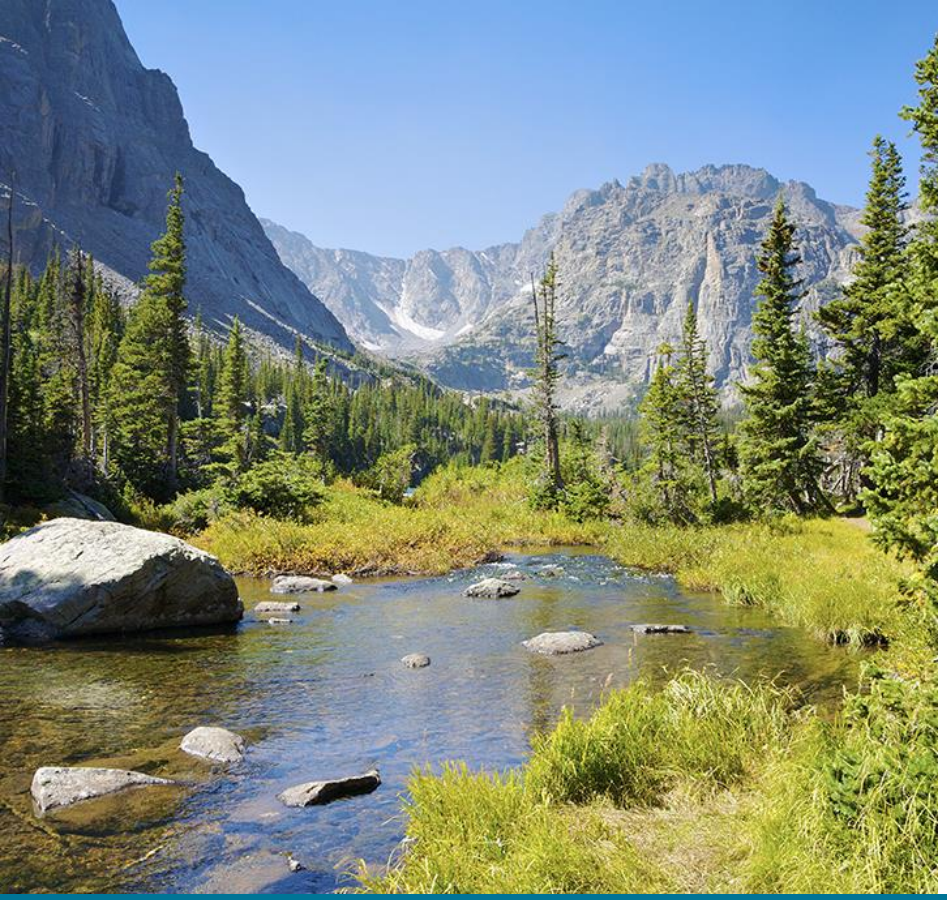


SMP Field Trip: Diversion Structure Assessment

river NETWORK
connecting people · saving rivers

WELCOME TO THE FIELD TRIP!

Diversion Structure Assessment

Summary of discussion topics

1. Introduction
2. Diversion Types and Diversion Effects
3. Fishway Types and Effectiveness
4. Rapid Diversion Assessment Approach
5. Detailed Diversion Assessment Approach
6. Field Evaluation

river NETWORK
connecting people · saving rivers

Introduction

Diversion Structure Assessment

Surface Water Diversions

- Flow diversions to support agricultural and municipal needs that can also impair the natural flow and sediment regimes

Dam/Reservoir Operations

- Peak flow reductions caused by normal reservoir operations, with potential augmentation to baseflow

river NETWORK
connecting people · saving rivers

Diversion Types

Diversion Structure Assessment

1. Dam
2. Push up dams
3. Channel spanning concrete weirs
4. Hybrid
5. Slide gates or stop logs
6. Constructed riffles
7. Obermeyer gate

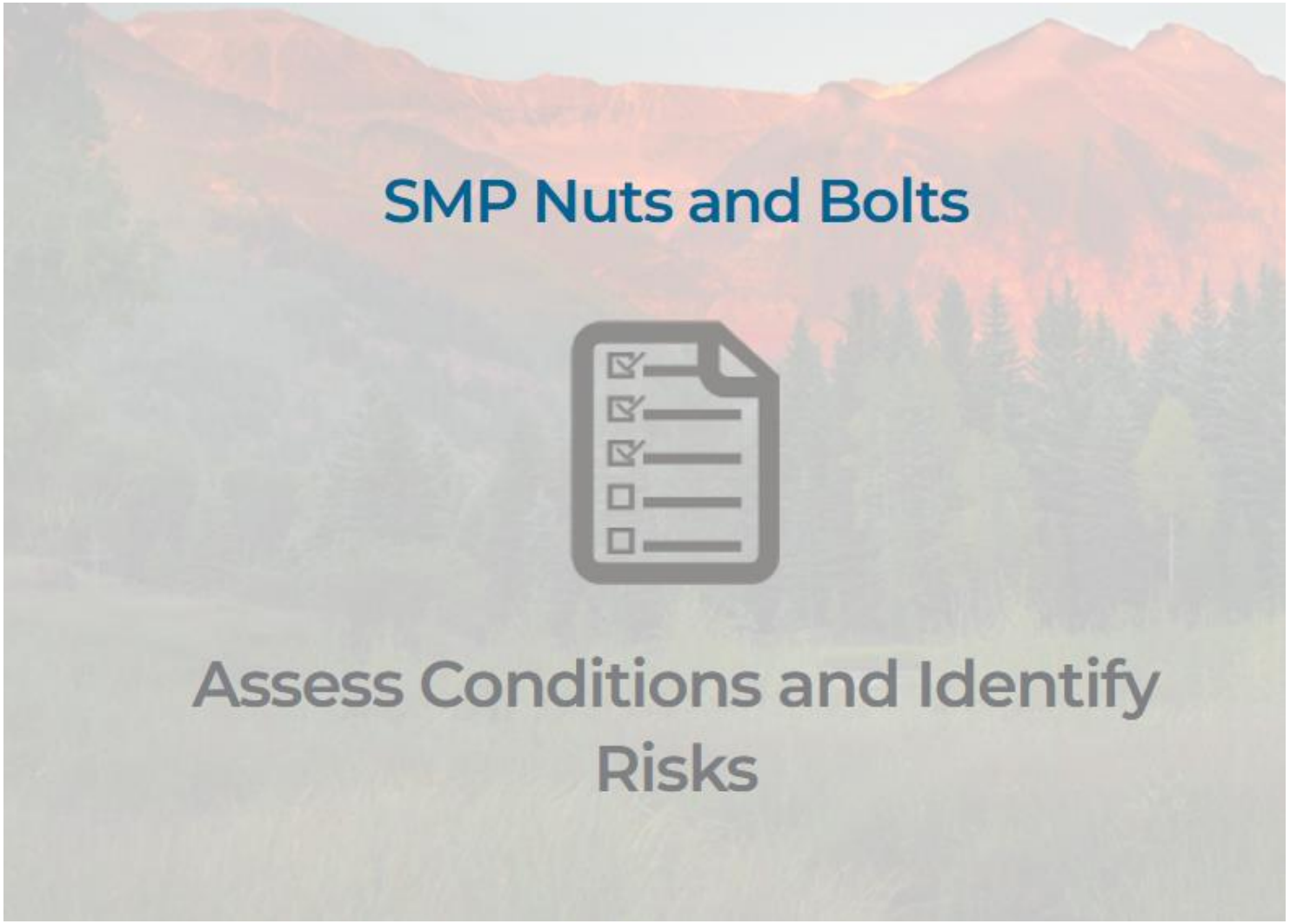
river NETWORK
connecting people · saving rivers

Diversion Effects

Diversion Structure Assessment

Diversion Effects

Diversion Structure Assessment



Diversion Effects

Diversion Structure Assessment

1

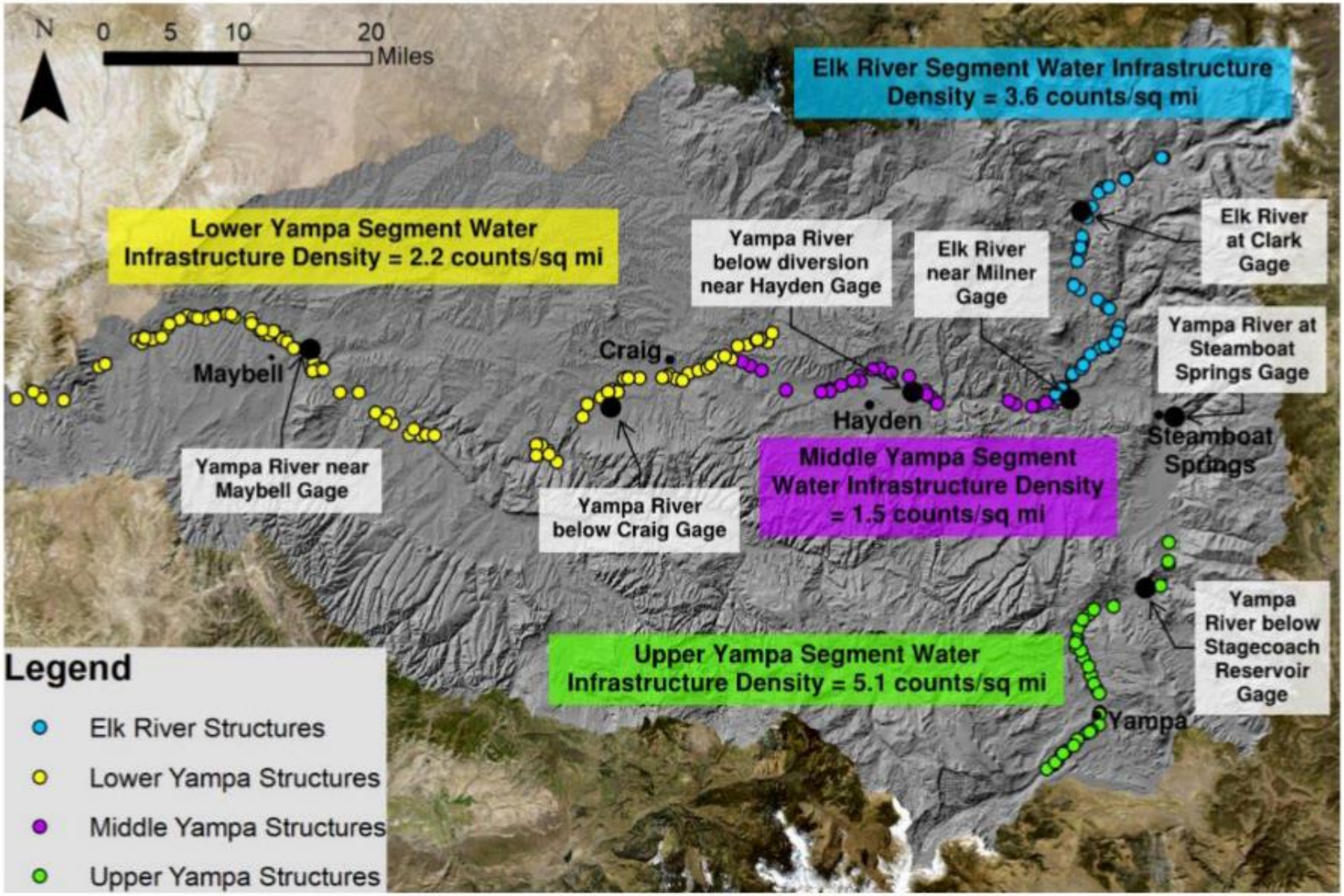
Diversion Infrastructure Assessments

Conducting an assessment of diversion infrastructure in areas with substantial agricultural irrigation can identify opportunities to improve agricultural producers' operations, as well as opportunities to improve river function variables such as fishery quality, bank stability, or hydrology. These assessments can be simple enough to be completed by trained volunteers, or complex enough to require a licensed engineer. Partnering with a fisheries biologist can help to assess fish passage impediments and opportunities. Infrastructure assessments must be undertaken only with the full cooperation of diversion structure owners, and illustrate clear benefits to them for their participation. The October 2020 Peer Workshop provides an overview of various approaches and goals for diversion assessments, and some are explained here.

- Rio Grande, Conejos River, and Saguache Creek Stream Management Plans
- North Fork of the Gunnison
- Middle Colorado
- Yampa Basin Integrated Water Management Plan

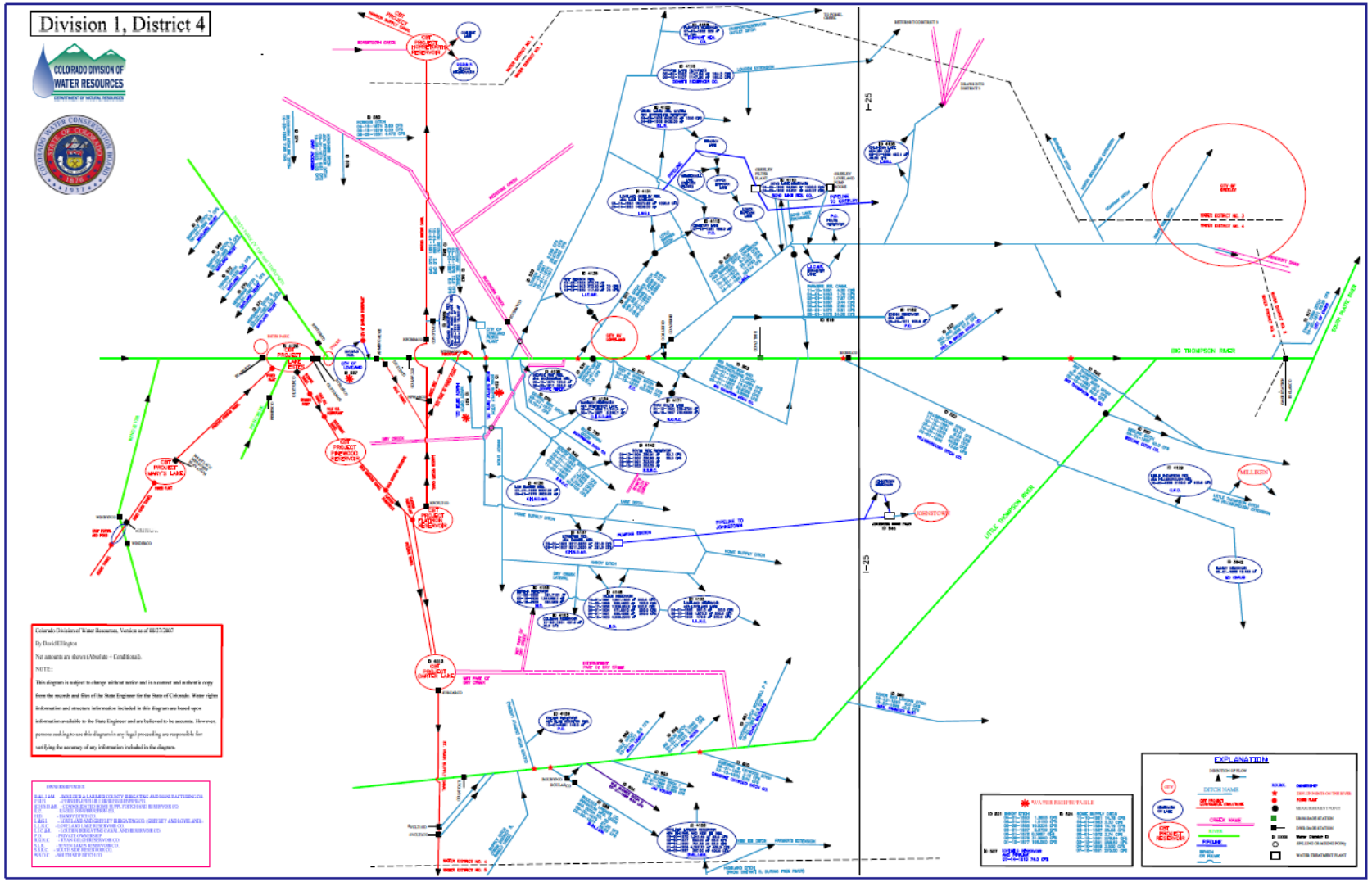
Diversion Effects

Diversion Structure Assessment



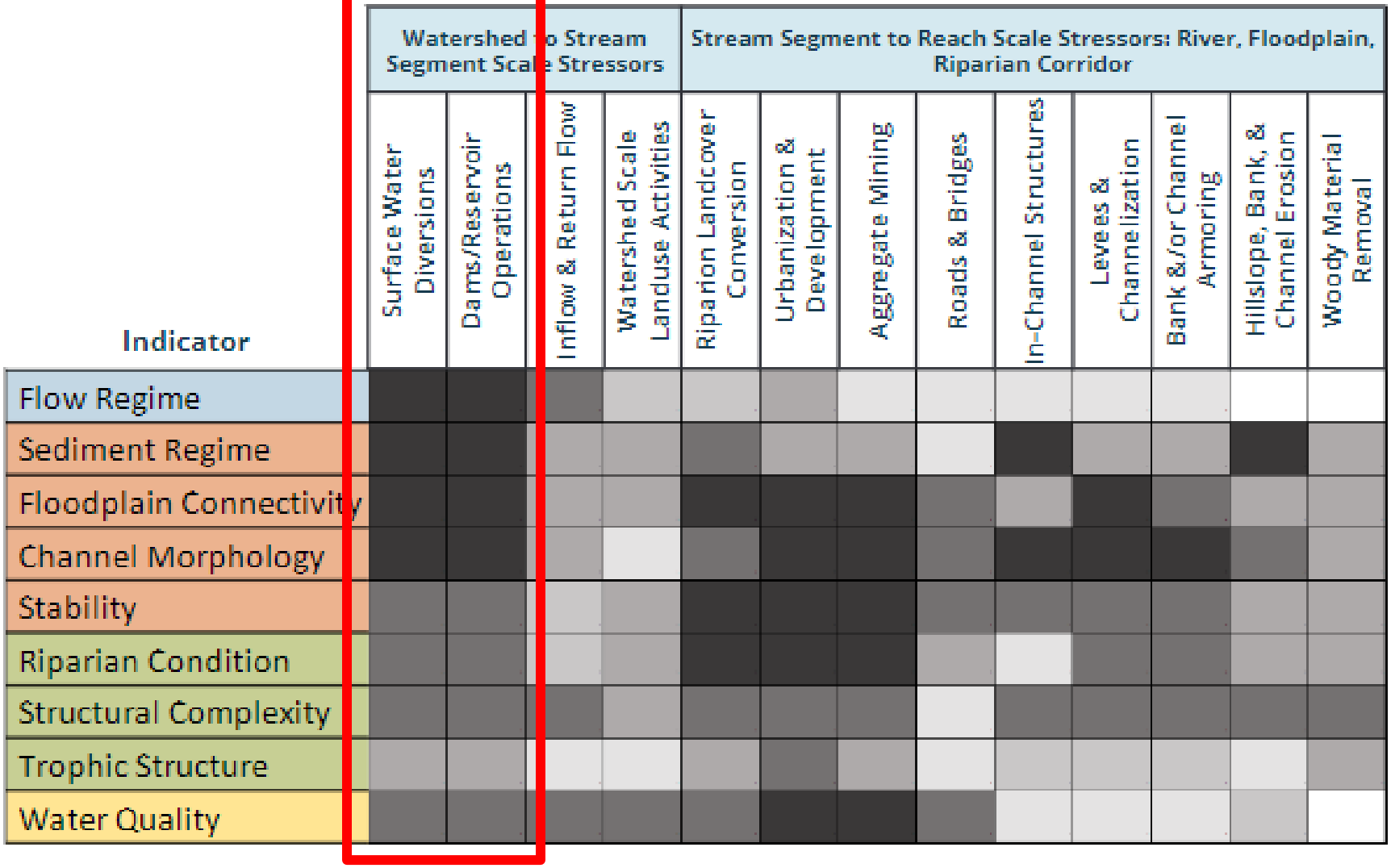
Diversion Effects

Diversion Structure Assessment



Diversion Effects

Diversion Structure Assessment



Diversion Effects

Diversion Structure Assessment

Hydrologic and Geomorphic impacts

- Flow Regime
- Sediment Transport → Continuity
- Stream Stability
- Disconnected Stream Length

river NETWORK
connecting people · saving rivers

Diversion Effects

Diversion Structure Assessment

Biological impacts

- Aquatic organism passage
- Entrainment
- Indirect effects on aquatic habitat from changes to geomorphology

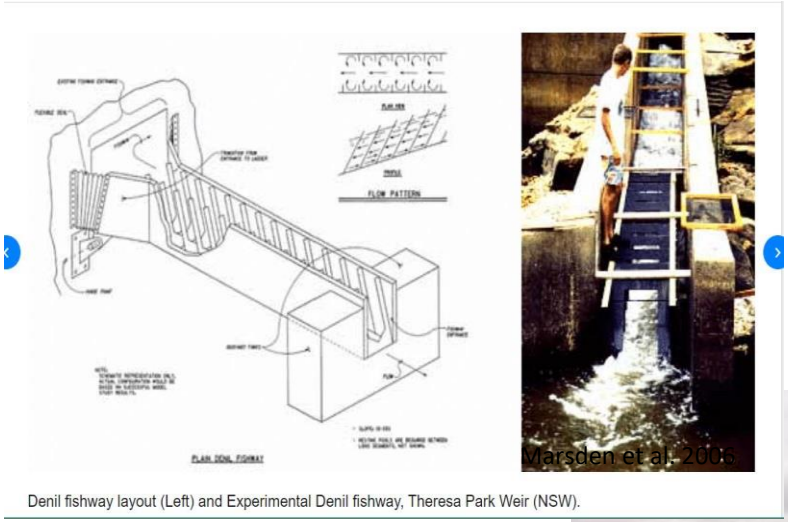
river NETWORK
connecting people · saving rivers

Fishway Types

Diversion Structure Assessment

Pool/weir, vertical slot, Denil/Alaska steeppass, rock ramp

Photo: Parcs Canada

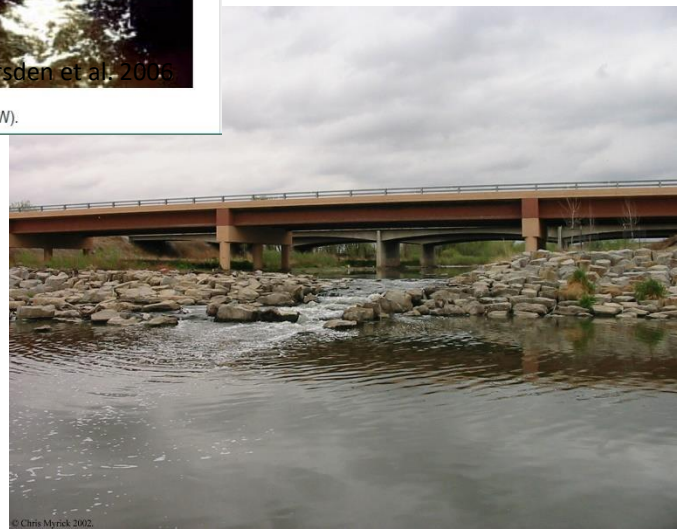


Marsden et al. 2003

Denil fishway layout (Left) and Experimental Denil fishway, Theresa Park Weir (NSW).

Photo: U.S. Department of Energy

river NETWORK
connecting people · saving rivers



Fishway Types

Diversion Structure Assessment

Rock ramp fishways highly variable

river NETWORK
connecting people · saving rivers

Fishway Types

Diversion Structure Assessment

Efficacy of fishway to allow passage depends on resident fish assemblage

https://westernnativetrout.org

https://coloradoriverrecovery.org/information/fish-species/colorado-pikeminnow/

river NETWORK
connecting people · saving rivers

Rapid Assessment

Diversion Structure Assessment

Conduct site visits to assess:

- Type of control structure at the headgate
- Type of measurement device and level of functionality
- Overall integrity and diversion functionality
- Ability of the structure to divert a wide range of flows and meet water users' needs
- Apparent deficiencies that may adversely affect ability to divert water
- Apparent deficiencies that may adversely affect recreational boating
- Feasibility of previously developed conceptual ideas for retrofits, if applicable

Rapid Assessment

Diversion Structure Assessment

Example Geomorphic Considerations

Sediment Transport Concern

- Assesses whether the diversion has the ability to pass sediment downstream and whether sediment aggradation or degradation in the vicinity of the diversion is a concern

Stream Stability

- Evaluates the level of bank or channel bed instability in the vicinity of the diversion structure

Reconnected Stream Length

- Quantifies how many miles of stream are reconnected, up and downstream, by removing cross channel diversion with poor hydraulics and/or geomorphic concerns

Rapid Assessment

Diversion Structure Assessment

Example Biological Considerations

- Quality and quantity of habitat that is reconnected
- Fish community present in vicinity of diversion
- Riparian considerations

river NETWORK
connecting people · saving rivers

Rapid Assessment

Diversion Structure Assessment

Other considerations

- Simplicity of Enhancements
- Safety Concerns
- Dry-Up Point Upstream
- Cost
- Aesthetics
- Historical values
- Property access

river NETWORK
connecting people · saving rivers

Alternatives Analysis & Prioritization

Diversion Structure Assessment

Alternatives Analysis & Prioritization Matrix

1. Objective method of prioritizing diversions for modification
2. Considerations entered into matrix
    - Weighted by relative importance
    - Ranked by score to determine top priorities
    - Sometimes requires ground-truthing for matrices with many alternatives.
3. Highly Variable!

river NETWORK
connecting people · saving rivers

Alternatives Analysis & Prioritization

Diversion Structure Assessment

Example: Draft Spreadsheet from South Boulder Creek

South Boulder Creek Fish Passage Assessment

Alternatives Scoring

	Ecological Benefits					Geomorphology/Logistics					Additional Considerations				
	Partial vs total barrier	Length of reconnected stream	Trout Present	Habitat Quality in Vicinity of Diversion	Invasives below diversion	Ability to Pass Minimum Flow	Diversion with high maintenance or repair needs	Stream stability benefits	Larger than natural obstacles to migration in reach	Simplicity of modification or removal	Availability of Funding	Ditch & land owner participation	Cost	Total	Rank
Criteria Weighting (3=Highest, 1=Lowest)	*3*	*3*	*1*	*2*	*2*	*3*	*3*	*1*	*1*	*2*	*3*	*2*	*2*		
Alternative Scoring (1=Best, 4=Worst)														**Total**	**Rank**
Community Ditch	1	4	1	4	1									26	
Davidson	2	1	1	3	1									18	
Goodhue	1	1	1	3	1									15	
Marshalville	1	1	1	4	1									17	
New Dry Creek Carrier	1	1	1	2	1									13	
Howard	1	2	1	2	1									16	
Leggett	1	4	2	4	4									33	

river NETWORK
connecting people · saving rivers

Alternatives Analysis & Prioritization

Diversion Structure Assessment

Example: Matrix from Big Thompson SMP

Photos	Aerial	Structure Name	Diversion Assessment					Geomorphic Assessment						Other Aspects			Total Score	Priority
			Overall Structural Integrity	Ability Divert Wide Range of Flows	Debris Concern	Maintenance Needs Exist	Willingness of Diversion Company	Fish Passage Feasibility	Reconnected Stream	Habitat Quality	Sediment Transport Concern	Stream Stability	Simplicity of Enhancements	Safety Concerns	Dry Up Point Upstream		
			Stable = 1 Unstable = 4	Good = 1 Bad = 4	Minor Debris Concern = 1 Major Debris Concern = 4	Doesn't Need Repairs = 1 Needs Repairs = 4	Not Willing = 1 Willing = 4	Unlikely = 1 Likely = 4	0 to 1 mile = 1 1 to 2 miles = 2 2 to 3 miles = 3 3 miles or more = 4	Good = 1 Bad = 4	Can Pass = 1 Can't Pass = 4	Good = 1 Bad = 4	Hard = 1 Easy = 4	Minimal Concerns = 1 A lot of Concerns = 4 (structure itself, but also proximity to people.)	Yes = 1 No = 4			
			Weighting															
			4	3	2	4	4	4	3	2	2	3	4	4	2			
		Handy Ditch Diversion	1	2	1	1	3	1	2	4	4	1	1	4	4	85	10
		Home Supply Ditch Diversion	1	2	1	1	4	1	2	4	4	1	1	4	4	89	9
		South Side Ditch Diversion	2	2	3	2	2	4	2	3	3	3	4	2	1	105	5
		Louden Ditch Diversion	2	2	2	2	1	4	1	3	3	2	4	2	4	99	6
		George Kist (Home Supply) Ditch Diversion	3	2	3	2	4	4	1	2	3	4	4	2	1	115	3
		Big Barnes Ditch Diversion	4	3	4	4	2	4	4	1	4	2	3	3	4	133	1
		Greely Loveland Irrigation Canal Diversions	2	2	3	2	4	3	3	3	4	2	2	4	2	113	4
		Big Thompson Ditch and Manufacturing Diversion	1	3	3	2	1	3	3	3	3	2	1	4	1	92	8
		Farmers Irrigation Canal Diversion	4	3	4	4	2	4	2	1	4	2	3	2	1	117	2
		Hillsborough Ditch Diversion	1	2	1	1	4	3	4	1	3	1	2	3	4	95	7

* The higher the score the better the project (i.e. the greater the need for infrastructure enhancement and feasibility of developing the enhancement)

Detailed Assessment

Diversion Structure Assessment

Objective Evaluation of Individual Structures

1. Evaluation elements of each structure can be used to produce scores for large-scale assessments
2. Can be used to identify issues with existing diversion that is already slated for improvement
    - Diversion improvement/modification projects often have a multitude of goals

river NETWORK
connecting people · saving rivers

Detailed Assessment

Diversion Structure Assessment

Yampa Diversion Infrastructure Assessment

Field Sheet

Structure Name _____WDID# _____Date _____Time_____

Decreed Flow rate (cfs) _____

J-U-B Engineers Field Evaluation Team Present: _____

Other Team Members Present: _____

Ditch Representative Present: _____ Phone Number:_____

Infrastructure, Irrigation

- Does a diversion structure exist that extends to, or near, bank full conditions? Yes No
  Condition? _____
  Material? _____
  Permanent or temporary? _____
  If temporary, how frequently does the owner need to rework material in the river? _____

- Are control structure(s) present immediately adjacent to the diversion? Yes No
  Description: _____
  Does the control structure allow the water user to regulate the inflow from the river? Yes No
  Description: _____

- Is a measuring device present? Yes No Is it installed correctly? Yes No
  What are the dimensions and type? _____
  Describe location. _____

- What is the conveyance infrastructure immediately down-ditch of diversion? Pipe Open
  Condition? _____

- Are diversion inefficiencies likely? Yes No
- Is surface tailwater leaving the end of the ditch present or likely? Yes No

- Does Infrastructure allow water to be turned back to the river? Yes No

- Does the infrastructure require the full water right be diverted in order to make deliveries? Yes No

river NETWORK
connecting people · saving rivers

bmurphy@rivernetwork.org;
aficke@geiconsultants.com