Beavers coppice or prune riparian vegetation for food and building material.
- Beavers build **lodges**, **food caches**, **dams**, & **canals**.
- Beavers need **ponds** for protection from predators and food storage
- Beaves build **dams** to create ponds
- Beavers dig **canals** to float building materials to their lodge and dams

Beaver

Beaver dams & channels

increased hydrologic heterogeneity

Floodplain wetland: ponds, canals, multiple channels, etc.

Vegetation & Wood

Fully Active Beaver Meadow

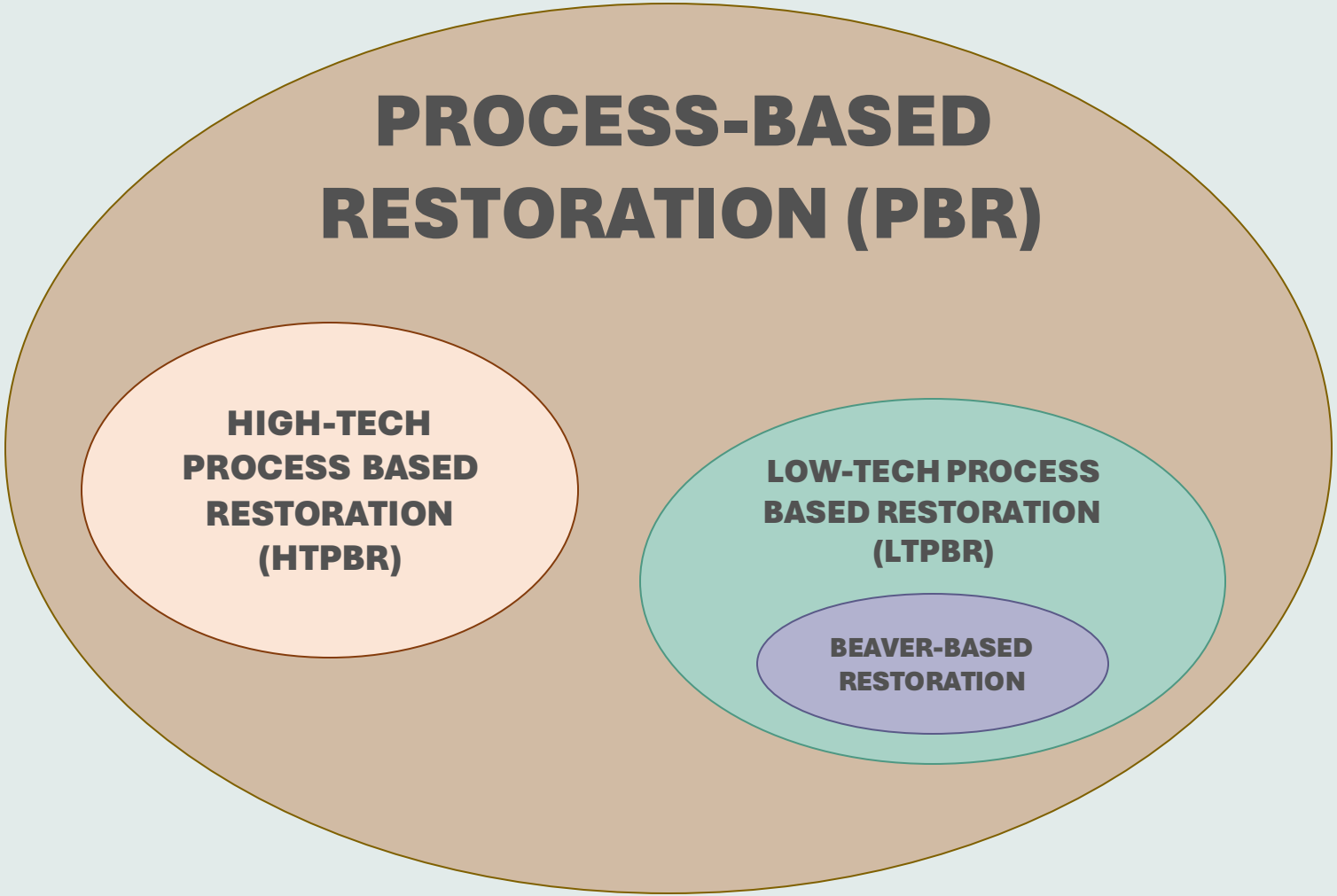
KEYSTONE BIOLOGICAL FEEDBACK LOOP OF TYPICAL BEAVER-INFLUENCED WETLAND.

WHAT IS BEAVER-BASED RESTORATION?

Beaver-based restoration is a form of low-tech process-based restoration that aims to reestablish natural processes that beaver performed prior to their systematic removal and suppression, ultimately supporting the recolonization of riverscapes by beaver.

Examples: strategic coexistence, relocation, & mimicry (BDAs & PALS)

Adapted from Jordan and Fairfax (2021) and Beardsley & Doran 2022


PROCESS-BASED RESTORATION (PBR)
HIGH-TECH PROCESS BASED RESTORATION (HTPBR)
LOW-TECH PROCESS BASED RESTORATION (LTPBR)
BEAVER-BASED RESTORATION

September 7, 2021: Pre-restoration implementation

Images curtesy of EcoMetrics

September 22, 2021: 2 weeks after restoration implementation

Images curtesy of EcoMetrics

August 22, 2022: 11 months after restoration implementation and est. 3 months after beaver moving in

Images curtesy of EcoMetrics

September 16, 2022: 1 year after phase 1 restoration implementation, 2 weeks after phase 2 restoration implementation, and est. 4 months after beaver moving in

Images curtesy of EcoMetrics

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QUESTIONS ON BEAVER-BASED RESTORATION?

GOALS AND EXPECTED OUTCOMES

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SITE SELCTION

Site selection is the practice of identifying a location for project implementation.

The purpose of site selection is to evaluate relevant data to choose the most suitable location for a project.

SITE SELCTION: BEAVER-BASED

Beaver-based restoration is only appropriate on riverscapes where beaver complexes naturally existed prior to human disturbance.

Wheaton et al. 2019, Pollock et al. 2017, and Beardsley & Doran 2022

SITE SELCTION: BEAVER-BASED

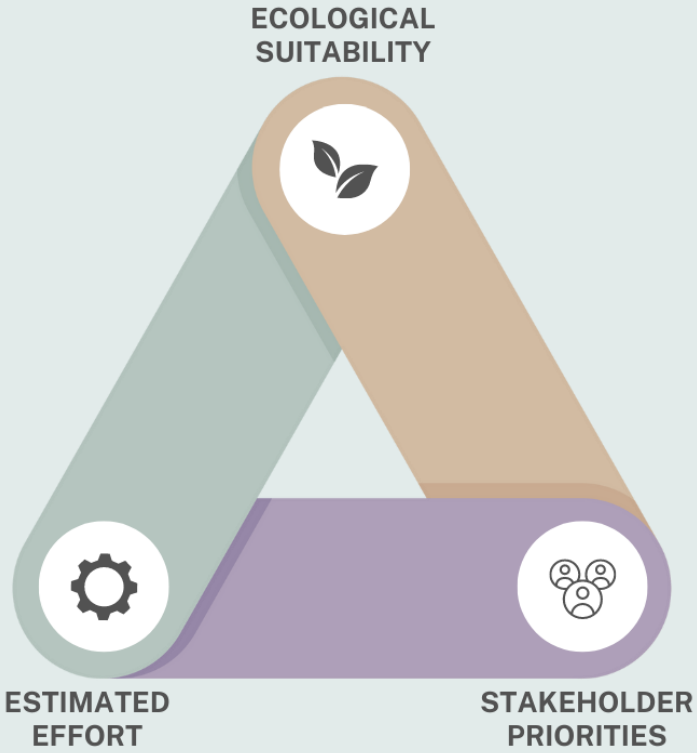
Beaver-based LTPBR is only appropriate on riverscapes where beaver complexes naturally existed prior to human disturbance.

Failing to take other critical criteria into consideration when selecting sites for beaver-related LTPBR projects puts the success of those projects at risk.

Note: Not every location where beaver would have naturally occurred is an ideal spot for LTPBR.

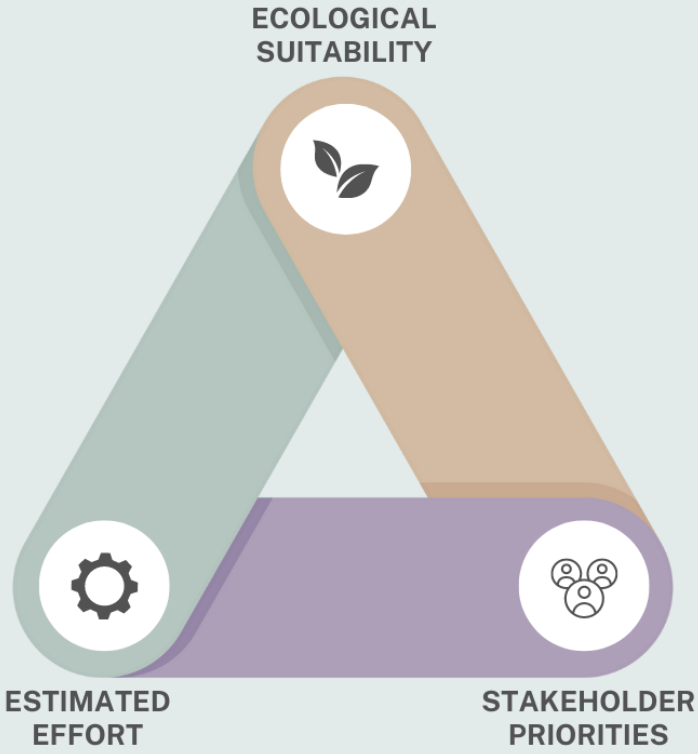
Wheaton et al. 2019, Pollock et al. 2017, and Beardsley & Doran 2022

SITE SELCTION: A UNIQUE BALANCE



SITE SELCTION: ECOLOGICAL SUITABILITY

- **KEY FACTORS:**
  - BEAVER POPULATION
  - HYDROLOGY
  - GEOMORPHOLOGY
  - VEGETATION
  - LAND USE/INFRASTRUCTURE



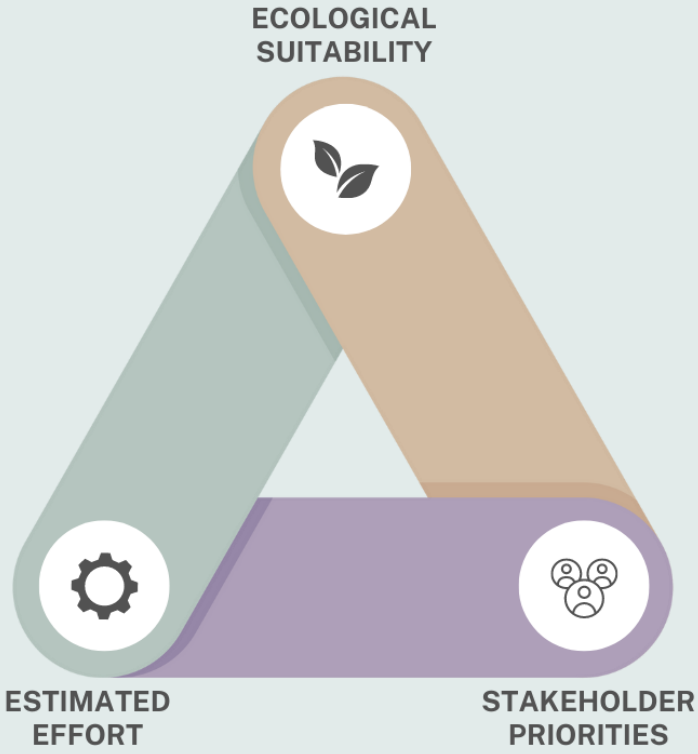
SITE SELCTION: ECOLOGICAL SUITABILITY

BEAVER POPULATION	• Current beaver activity & capacity • Historical beaver capacity • Restorable beaver capacity
HYDROLOGY	• Perennial flow • Flow volume
GEOMORPHOLOGY	• Wide valley-bottom • Low-gradient
VEGETATION	• Lots of woody and herby vegetation
LAND USE/INFRASTRUCTURE	• Minimal land use and infrastructure conflicts

Beardsley & Doran 2022

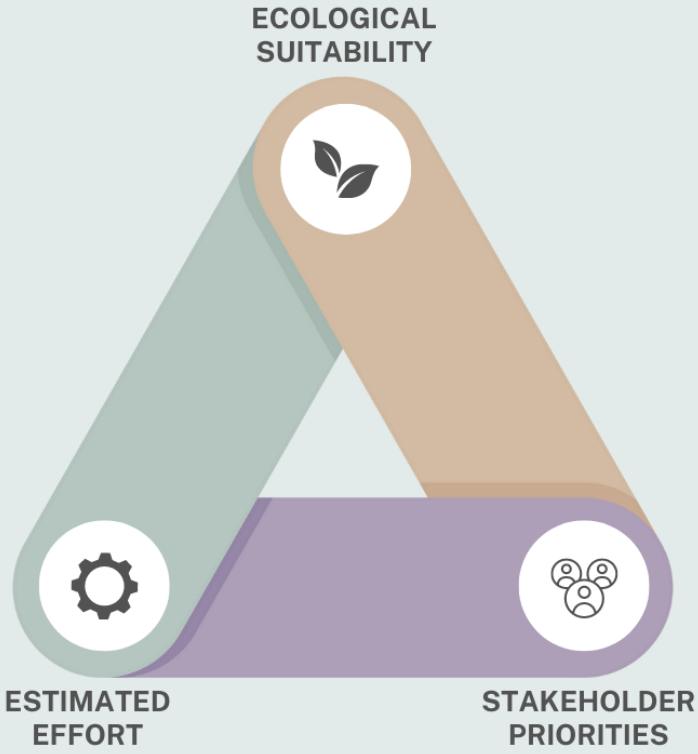
SITE SELCTION: STAKEHOLDER PRIORITIES

- **STAKEHOLDER IDENTIFICATION**
  - Project proponents
  - Land owners/managers
  - Funders
  - Local organizations
  - Water Conservancy Districts
  - Tribes
  - Many more!



SITE SELCTION: STAKEHOLDER PRIORITIES

- **KEY FACTORS:**
  - LOCATION
  - DRIVING PROJECT PURPOSE
  - INDIVIDUAL GOALS, MISSIONS, AND CONFLICTS

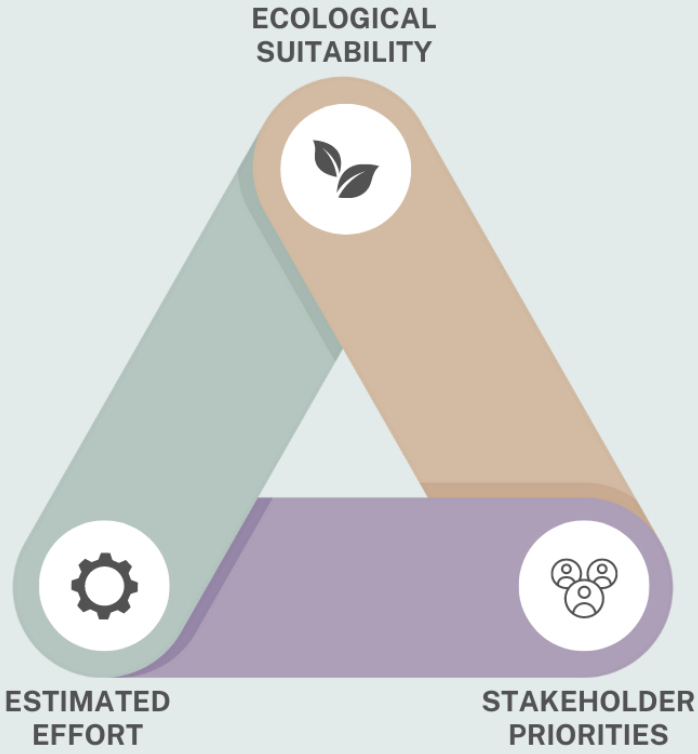


SITE SELCTION: STAKEHOLDER PRIORITIES

LOCATION	• Watershed -> reach • Land ownership • Land use • Water use
DRIVING PROJECT PURPOSE	• Riverscape/watershed health • Fish & wildlife habitat • Fire breaks/recovery • Sediment retention • Flood mitigation
MISC.	• Perceived and actual conflicts • Long term management goals • Stakeholder missions

SITE SELCTION: ESTIMATED EFFORT

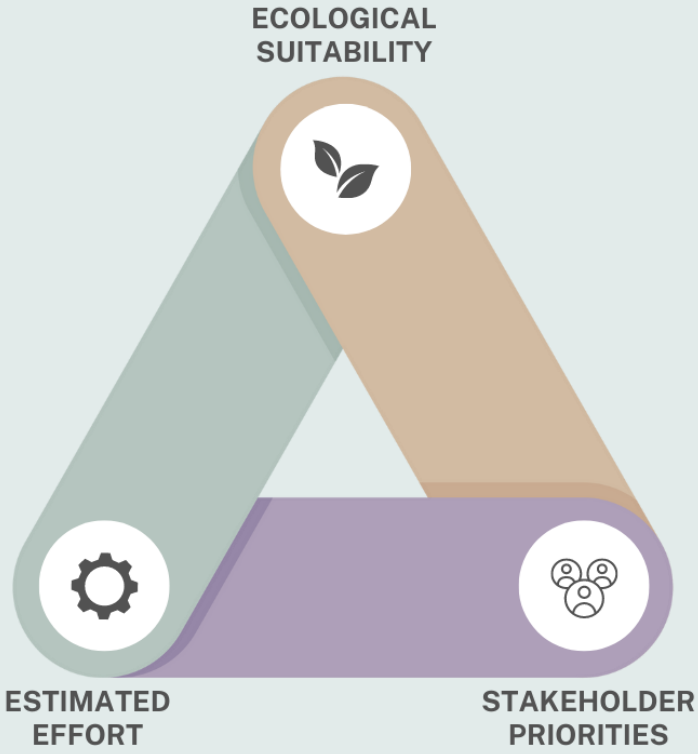
- **KEY FACTORS:**
  - LOCATION
  - IMPAIRMENT
  - MATERIALS



SITE SELCTION: EFFORT

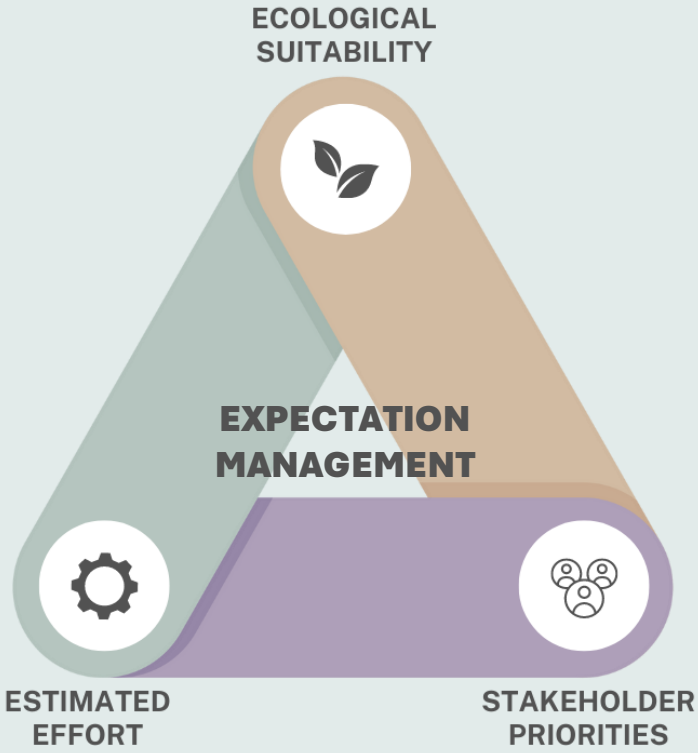
LOCATION	• Accessibility • Land ownership
IMPAIRMENT	• Beaver population • Hydrology • Geomorphology • Vegetation • Land use/infrastructure
MISC.	• Native material supply • Sediment composition • Funding longevity

SITE SELCTION



SITE SELCTION: EXPECTATION MANAGEMENT

- Well executed site selection should result in good expectation management.



SITE SELCTION: EXPECTATION MANAGEMENT

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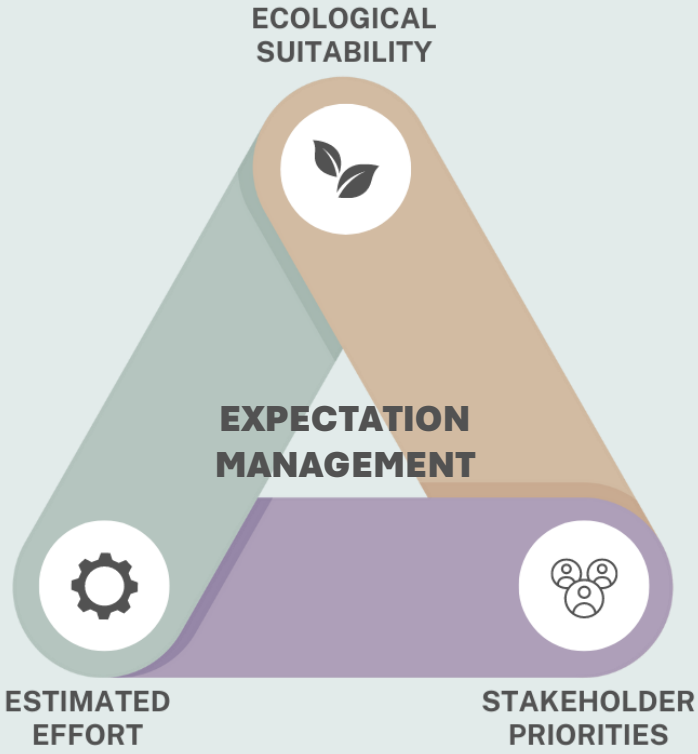
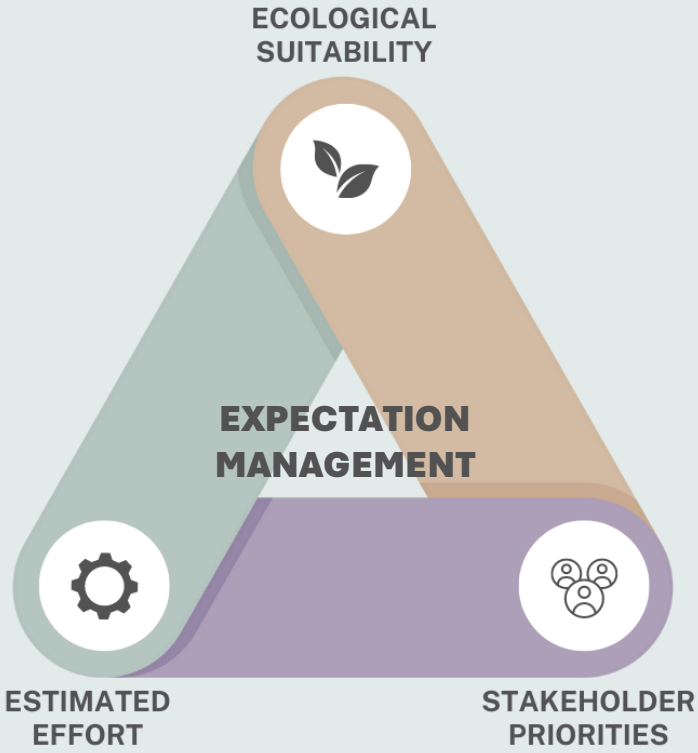
- **“4. BE EXPLICIT ABOUT EXPECTED OUTCOMES”**



SITE SELCTION: EXPECTATION MANAGEMENT

- Well executed site selection should result in good expectation management.
- “4. BE EXPLICIT ABOUT EXPECTED OUTCOMES”
- **If you know the ecological suitability, stakeholder priorities, and estimated effort involved, you can make better predictions about expected outcomes.**

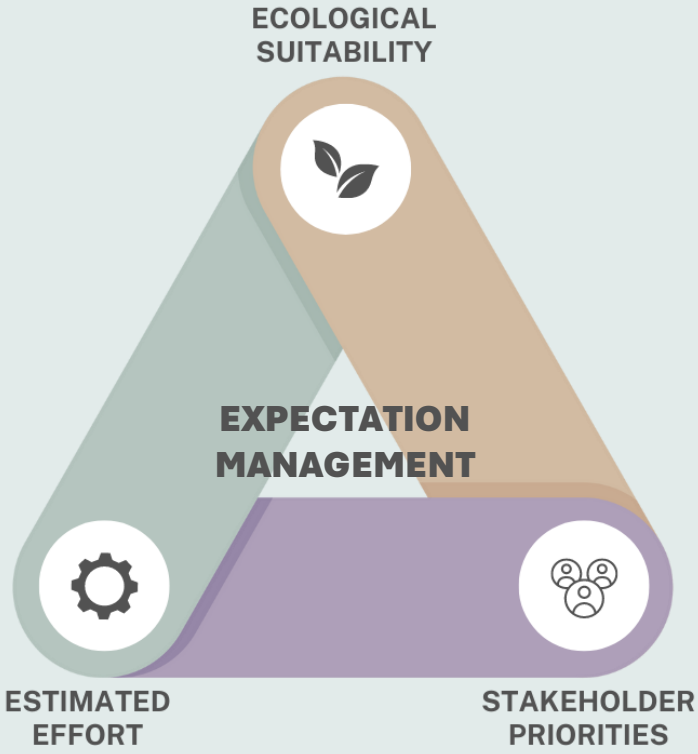


SITE SELCTION: EXPECTATION MANAGEMENT

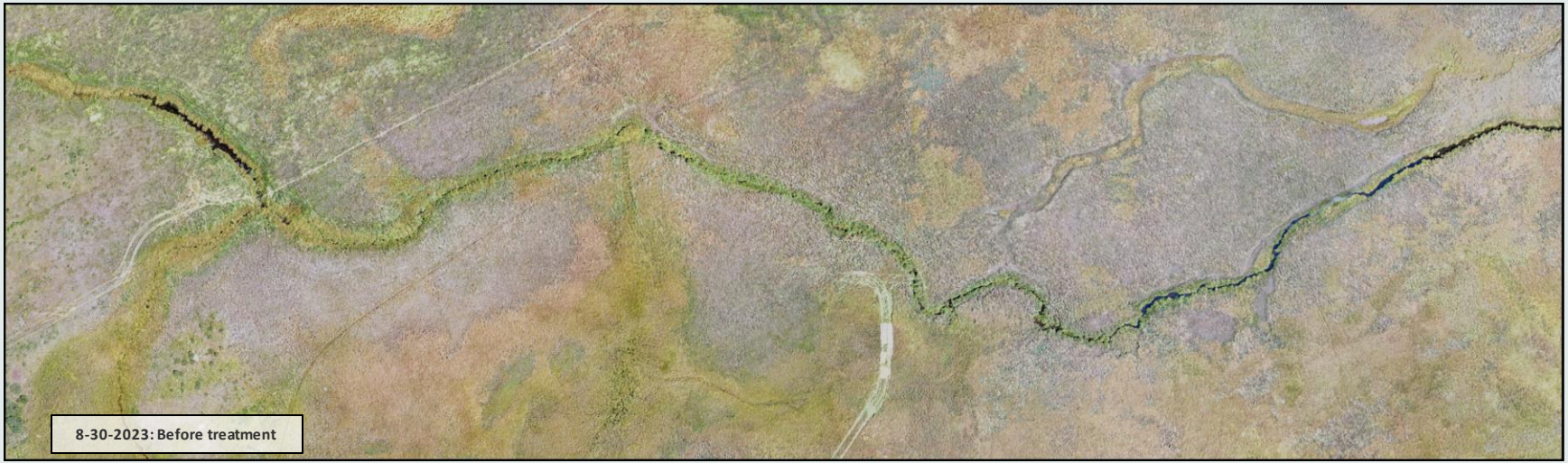
COST	• Cost varies greatly • Total costs can add up, especially over multiple years of applications
TIME	• Time to recovery varies greatly • Most sites require more than on application of structures
ENERGY	• Typical hurdles include funding, permitting, finding qualified practitioners, implementation, monitoring, adaptive management, conflicts, etc. • Are you ready to put effort into a project in the long term?
OUTCOMES	• Outcomes for LTPBR can vary widely. • It can take many years for beaver to return to a site, for it to achieve stage-0, and other markers of success to come about.

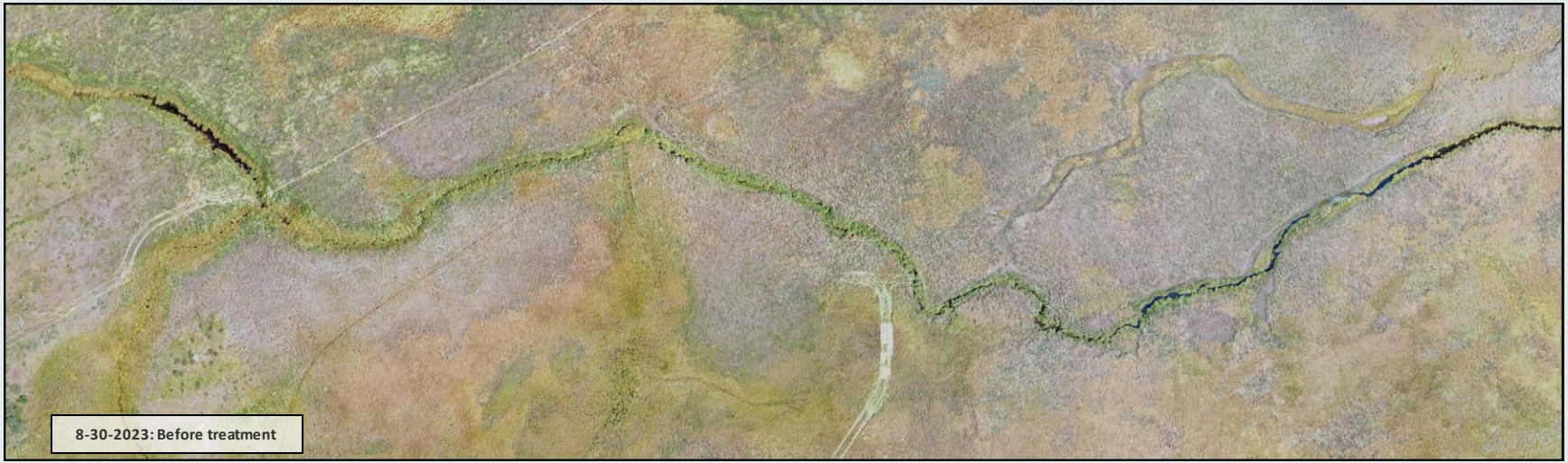
SITE SELCTION

Good site selection is the primer for successful projects and happy stakeholders.



A UNIQUE EXAMPLE: CRESTED BUTTE, CO


8-30-2023: Before treatment



STAKEHOLDER PRIORITIES:

- Restore open space parcel
- Open to long term relationship
- Appropriate funding and timeline

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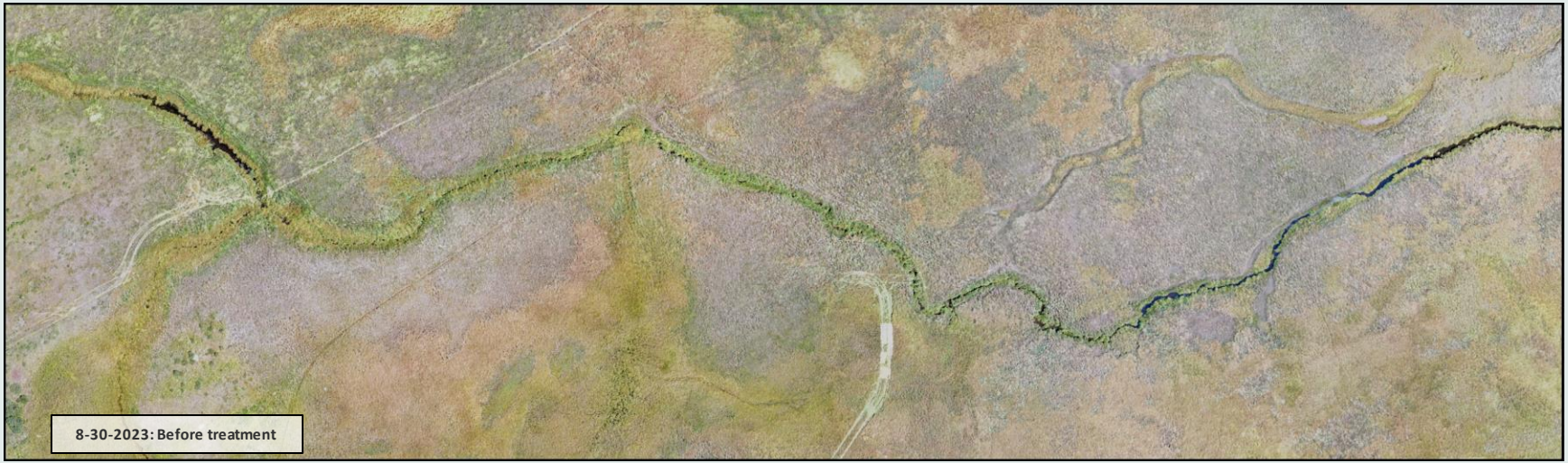
ECOLOGICAL SUITABILITY:

- Historic beaver occupancy
- Vegetation main limitation



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EFFORT:

- Moderate to high effort
- already removing fencing and limiting grazing
- Limited on-site materials

STAKEHOLDER PRIORITIES: EXCELLENT

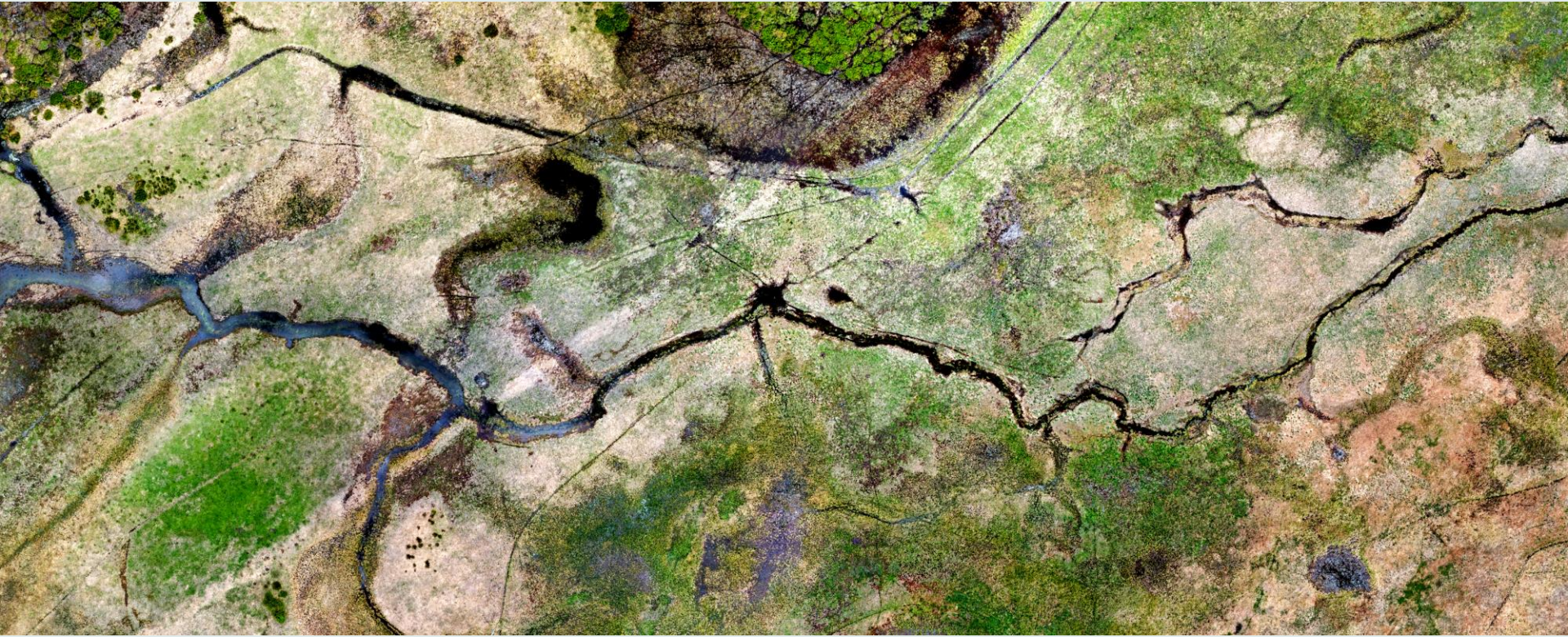
ECOLOGICAL SUITABILITY: MODERATE

EFFORT: MODERATE TO HIGH

EXPECTATION MANAGEMENT: EXCELLENT


8-30-2023: Before treatment

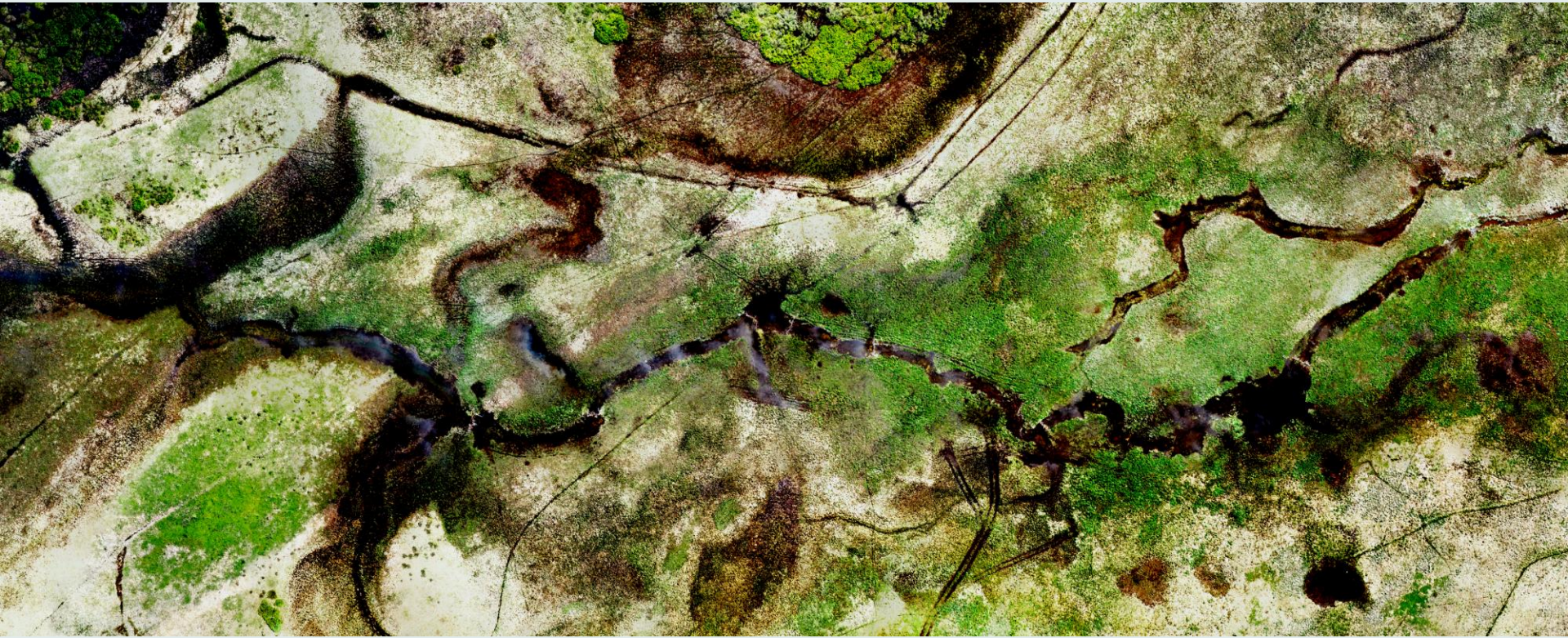

Beaver dam analog (27)
Sod speedbump (1)
Woody material structure (10)
10-25-2023: After treatment



June 11, 2023: Pre-restoration implementation (high flow)

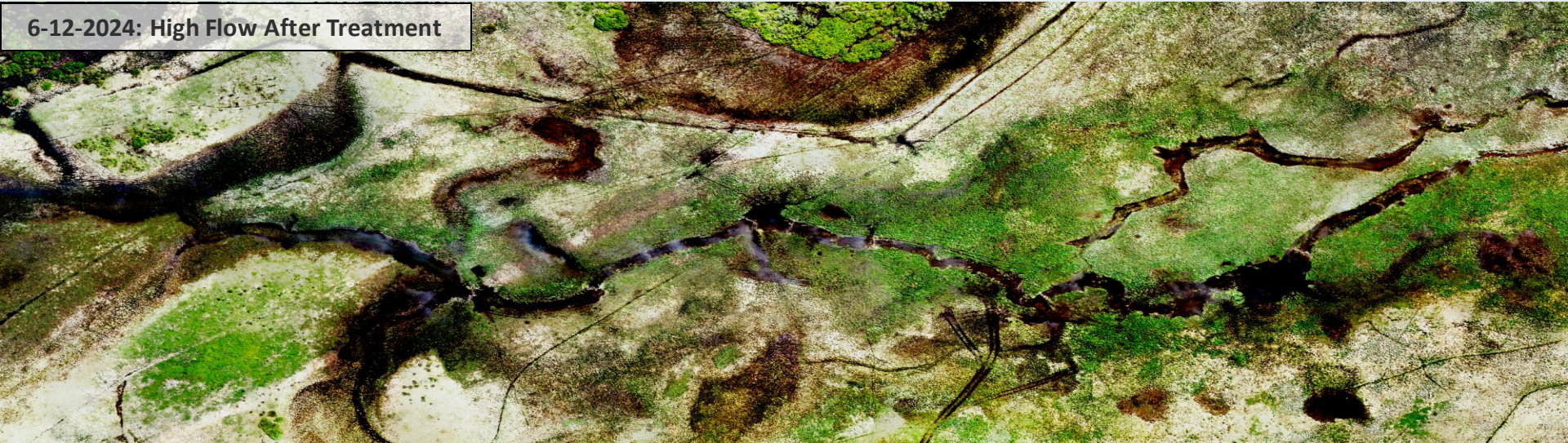
August 8, 2023: before restoration implementation (low flow)

October 25, 2023: 5 weeks restoration implementation (low flow)



June 12, 2024: 9 months after phase 1 restoration implementation (high flow)


6-11-2023: High Flow Before Treatment


6-12-2024: High Flow After Treatment


10-25-2023: Low Flow After Treatment


6-12-2024: High Flow After Treatment

Good site selection is the primer for successful projects and happy stakeholders.

QUESTIONS ON SITE SELECTION?

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EXPECTED OUTCOMES OF BEAVER-BASED RIVERSCAPE RESTORATION

- Beaver population increases
- No. of beaver dams & canals increases
- Sediment, hydrologic, and temperature heterogeneity increases
- Long-term sediment aggradation increases
- Extent, density, and biodiversity of riparian/wetland species increases

Adapted from Nash et. al (2021)

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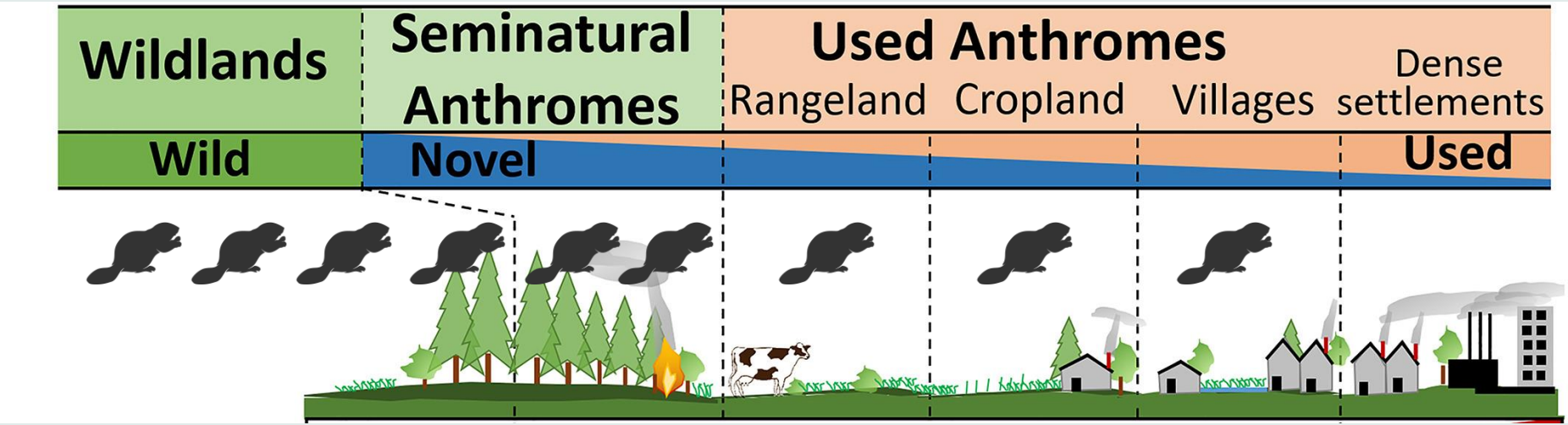
EXPECTED OUTCOMES OF BEAVER-BASED RIVERSCAPE RESTORATION

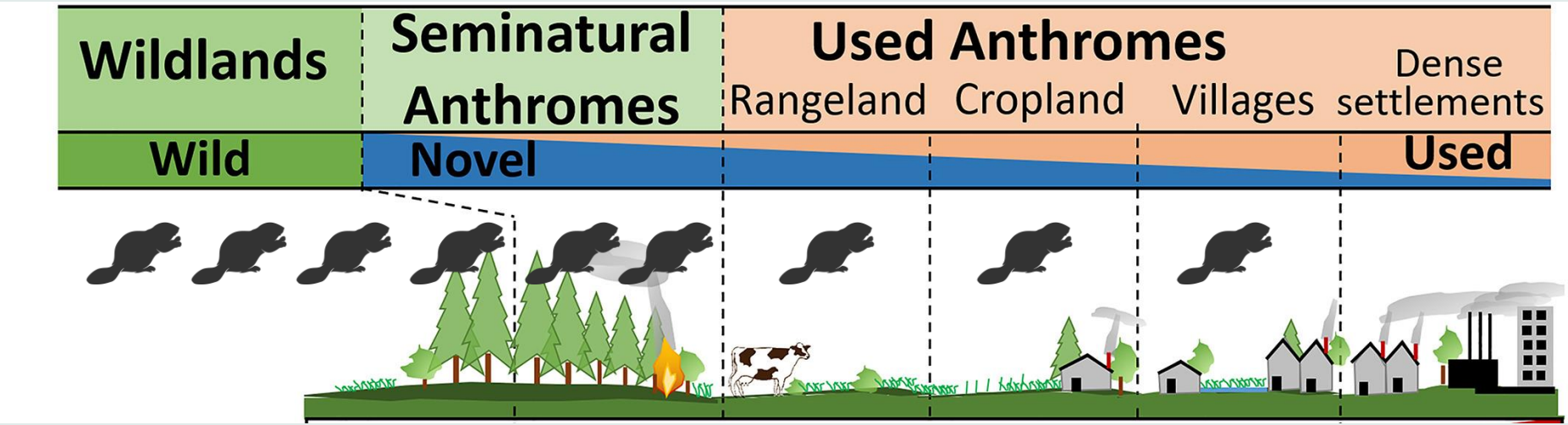
1. Beaver population increases

LANDSCAPE-SCALE GOAL:
THE RETURN OF VIABLE AND RESILIENT BEAVER POPULATIONS TO THEIR NATIVE RANGES.



Adapted from Johnson et al. (2019)

***Anthrome = human-influenced biome** sustained through complex interactions between natural and human systems



WHAT HAPPENS WHEN BEAVER INTERACT WITH HUMANS?

Adapted from Johnson et al. (2019)

***Anthrome = human-influenced biome** sustained through complex interactions between natural and human systems

Beaver build dams...

on drainage structures...

on irrigation headgates...


behind culverts...


in front of culverts...


and inside of culverts...


and... beaver chew trees.

CONFLICTS CAN HAVE BIG CONSEQUENCES

These interactions cost landowners and land managers time & money.

These conflicts can lead to:

- lethal management of beaver
- decreased tolerance for beaver
- decreased enthusiasm or support for beaver-based restoration efforts

HIGH-HANGING FRUIT

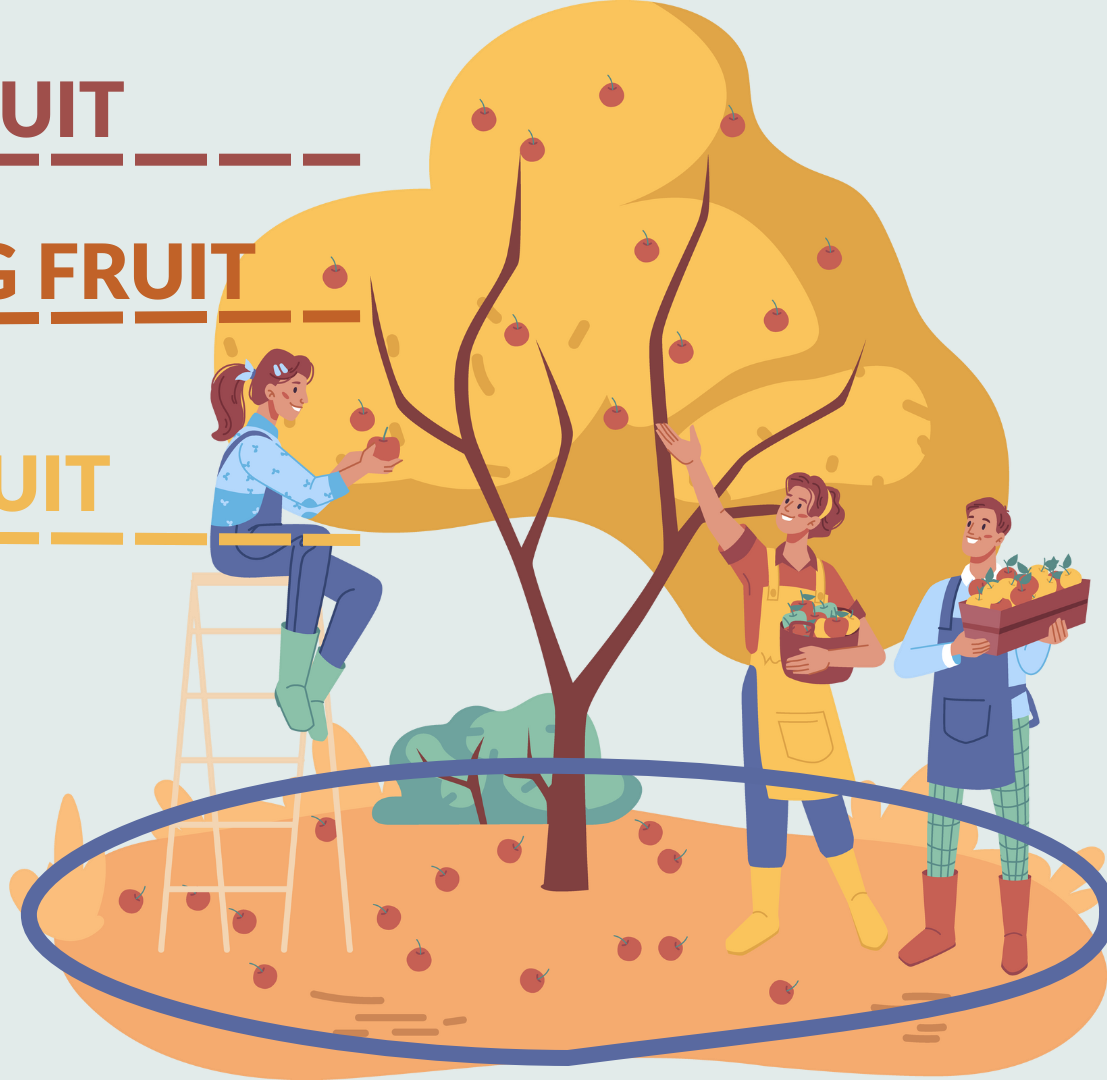
MEDIUM-HANGING FRUIT

LOW-HANGING FRUIT

HIGH-HANGING FRUIT

MEDIUM-HANGING FRUIT

LOW-HANGING FRUIT



HIGH-HANGING FRUIT

MEDIUM-HANGING FRUIT

LOW-HANGING FRUIT

GROUND FRUIT

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HOW CAN WE RESOLVE CONFLICTS WITH BEAVER?

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PRIMARY BEAVER COEXISTANCE STRATEGIES

1. Tree Wrapping
2. Starter Dams
3. Culvert Protective Fences
4. Fence and Pipe Device

PRIMARY BEAVER COEXISTANCE STRATEGIES

1. **Tree Wrapping**
2. Starter Dams
3. Culvert Protective Fences
4. Fence and Pipe Device

TREE WRAPPINGS

THE ISSUE: Beaver will take down trees for food and building materials. Usually this is an issue in residential or suburban areas with planted or highly valued individual trees.

THE SOLUTION: Protecting trees by wrapping them in wire mesh. Installing 2”x4” wire mesh cylinders with a minimum of a 3”-6” gap around the base of tree trunks. This keeps the beaver from accessing the trees, when done properly it’s 100% effective.

DIFFICULTY/EXPENSE:

Relatively inexpensive and easy!

PRIMARY BEAVER COEXISTANCE STRATEGIES

1. Tree Wrapping
2. **Starter Dams**
3. Culvert Protective Fences
4. Fence and Pipe Device

STARTER DAMS

THE ISSUE: Sometimes land managers or restoration practitioners want to preemptively protect a culvert or other structure from expected increases in beaver activity or in areas where beaver are known to sometimes be active.

THE SOLUTION: A porous starter dam (not dissimilar from a BDA) can be installed preemptively approximately 10-15' upstream of a culvert to prevent beaver from damming directly on a culvert. It works by encouraging the beaver to dam upstream of the culvert (on the starter dam) rather than inside the culvert. These are the simplest and

DIFFICULTY/EXPENSE:

Relatively inexpensive and easy!

image courtesy of EcoMetrics LLC

PRIMARY BEAVER COEXISTANCE STRATEGIES

1. Tree Wrapping
2. Starter Dams
3. **Culvert Protective Fences**
4. Fence and Pipe Device

FENCE DEVICE

THE ISSUE: Beaver damming a culvert, irrigation headgate, or similar structure.

THE SOLUTION: A fence installed in a specific way to prevent beaver from damming a culvert – built with enough surface area and strength to tolerate some damming. Fencing can be used where there is little to no tolerance for upstream flooding.

DIFFICULTY/EXPENSE:

Moderate expense and expertise required.

PRIMARY BEAVER COEXISTANCE STRATEGIES

1. Tree Wrapping
2. Starter Dams
3. Culvert Protective Fences
4. **Fence and Pipe Device**

FENCE AND PIPE DEVICE

THE ISSUE: Flooding from damming is too high and threatening some form of infrastructure.

THE SOLUTION: Fence and pipe devices allow beaver to have some ponding while limiting the height of the water to a safe level.

Install a small exclusion fence directly on structure with a pond leveler pipe that controls the height of the dam. End of pipe is fitted with a fence “filter”. Pool depth must be at least three feet for device to be effective.

DIFFICULTY/EXPENSE:

Moderate expense and expertise required.

images courtesy of EcoMetrics LLC.

HIGH-HANGING FRUIT

MEDIUM-HANGING FRUIT

LOW-HANGING FRUIT

GROUND FRUIT

QUESTIONS ON CONFLICT RESOLUTION?

ACKNOWLEDGMENTS

These projects would not be possible without the amazing support of many partners and funders!
Projects featured in this presentation were funded by National Forest Foundation, Colorado Parks and Wildlife, Town of Creste d Butte, Sustainable Tourism and Outdoor Recreation Committee, Beaver Institute, Biophilia Foundation, and Coal Creek Watershed Coalition.
A big enough thank you cannot be said for all the volunteers who have come on site to perform meaningful work!

QUESTIONS?

ALLI@ARABLEEARTH.COM