The FIT Principle: A Wetland Restoration Roadmap for Practitioners

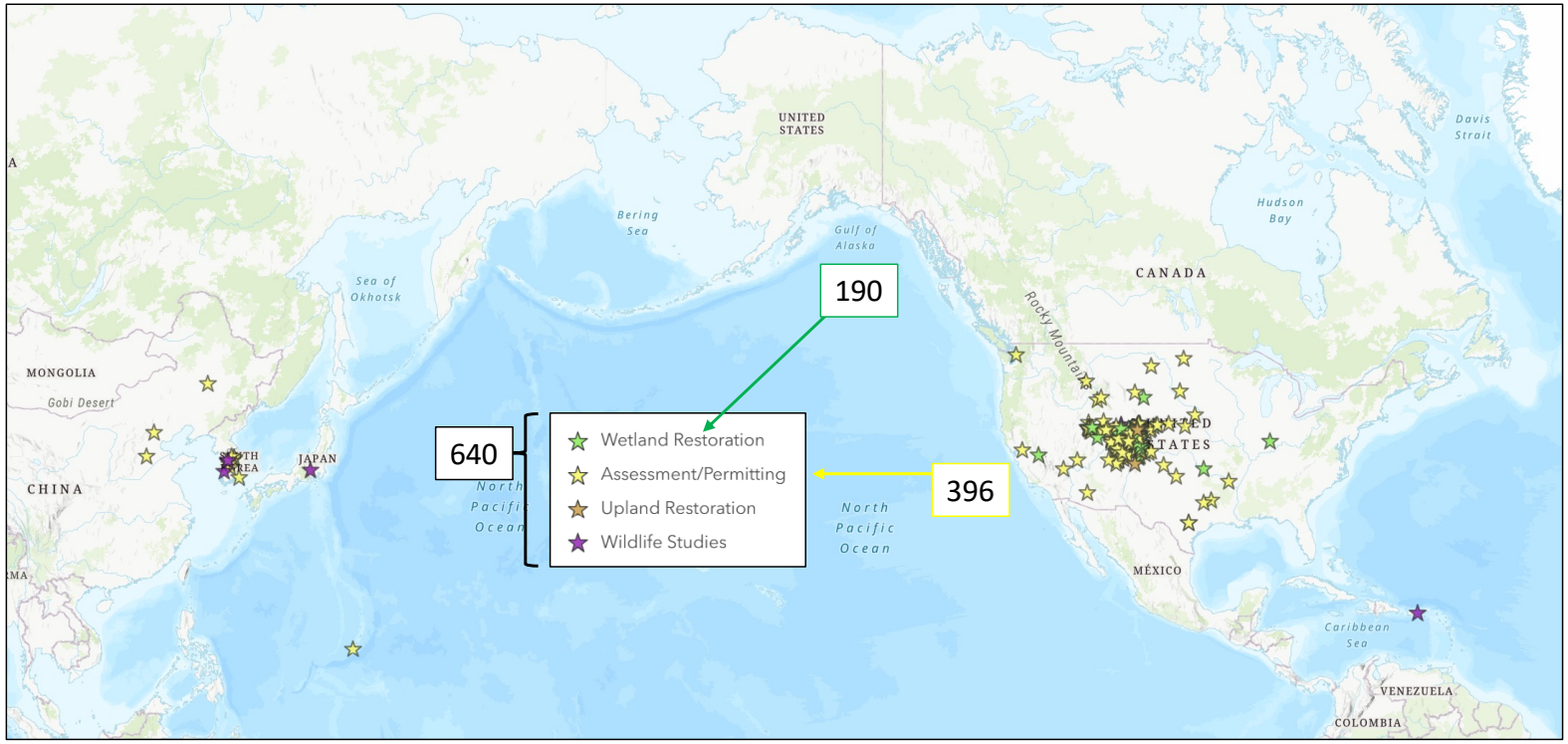
Andy Herb, AlpineEco

Project RARE

Science and Practice in Service of Wetlands

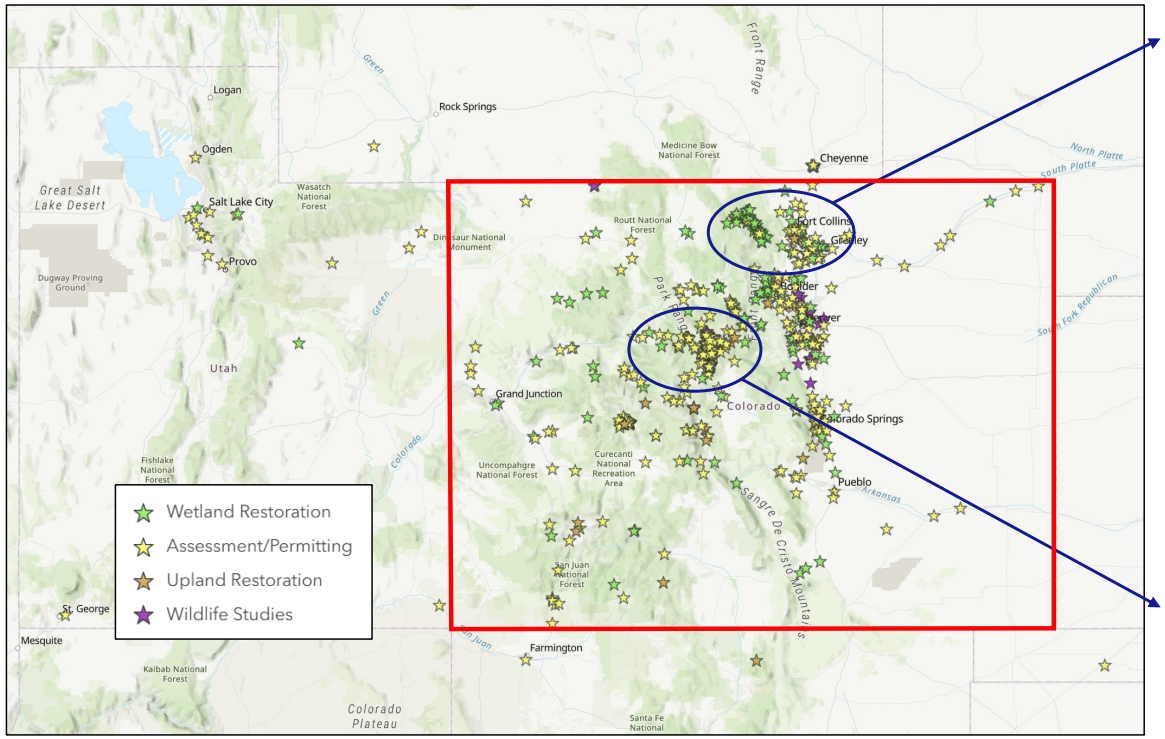
March 18, 2026

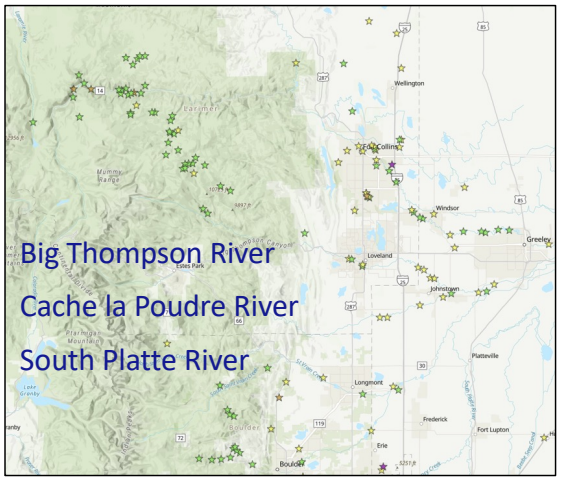
Introduction

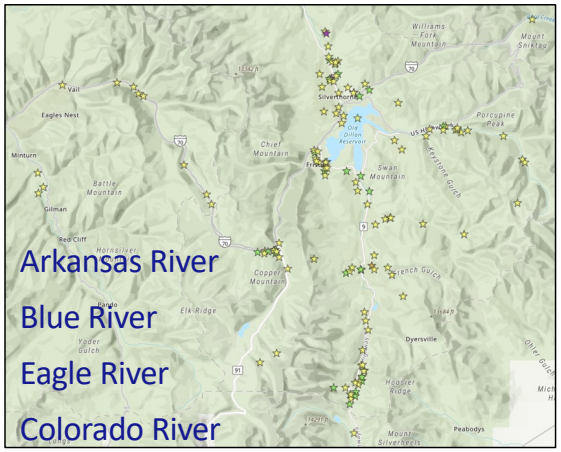


Introduction

Introduction







Outline

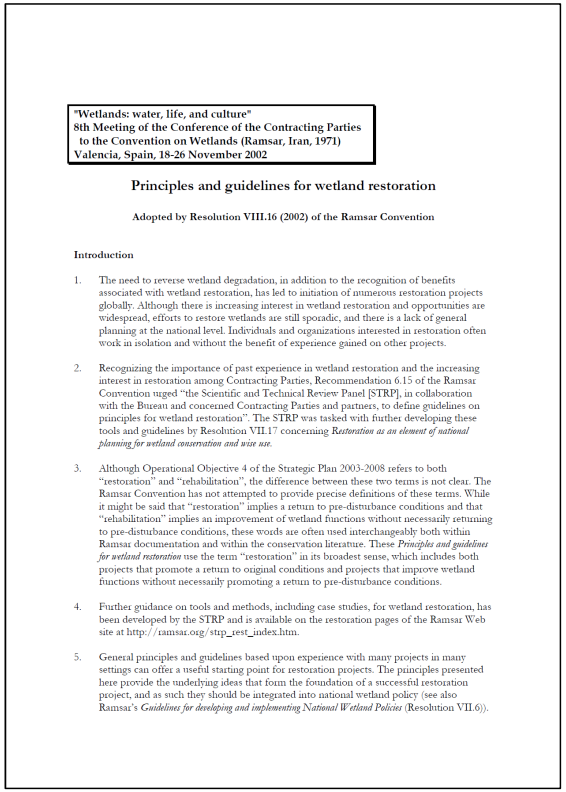
- Ramsar Guidance
- FIT Principle: Understanding the Problem
- Restoration Treatments
- Looking Ahead
- Key Points

Bella Coola, BC

Ramsar Guidance

Principles and Guidelines for Restoration (2002)

- Clear goals, objectives, and performance standards
- Consideration of natural processes
- Watershed approach
- Stakeholder engagement
- Self-maintenance
- Stewardship and adaptive management



"Wetlands: water, life, and culture"
8th Meeting of the Conference of the Contracting Parties
to the Convention on Wetlands (Ramsar, Iran, 1971)
Valencia, Spain, 18-26 November 2002

Principles and guidelines for wetland restoration

Adopted by Resolution VIII.16 (2002) of the Ramsar Convention

Introduction

1. The need to reverse wetland degradation, in addition to the recognition of benefits associated with wetland restoration, has led to initiation of numerous restoration projects globally. Although there is increasing interest in wetland restoration and opportunities are widespread, efforts to restore wetlands are still sporadic, and there is a lack of general planning at the national level. Individuals and organizations interested in restoration often work in isolation and without the benefit of experience gained on other projects.

2. Recognizing the importance of past experience in wetland restoration and the increasing interest in restoration among Contracting Parties, Recommendation 6.15 of the Ramsar Convention urged "the Scientific and Technical Review Panel [STRP], in collaboration with the Bureau and concerned Contracting Parties and partners, to define guidelines on principles for wetland restoration". The STRP was tasked with further developing these tools and guidelines by Resolution VII.17 concerning *Restoration as an element of national planning for wetland conservation and wise use.*

3. Although Operational Objective 4 of the Strategic Plan 2003-2008 refers to both "restoration" and "rehabilitation", the difference between these two terms is not clear. The Ramsar Convention has not attempted to provide precise definitions of these terms. While it might be said that "restoration" implies a return to pre-disturbance conditions and that "rehabilitation" implies an improvement of wetland functions without necessarily returning to pre-disturbance conditions, these words are often used interchangeably both within Ramsar documentation and within the conservation literature. These *Principles and guidelines for wetland restoration* use the term "restoration" in its broadest sense, which includes both projects that promote a return to original conditions and projects that improve wetland functions without necessarily promoting a return to pre-disturbance conditions.

4. Further guidance on tools and methods, including case studies, for wetland restoration, has been developed by the STRP and is available on the restoration pages of the Ramsar Web site at http://ramsar.org/stp_rest_index.htm.

5. General principles and guidelines based upon experience with many projects in many settings can offer a useful starting point for restoration projects. The principles presented here provide the underlying ideas that form the foundation of a successful restoration project, and as such they should be integrated into national wetland policy (see also Ramsar's *Guidelines for developing and implementing National Wetland Policies* (Resolution VII.6)).

Ramsar Guidance

Benefits of Wetland Restoration (2012)

- Stop wetland loss
- Prioritize wetland protection & restoration
- Role of restoration
- Holistic restoration objectives
- Recognize the full suite of restoration benefits

STRP
Scientific and Technical Review Panel

Briefing Note
Number 4, May 2012

Ramsar
Ramsar Convention on Wetlands

Purpose of this BN

This Briefing Note provides advice on how to prioritize and implement the adopted Ramsar principles and guidelines on wetland restoration (Annex 1). It also advises on the relevance of other guidance to assist the following audiences in restoring wetlands:

- Ramsar National Focal Points; national, subnational and local policy-makers; legislators and regulators; administrators; planning and implementing bodies involved in restoration of degraded wetlands; and
- Practitioners implementing wetland restoration activities on the ground, including inter alia wetland managers, NGOs, communities, corporations, and local/state/provincial councils and administrative units.

Authors

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Robert McInnes, STRP Representative of the Society of Wetland Scientists

The benefits of wetland restoration

The primary objective of this Briefing Note is to raise awareness, across all sectors, of the potential benefits of wetland restoration. Its intention is to catalyse efforts that stem the loss and degradation of wetlands, enhance ecosystem functioning, and thus increase wetland benefits. By highlighting the linkages with existing Ramsar documentation, this Briefing Note expands upon the existing guidance on wetland restoration while referencing other examples of publicly available documents in the last section.

Key Messages

Stop the global loss of wetlands

The world's wetlands continue to be lost and degraded at an alarming rate as a result of human activities. Consequently, the essential benefits provided by wetlands to people continue to be seriously eroded. These benefits, derived from wetland ecosystem services, are unique, varied and extend across many sectors, but their contribution and value is not always fully captured in wetland management decision-making. A better understanding of wetland benefits is required in order to make the case for halting further loss and degradation, and to support activities that assist in the recovery of their biodiversity and ecosystem functioning.

Prioritize the protection and restoration of wetlands

Removing the stressors or pressures on the ecological character of wetlands is the best practice for preventing further loss and degradation; when this is not feasible, however, or when degradation has already occurred, wetland restoration must be considered as a potential response option. The commitments and obligations under the Ramsar Convention clearly mandate wise use and the avoidance of wetland loss and degradation in the first instance. The Convention has also provided national governments and others with a framework on how to avoid, mitigate and compensate for wetland loss and degradation which includes opportunities for wetland restoration.

Understand the appropriate role for wetland restoration

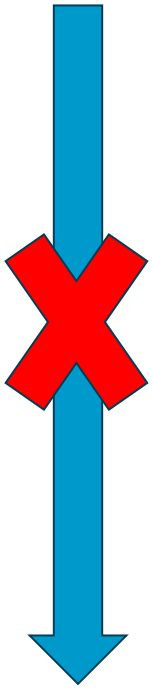
Restoration is not a substitute for protecting and ensuring the wise use of wetlands, i.e., the potential to restore a wetland is not a justification or suitable trade-off for the continued degradation of wetlands. Furthermore, while restoration can play an important role in enhancing wetland benefits, experience shows that a "restored" wetland rarely provides the full range and magnitude of services delivered by a wetland that has not been degraded.

Encourage holistic wetland restoration objectives

In the past, some wetland restoration efforts have failed due to, among other things, narrow objectives which focus on one benefit or a partial suite of ben-

Download PDF at www.ramsar.org/bn/bn4.pdf

The FIT Principle



Form and **F**unction

Project goals, objectives, and performance standards crafted to replace form, function, and processes

Investigate and **I**ntegrate

Ecological and cultural evaluation of the restoration area, potential reference sites, and the greater watershed

Technique and **T**ime

A dedication to sound science with thoughtful and informed project planning, design, implementation, monitoring, and adaptive management

The FIT Principle

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A n to sound science with thoughtful and informed project
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The FIT Principle

Understanding the Problem

- Processes, not just form and function
- Need to consider historic and current conditions
- Watershed scale and site level assessment
- Stakeholder engagement
- Reference and/or proxy reference sites

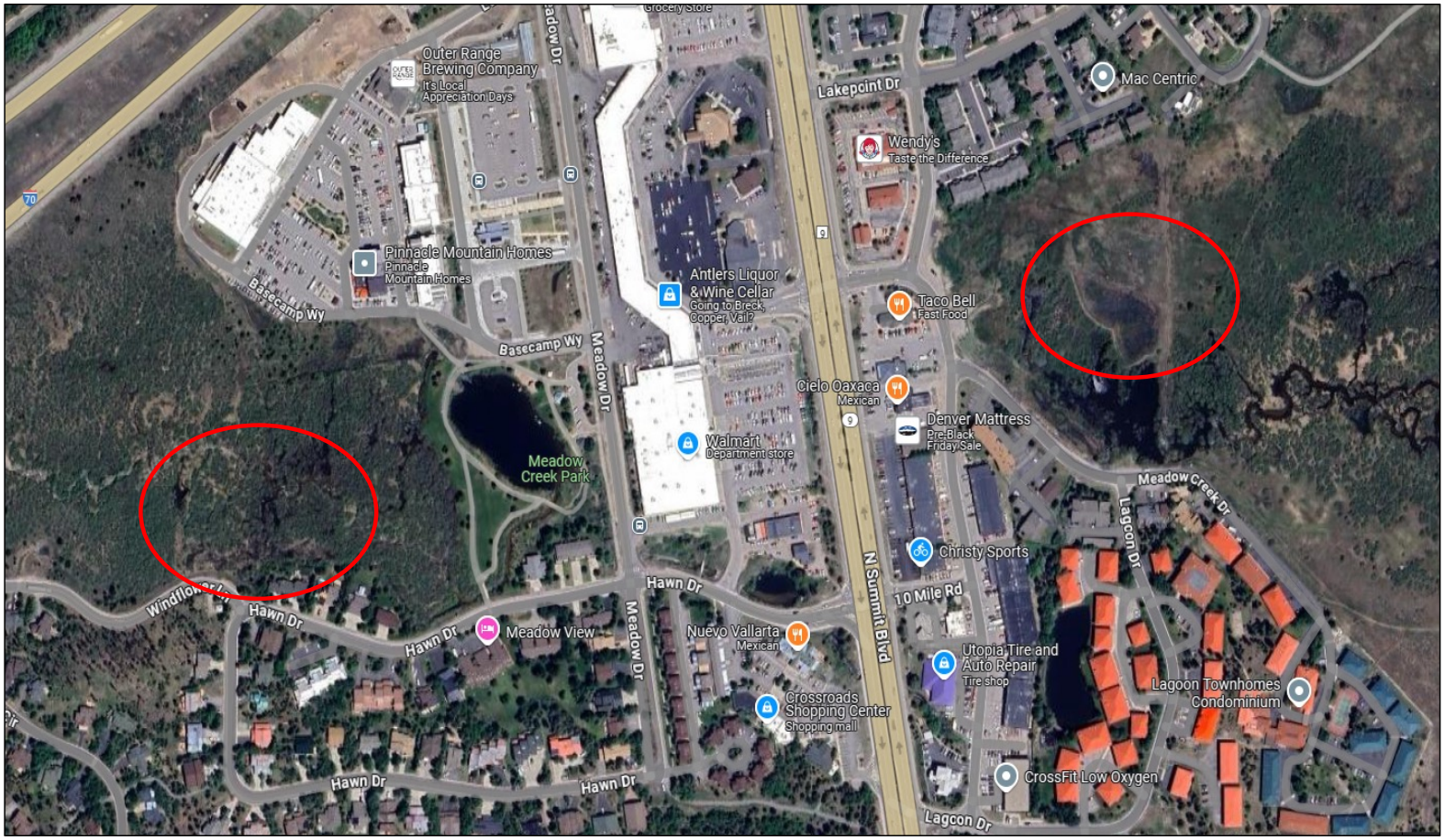
Goals and Objectives

The FIT Principle

Goals and Objectives

- Goals defined through assessment
- Goals underpinned by objectives
- Objectives must be measurable
- Performance standards based on objectives
- Desired outcome (“success”) = satisfying performance standards
- Determined through monitoring

The FIT Principle



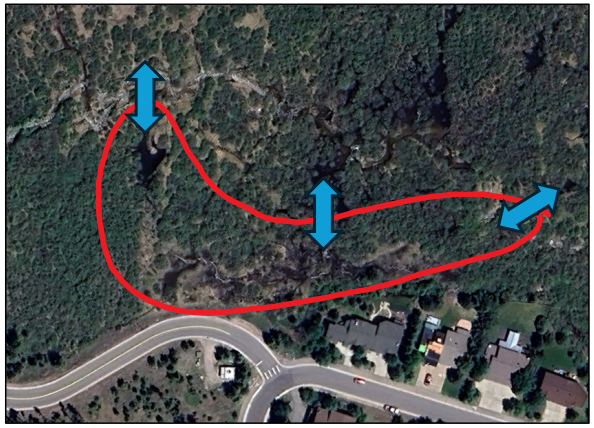
Form Function Investigate Integrate Technique Time

Target form:

Dynamic floodplain wetland

Dynamic site gets much higher scores for:

- Characteristic wildlife habitat
- Food chain support
- Nutrient/toxicant removal
- Flood attenuation



Dynamic

Static


Flow
Google

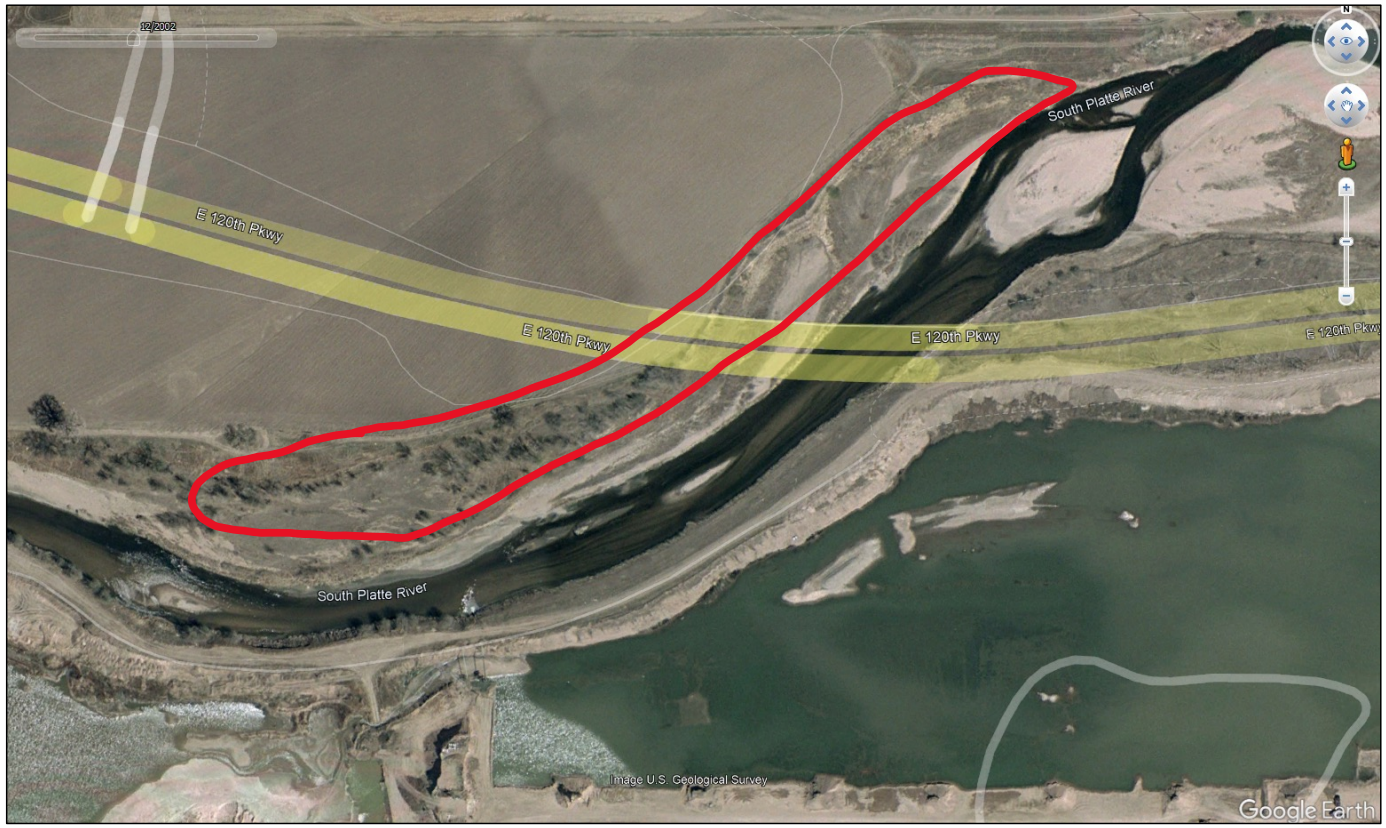
Target form:

Dynamic floodplain wetland

Target functions:

- Characteristic wildlife habitat
- Food chain support
- Nutrient/toxicant removal
- Flood attenuation
- Short and Long-Term Water Storage

2002



Target form:

Dynamic floodplain wetland

Target functions:

- Characteristic wildlife habitat
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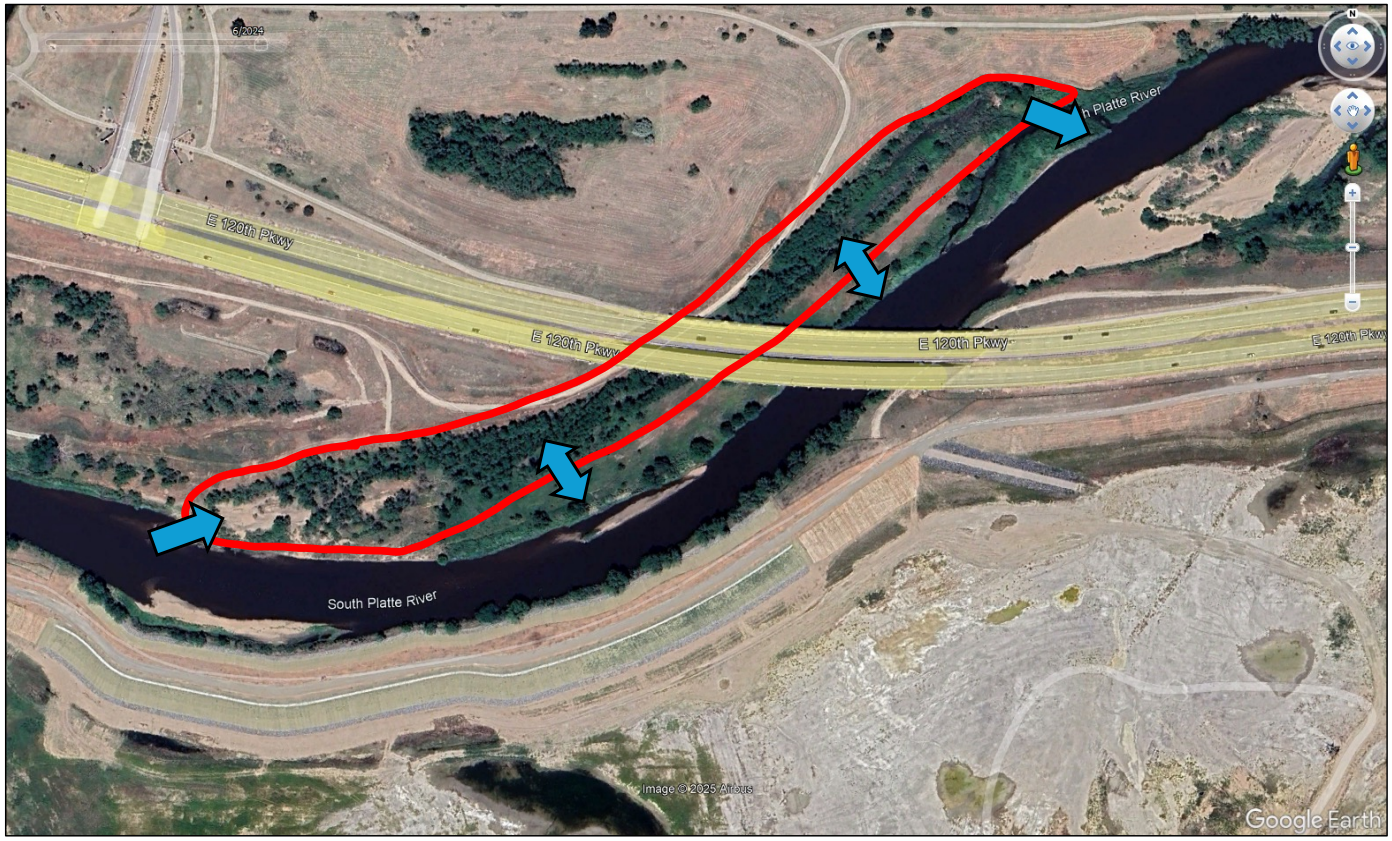
- Flood attenuation
- Short and Long-Term Water Storage

2024




2005


E 120th Pkwy
Colorado
Google Street View
Sep 2023
See more dates
2024


West Lake
Colorado River
Colorado River
29 Rd
C Rd
C Rd
Colorado River
River Bend Lane
Brook View Ln
Orchard Mesa
Google Earth

Target form:

Wetland (instead of pond)

Target functions:

- Flood attenuation
- Nutrient/toxicant removal
- Food chain support
- Native fish habitat
- Native bird habitat

Reference reach

Adjacent “restored” reach
(not like reference)

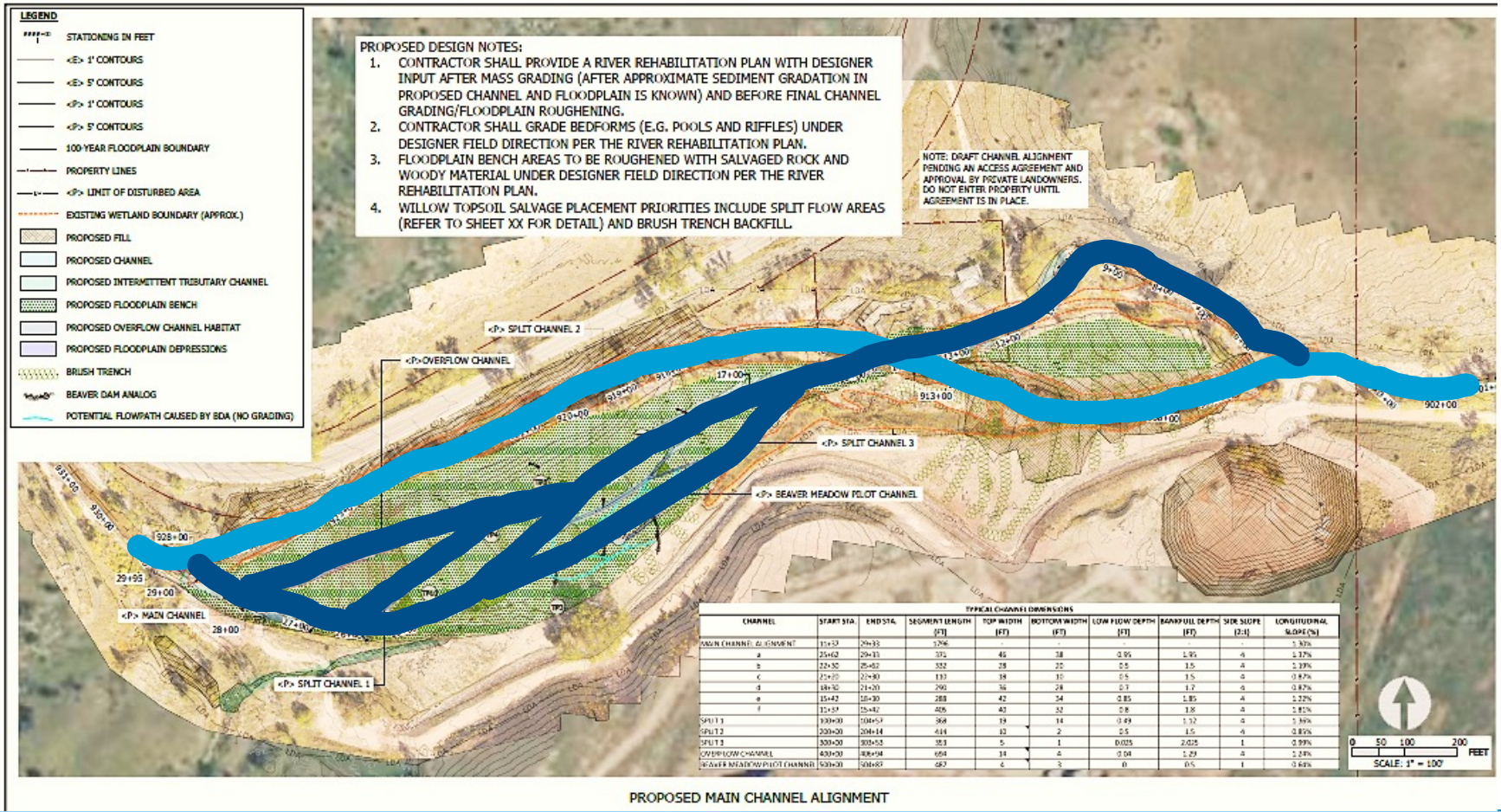
Target form:

Multi-thread channel with wetlands

Target functions:

- Flood attenuation
- Nutrient/toxicant removal
- Food chain support
- Native fish and amphibian habitat

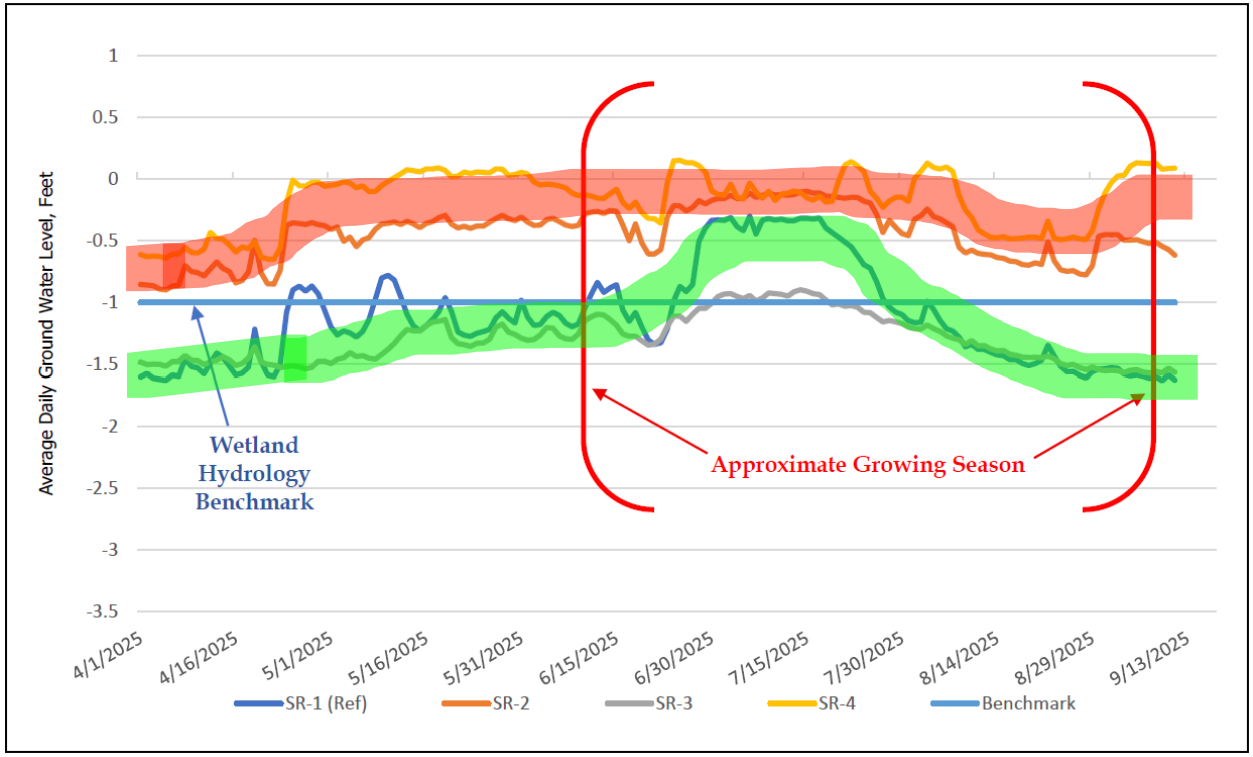
Form and function impaired



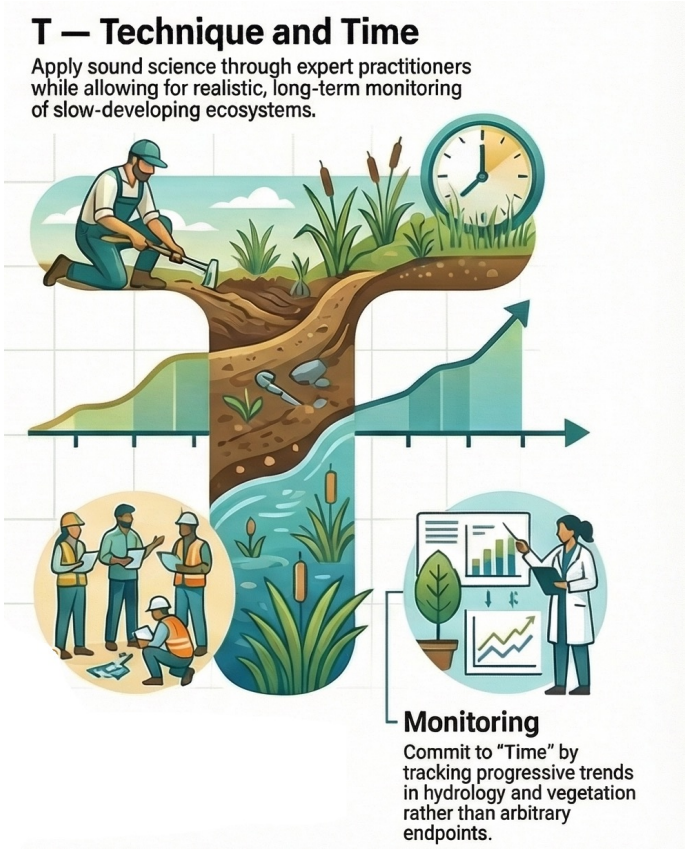
TYPICAL CHANNEL DIMENSIONS

CHANNEL	START STA.	END STA.	SEGMENT LENGTH (FT)	TOP WIDTH (FT)	BOTTOM WIDTH (FT)	LOW FLOW DEPTH (FT)	BANKFULL DEPTH (FT)	SIDE SLOPE (Z:1)	LONGITUDINAL SLOPE (%)
MAIN CHANNEL ALIGNMENT	15+53	29+33	1796	-	-	-	-	-	1.30%
a	25+62	29+33	371	46	38	0.95	1.95	4	1.37%
b	22+30	25+62	332	28	20	0.5	1.5	4	1.39%
c	21+20	22+30	110	18	10	0.5	1.5	4	0.87%
d	18+30	21+20	290	36	28	0.7	1.7	4	0.87%
e	15+42	18+30	288	42	34	0.85	1.85	4	1.22%
f	11+57	15+42	405	40	32	0.8	1.8	4	1.81%
SPLIT 1	100+30	104+57	368	19	14	0.49	1.32	4	1.36%
SPLIT 2	200+20	204+14	414	12	2	0.5	1.5	4	0.85%
SPLIT 3	300+20	300+53	353	5	1	0.025	2.025	1	0.99%
OVERFLOW CHANNEL	400+00	406+94	694	14	4	0.04	1.29	4	1.28%
BEAVER MEADOW PILOT CHANNEL	500+00	506+87	687	6	3	0	0.5	1	0.66%

PROPOSED MAIN CHANNEL ALIGNMENT


Average Daily Ground Water Level, Feet
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
4/1/2025
4/16/2025
5/1/2025
5/16/2025
5/31/2025
6/15/2025
6/30/2025
7/15/2025
7/30/2025
8/14/2025
8/29/2025
9/13/2025
Wetland Hydrology Benchmark
Approximate Growing Season
SR-1 (Ref)
SR-2
SR-3
SR-4
Benchmark

The FIT Principle: Restoration Treatments



Restoration Treatments

Low-Tech

- Simple design, lower cost, usually short-term
- Ditch blocks, log jams, brush trenches, beaver mimicry, etc.

High-Tech

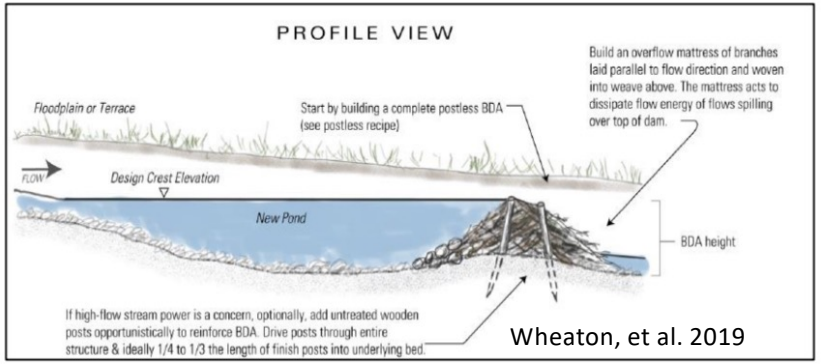
Detailed and often engineered design, higher cost, usually involves earthwork, longer-term

High-Tech projects can involve lots of Low-Tech treatments

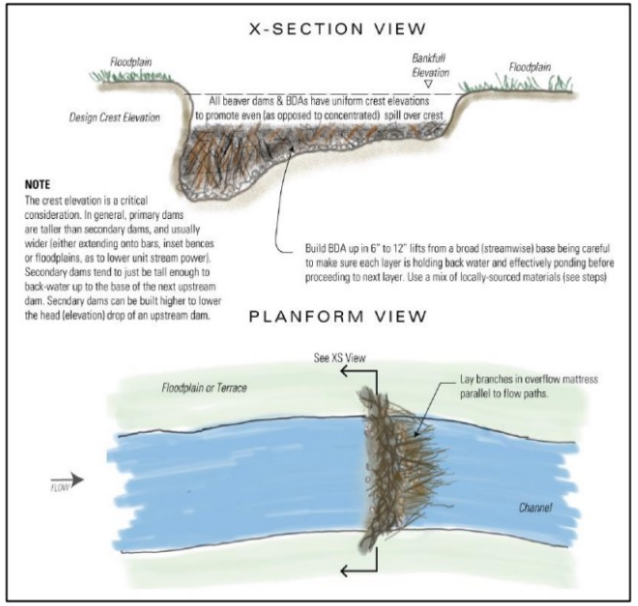
Restoration Treatments

Beaver Mimicry

- Beaver Dam Analogs (BDAs)
- Post-Assisted Log Structures (PALS)



Wheaton, et al. 2019



Restoration Treatments

Beaver Mimicry

These are intended to be temporary!

Restoration Treatments

Beaver Mimicry

Restoration Treatments

Beaver Mimicry

Restoration Treatments

Live Plants (Transplants)

Restoration Treatments

Live Plants (Brush Trenches)

Restoration Treatments

Live Plants: Other Ways to Use Equipment

Restoration Treatments

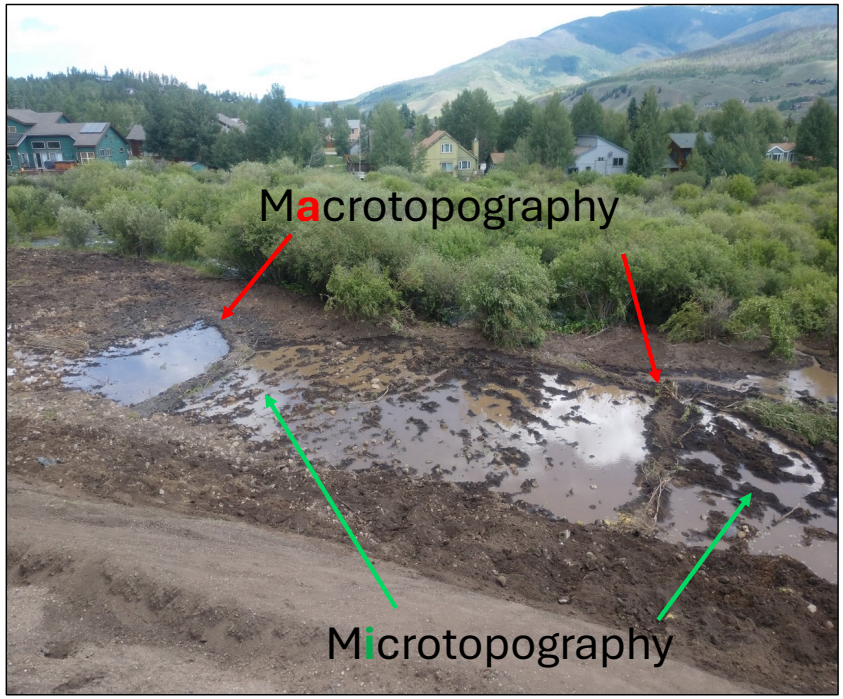
Live Plants: Container (Nursery) Stock

Restoration Treatments

Earthwork: Ditch Plugs

Restoration Treatments

Earthwork: Finish Grading



Restoration Treatments

Earthwork: Road Removal

Restoration Treatments

Earthwork: Road Removal

July 2024

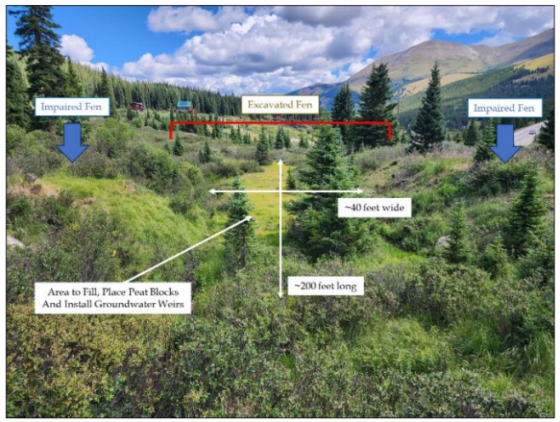
October 2024

Restoration Treatments

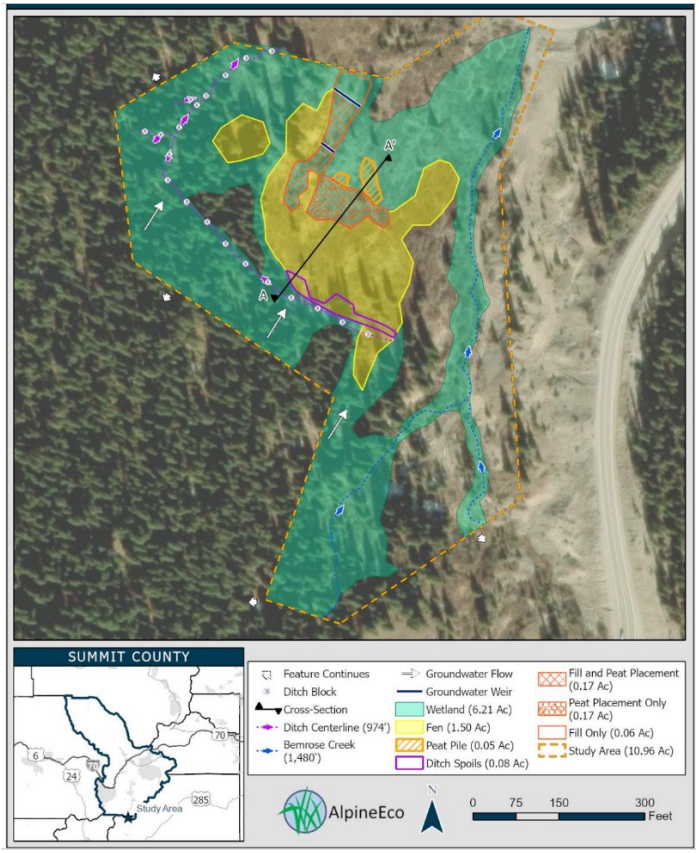
Earthwork: Road Removal

Restoration Treatments

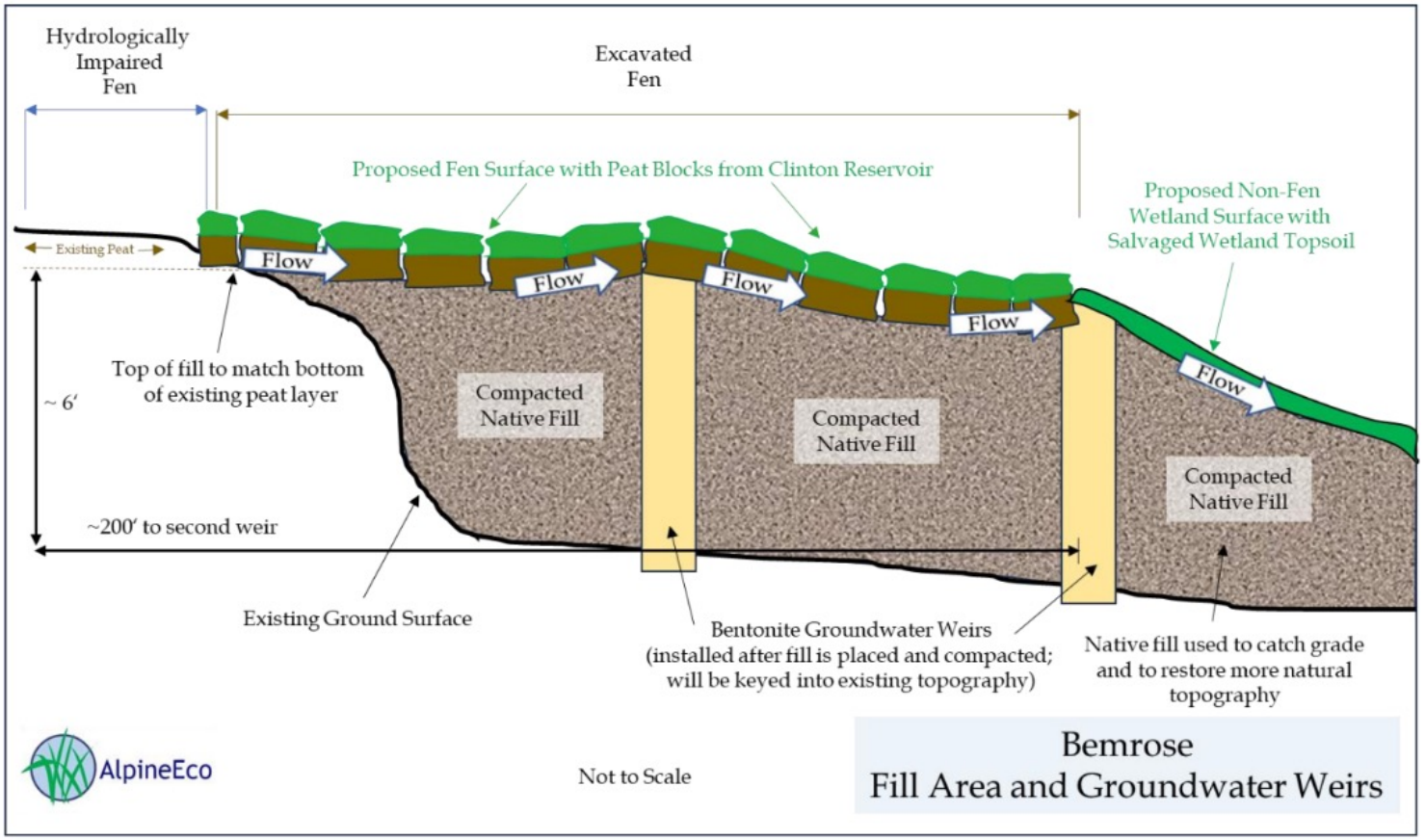
Earthwork



Photos of the Bemrose Fill Area, looking down-gradient from the impaired fen (left, 8/11/23) and up-gradient from the existing non-fen wetland where wetland topsoil will be salvaged (right, 7/27/20)



Form Function Investigate Integrate Technique Time


Hydrologically Impaired Fen
Excavated Fen
Proposed Fen Surface with Peat Blocks from Clinton Reservoir
Proposed Non-Fen Wetland Surface with Salvaged Wetland Topsoil
Existing Peat
Flow
Flow
Flow
Flow
Flow
Top of fill to match bottom of existing peat layer
~ 6'
Compacted Native Fill
Compacted Native Fill
Compacted Native Fill
~200' to second weir
Existing Ground Surface
Bentonite Groundwater Weirs (installed after fill is placed and compacted; will be keyed into existing topography)
Native fill used to catch grade and to restore more natural topography
AlpineEco
Not to Scale
Bemrose
Fill Area and Groundwater Weirs

Restoration Treatments

Earthwork: Floodplain Restoration (Combined Treatments)

Large-scale earthwork treatments can be expensive but often necessary for highly degraded sites

Form Function Investigate Integrate Technique Time

Processes in Action!

Looking Ahead

How do we do better?

- Smarter monitoring
  - More frequent, simpler monitoring
  - Longer monitoring periods
  - Committing to adaptive management
- Information sharing and training
  - Connecting research and practice
- Responding to climate change
  - Wetland protection
  - Migration corridors – coasts and floodplains
  - Environmental flows

The Ecological Society of America

esa

Key Points

- Thorough site and watershed assessment to replace form and function with focus on processes
- Use assessment and reference sites to target form and function; will require creativity and local knowledge for heavily modified systems
- Thoughtful goals and performance standards
- Be innovative and creative with restoration approaches founded in science
- Consider both high- and low-tech solutions
- Use equipment to increase efficiency
- Simpler monitoring programs
- Share knowledge!


Edited by
Peter Gell | Nick Davidson | Max Finlayson
RAMSAR WETLANDS
VALUES, ASSESSMENT, MANAGEMENT
ELSEVIER
ALPINEECO
Andy Herb
alpine-eco.com

F — Form and Function

Design project goals to replace specific wetland elements and ecological roles identified through assessments.

I — Investigate and Integrate

Evaluate the watershed and community needs to weave ecological and cultural findings into the design.

Planning & Design

Use "Investigate" to find reference sites that serve as biological blueprints for the project.

T — Technique and Time

Apply sound science through expert practitioners while allowing for realistic, long-term monitoring of slow-developing ecosystems.

Monitoring

Commit to "Time" by tracking progressive trends in hydrology and vegetation rather than arbitrary endpoints.