

# Fish Passage in the Bad River Watershed in Northern Wisconsin

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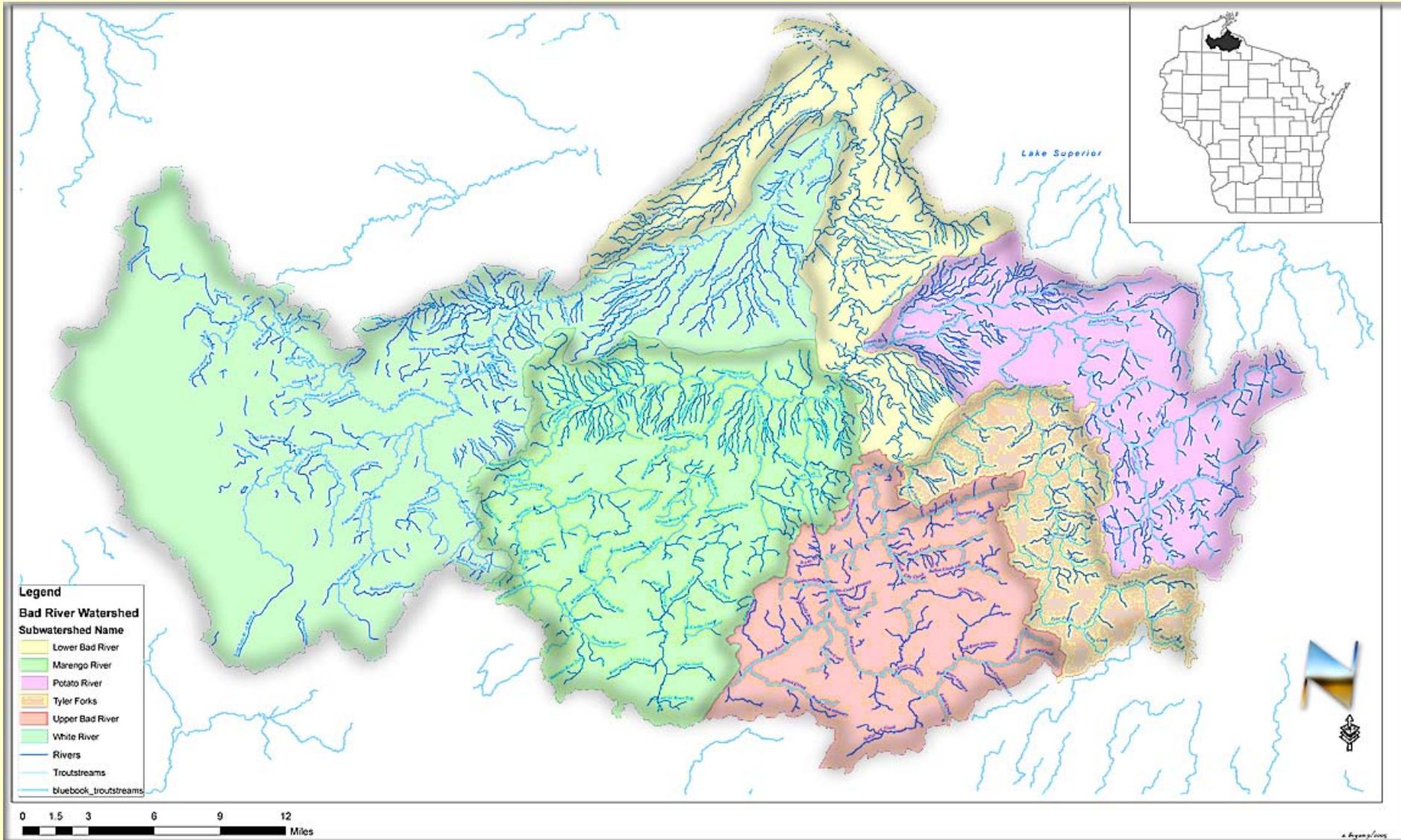
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**Structured Decision Making Workshop – NCTC Dec 8-12 2008**

# Bad River Watershed

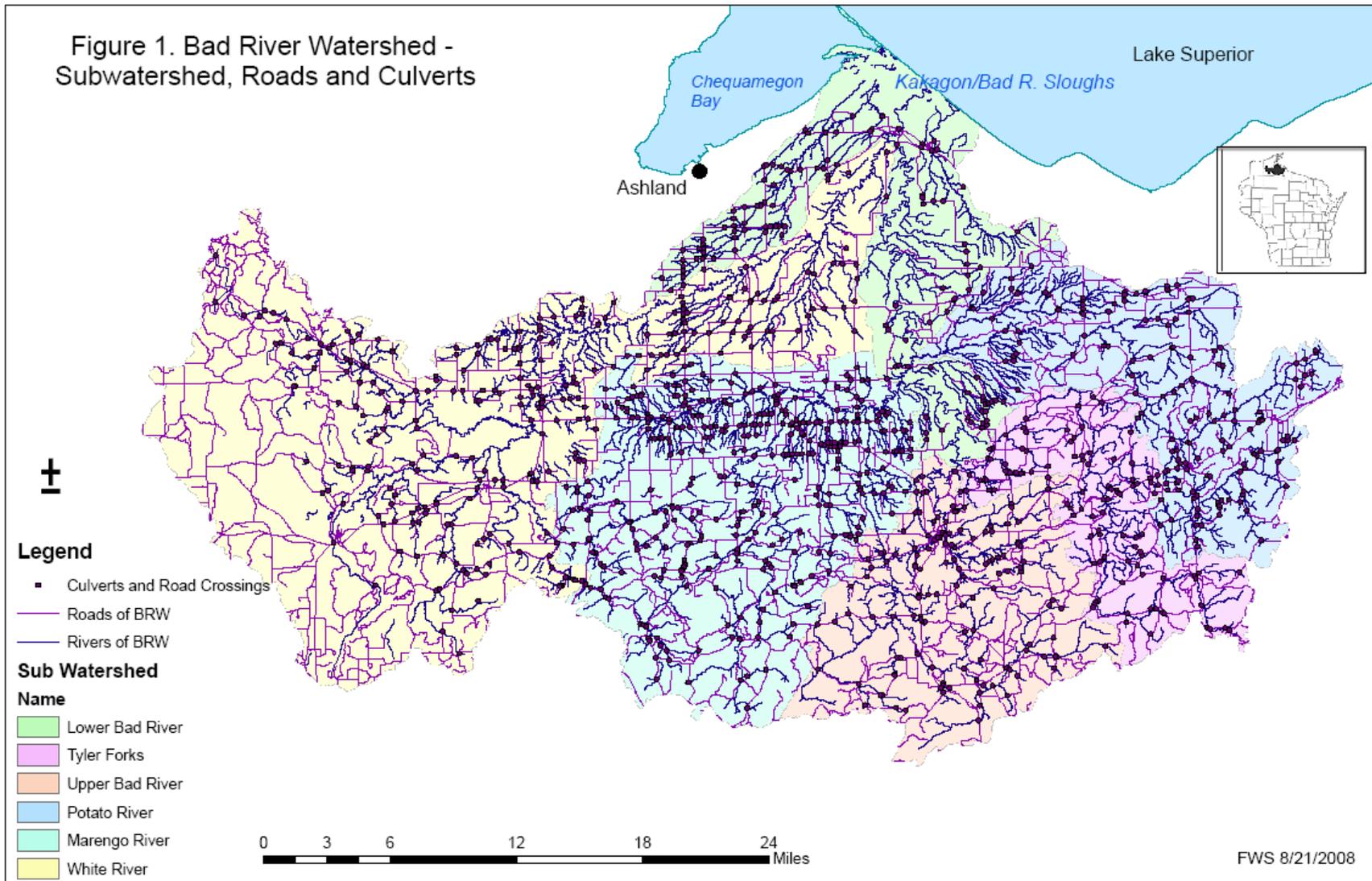


# Bad River Watershed

- 1,054 square miles
- 1,500 stream miles
- 1,122 road crossings
- Recreational fishing
- Primarily rural, forested landscape
- Largest contributor of sea lamprey on the south shore of Lake Superior
- Self-sustaining population of lake sturgeon



Figure 1. Bad River Watershed -  
Subwatershed, Roads and Culverts





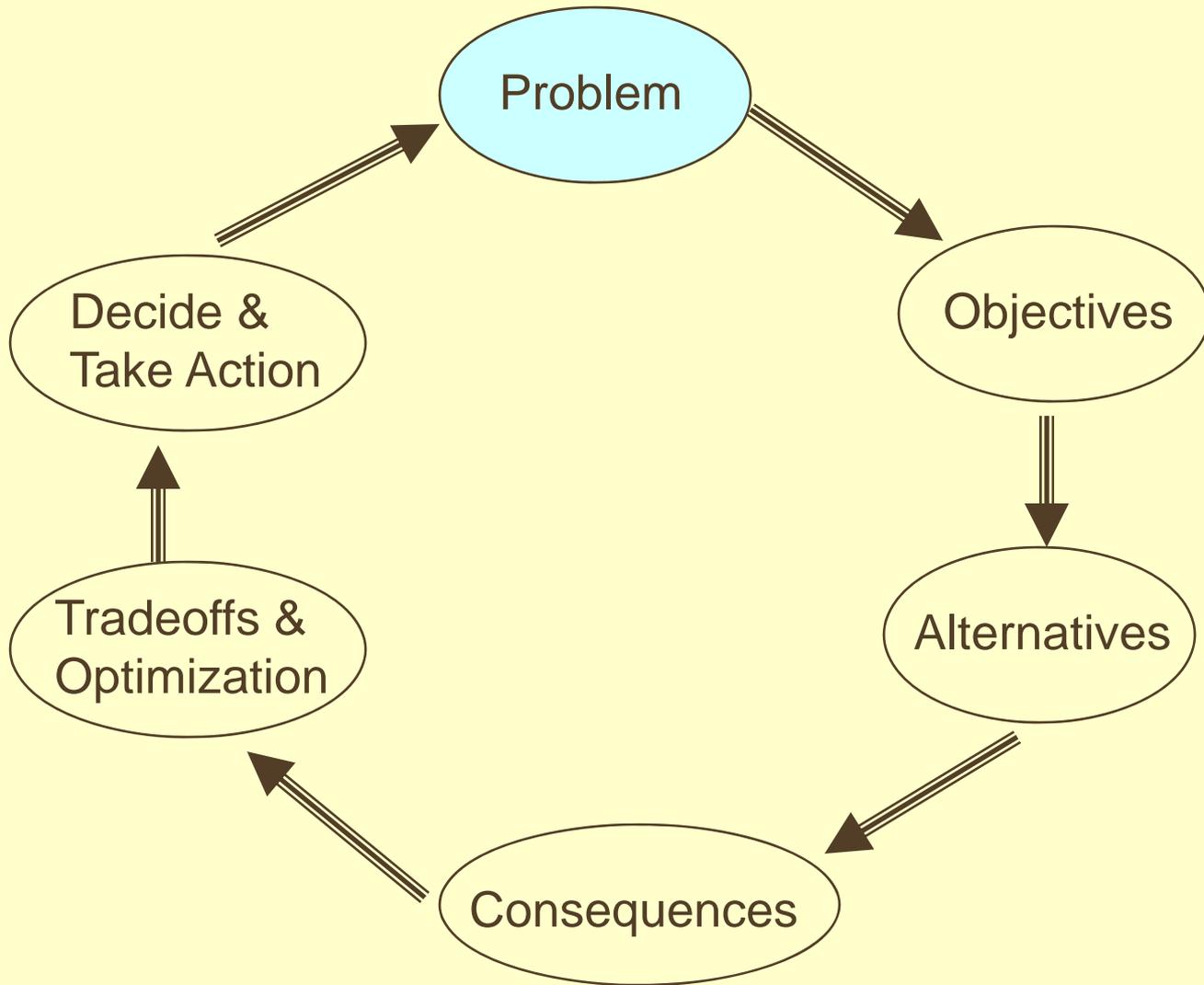
**Perched**

**Velocity Barrier**

**Deterioration of  
Pipe – Center  
Collapsing**

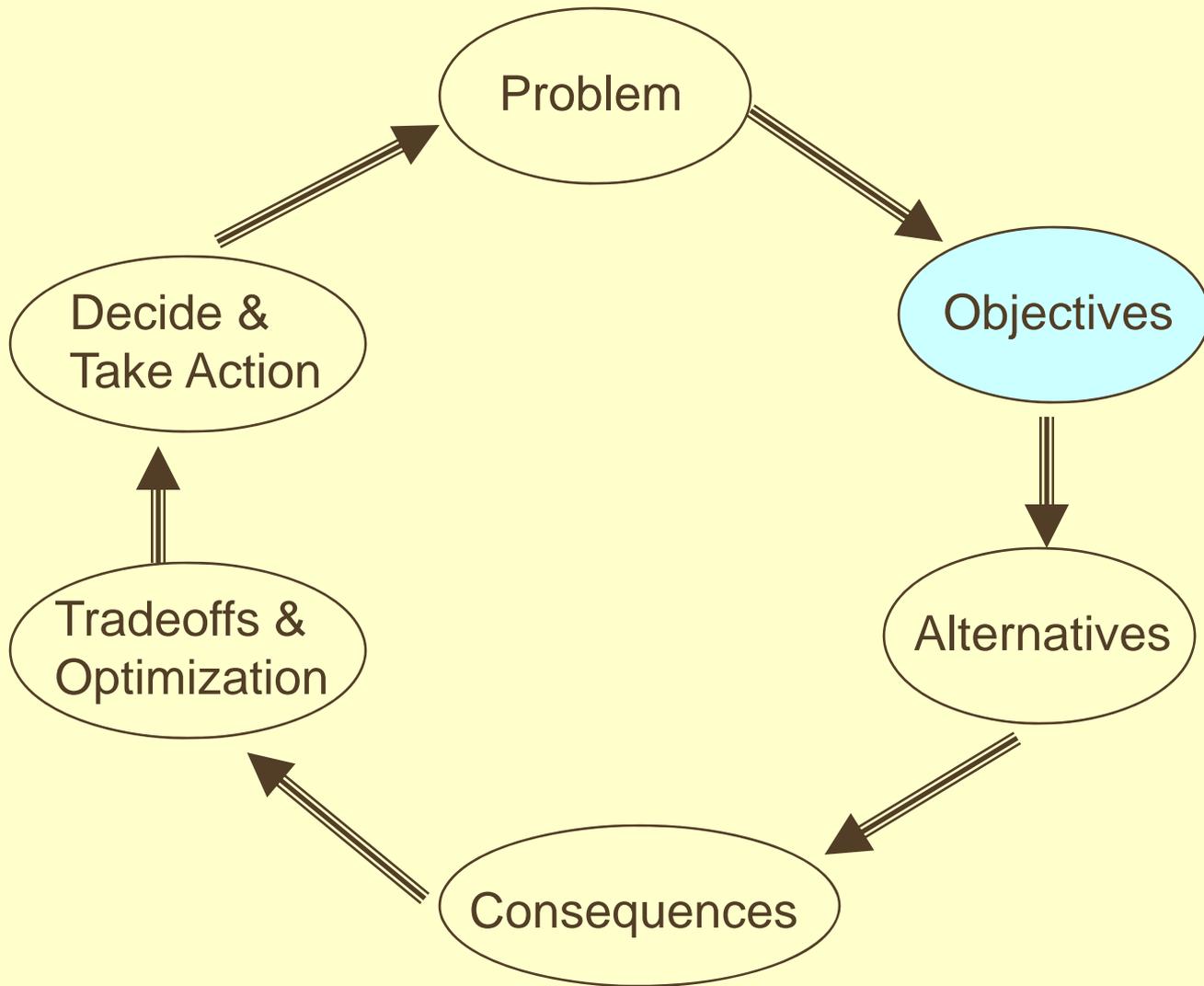






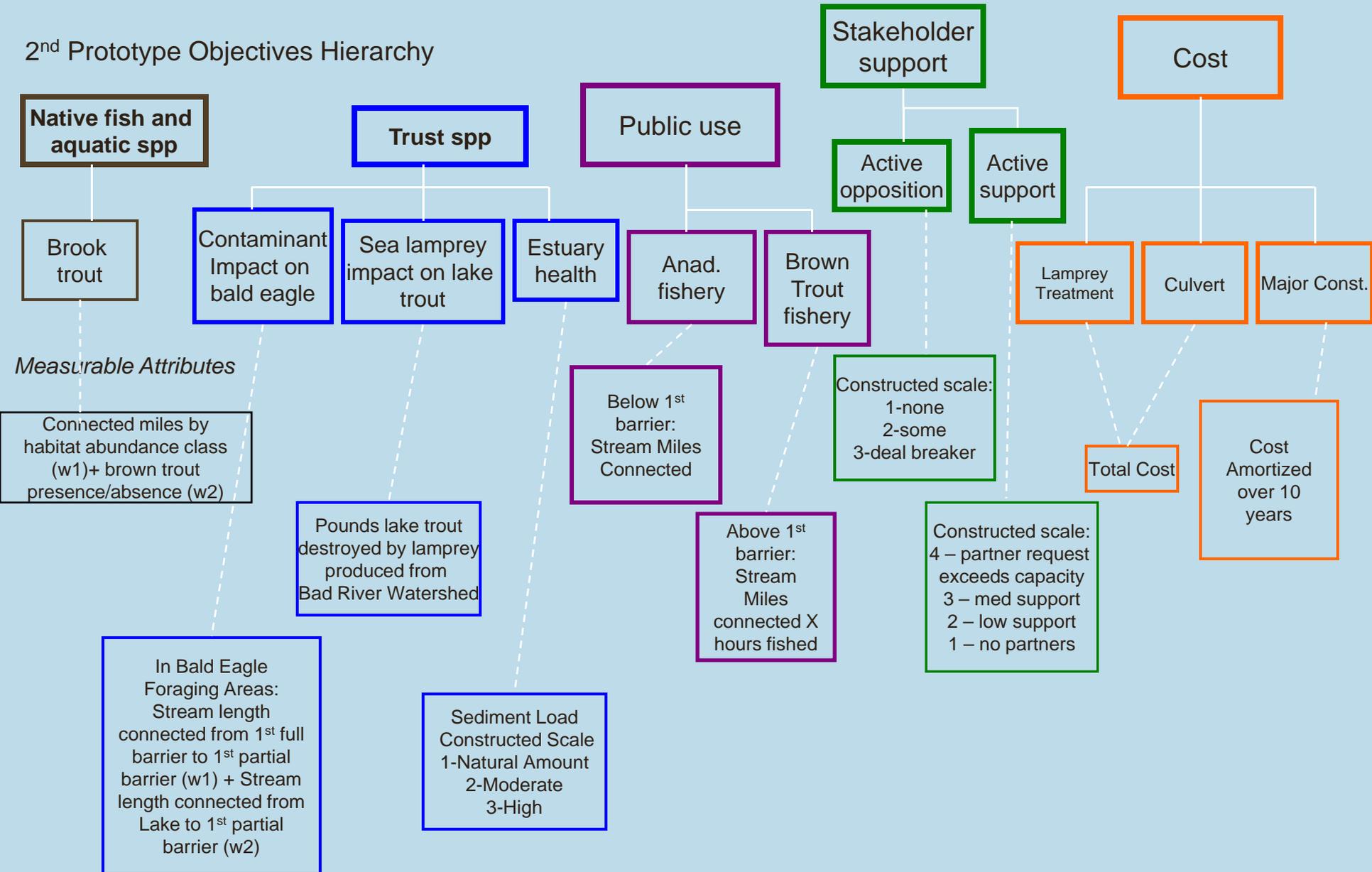
# Problem (Decision Statement)

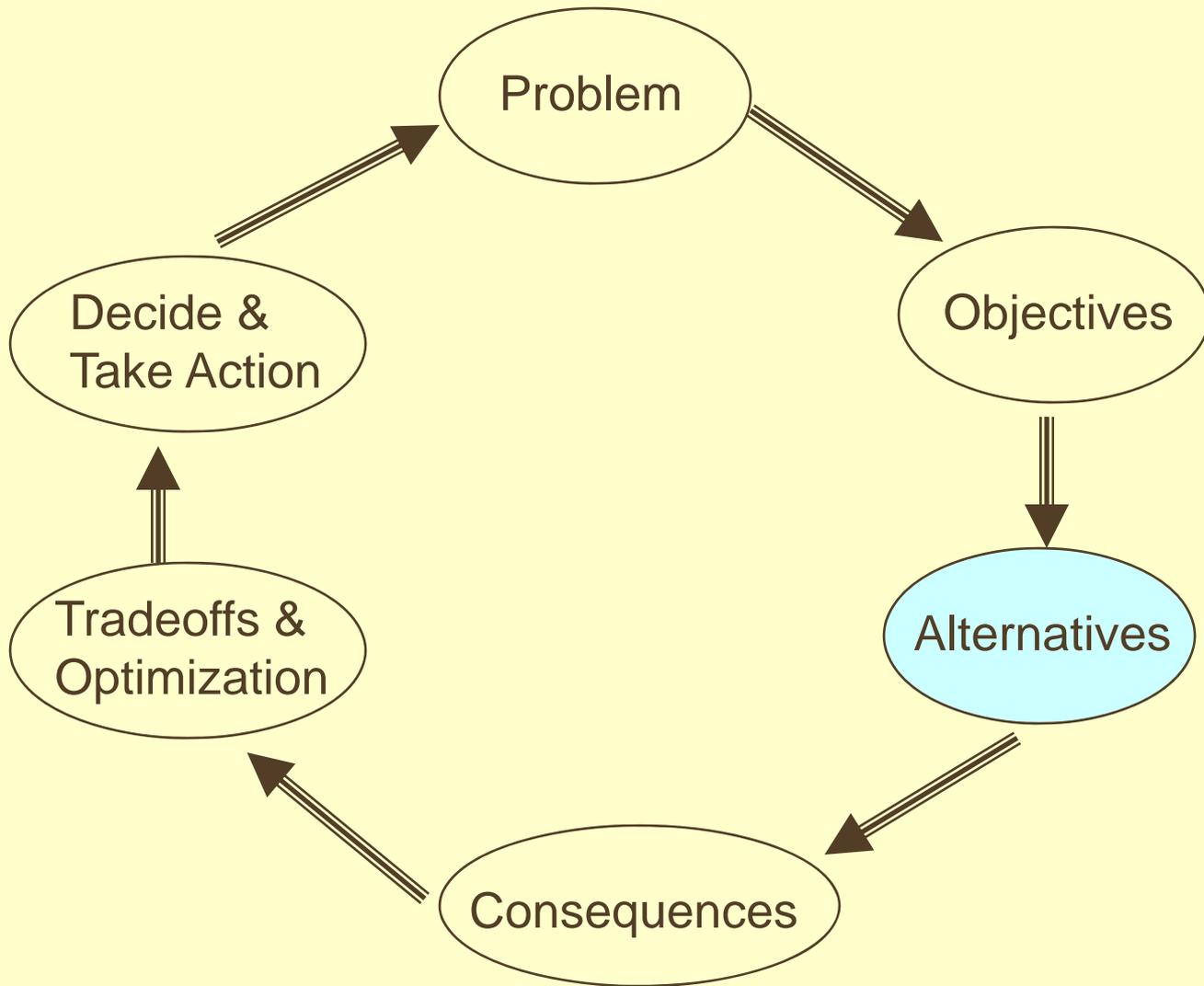
- Decision
  - How do we best manage barriers for fish passage in the Bad River Watershed over the next 10 years.
    - Removal and/or replacement
    - Add - barriers to prevent sea lamprey
    - Modify – allow selective fish passage



# Objectives

2<sup>nd</sup> Prototype Objectives Hierarchy





# Actions for Alternative Selection

Strategy Table

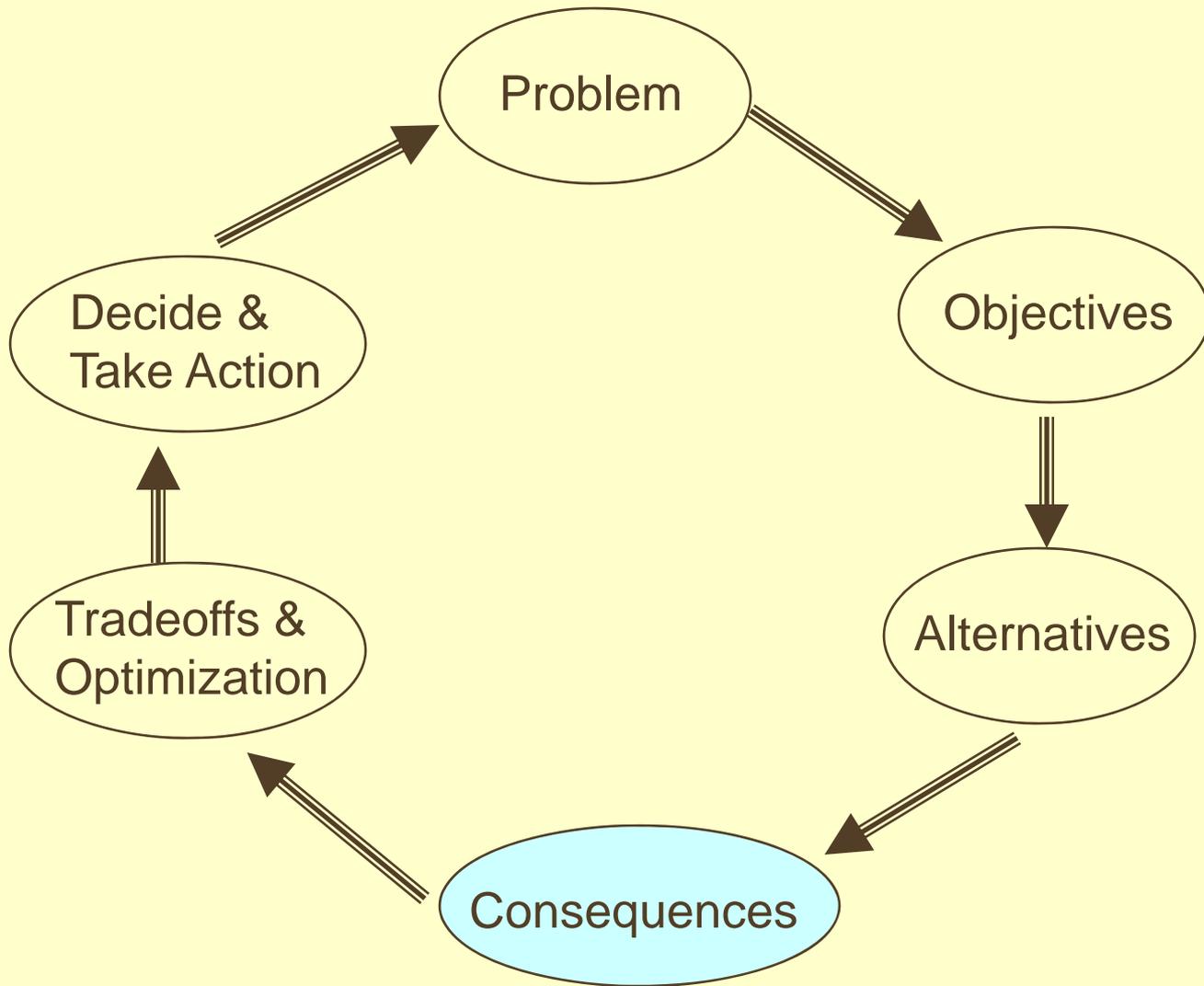
Culvert replacement above 1st barrier	Dam removal or fish passage	Culvert replacement below 1st barrier	Build new barrier with fishway
None	None	None	None
High Quality Habitat	Remove all dams	High Quality Habitat	High Quality Habitat
Start from uppermost barrier	Build fishway all dams	Start from uppermost barrier	Target reaches hard to treat for lamprey
Start from lowermost barrier	Remove WR dam	Start from lowermost barrier	Partner Requests
In select subwatersheds	Build fishway WR dam	In select streams	Marengo River
	Remove lowhead dams		
	Build fishway lowhead dams		

# Parking Lot

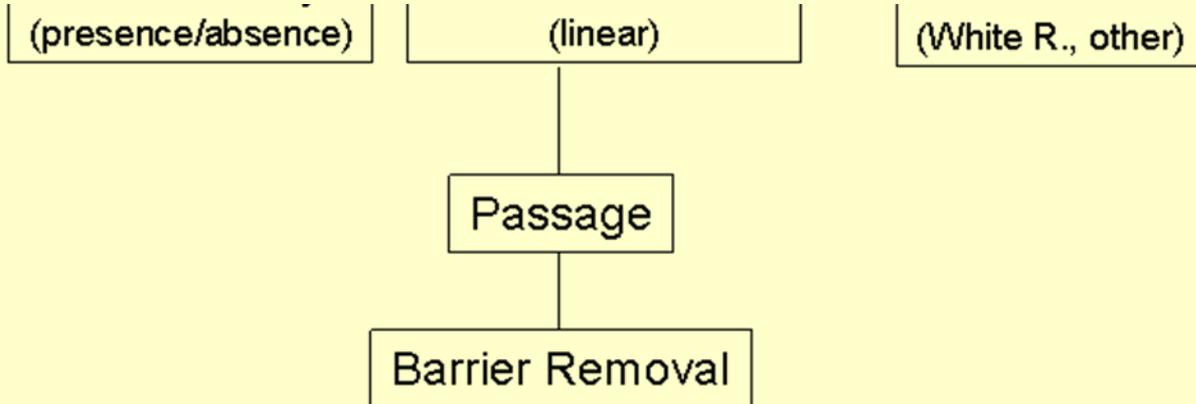
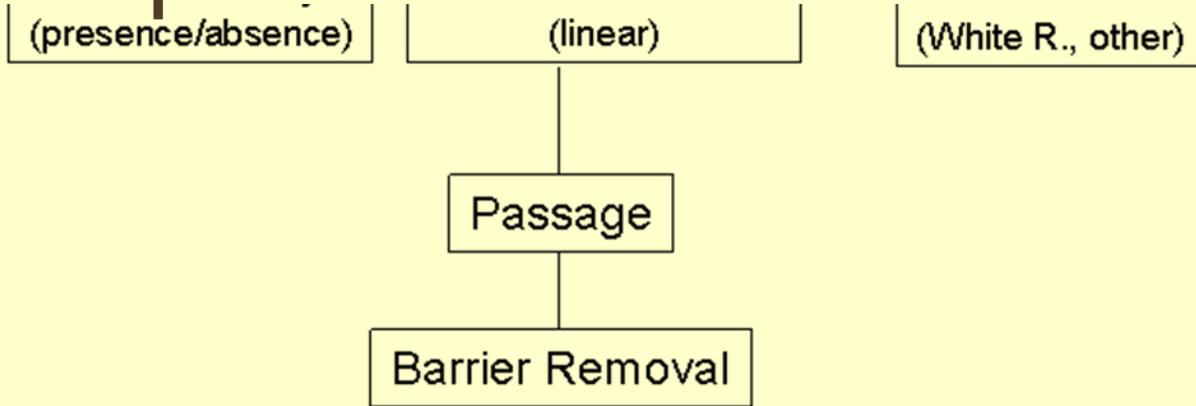


# Alternatives Portfolio

STRATEGIC PORTFOLIO OF ACTIONS					
Alternatives		Culvert replacement above 1st barrier	Dam removal or fishway	Culvert replacement below 1st barrier	Build new barrier with fishway
<b>A</b>	<b>Status Quo</b>	High quality habitat Start lower	none	High quality habitat	none
<b>B</b>	<b>Tribe</b>	none	none	High quality habitat Start lower	High quality habitat Hard to treat Partner requests
<b>C</b>	<b>Recreational Fishing</b>	High quality habitat Start lower	Build passage at lowhead dams	High quality habitat Start lower	High quality habitat
<b>D</b>	<b>Native Fish</b>	High quality habitat Start lower	none	none	High quality habitat
<b>E</b>	<b>Stream Structure &amp; Function</b>	Start lower	Remove all dams	Start lower	none
<b>F</b>	<b>No Barrier Management</b>	none	none	none	none
<b>G</b>	<b>Exuberance Alt</b>	In select subwatershds Start upper	none	In select streams	Marengo

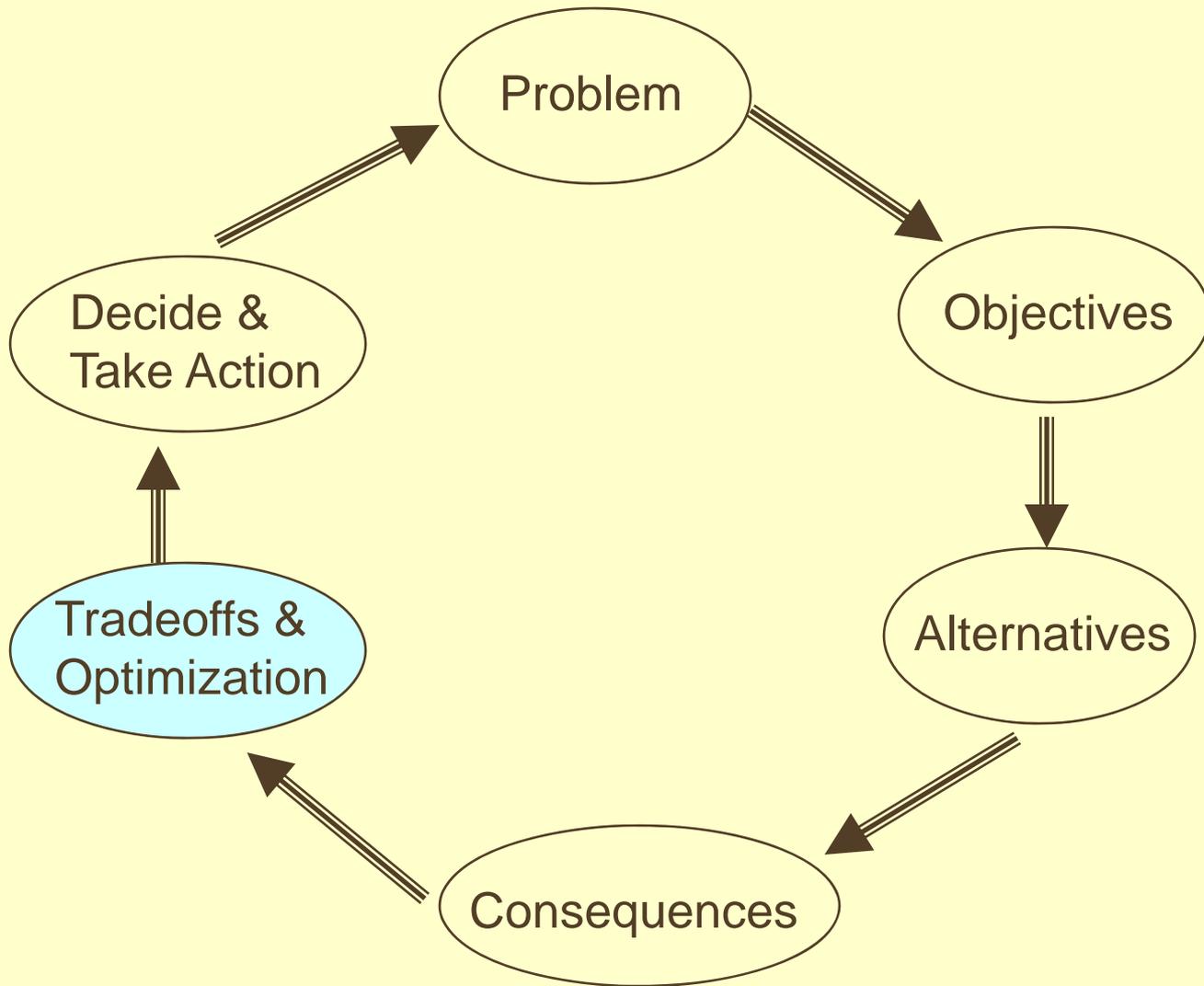


# Consequences: Influence Diagram



# Consequences

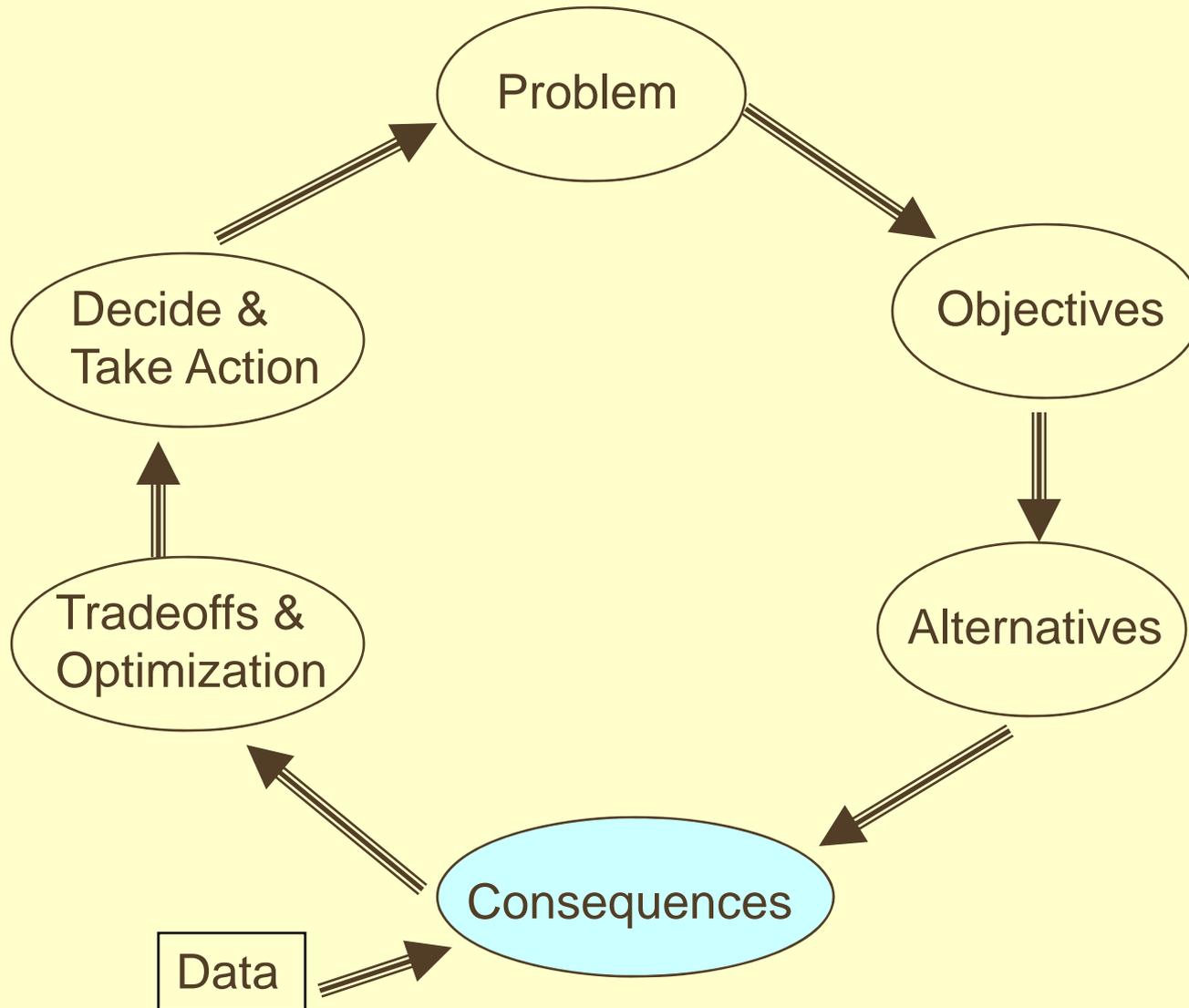
RAW SCORES		Alternatives (Portfolio of Actions)					
Sub-objective	Goal	Status quo	Rec fishing	Native spp	No barrier mgt	Exuberance	Units
Brook trout	Max	7.1	5.9	16.0	4.6	12.8	avg mi
Culvert cost	min	4,000,000	4,000,000	4,000,000	0	4,000,000	\$
Lamprey cost	min	900,000	1,310,000	1,210,000	900,000	1,210,000	\$
Major project cost	min	0	1,400,000	1,000,000	0	1,000,000	\$
Estuary health	min	2	2	2	3	2	1-3
Bald eagle	Min	2	3	1	1	3	1-4
Lake trout	Min	720,000	360,000	360,000	720,000	360,000	lbs
Anadramous fishery	Max	500	557	500	500	500	miles
Brown Trout fishery	Max	12,000	14,900	10,000	7,000	8,400	hours
Active opposition	Min	1	2	2	2	2	1-3
Active engagement	max	4	2	2	1	3	1-4



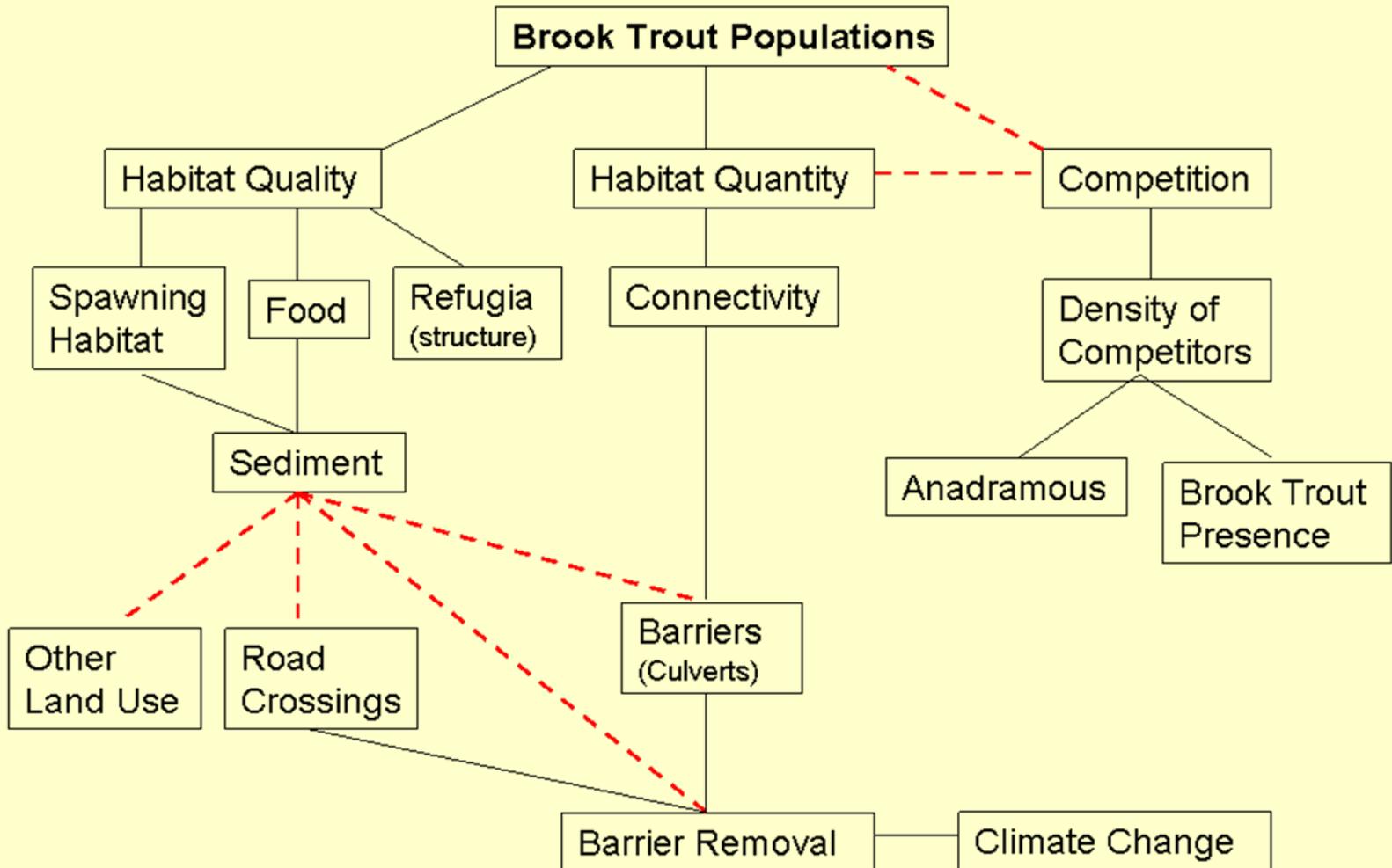
# Weighted Scores

Treatment (Portfolio of Alternatives)						
Status quo	Bad River Tribe	Rec fishing	Native spp	Physical structure and function	No barrier mgt	Exuberance
0.57	0.34	0.44	0.59	0.25	0.37	0.50
0.59	0.38	0.43	0.57	0.20	0.51	0.49
0.64	0.45	0.48	0.62	0.20	0.54	0.54

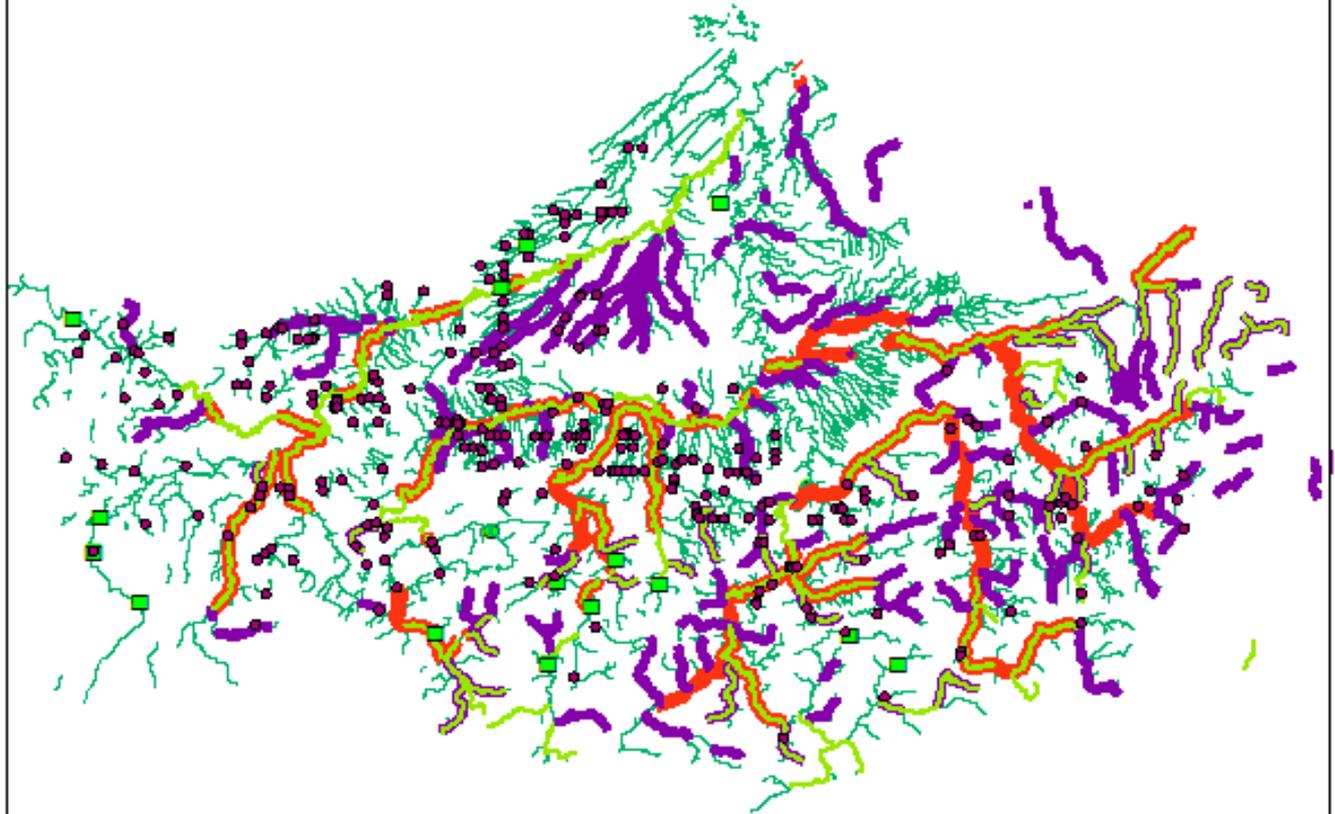
# Circle Back to Consequences



# Uncertainty



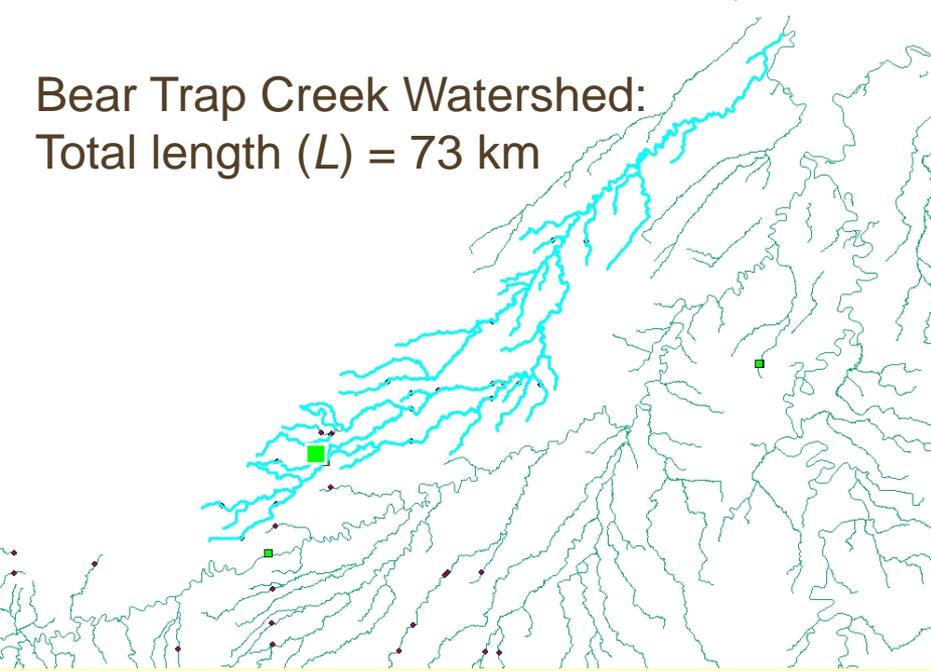
# Uncertainty



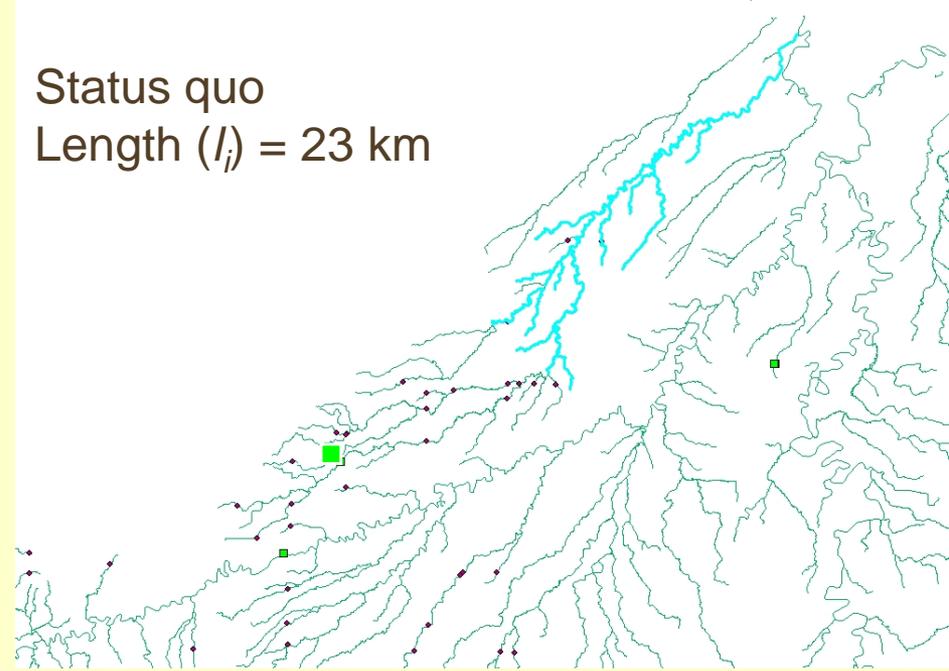
## Legend

- Culvert barriers
- Dams
- Brown trout = present
- Brook trout = 1
- Brook trout = 2
- River
- Natural barriers

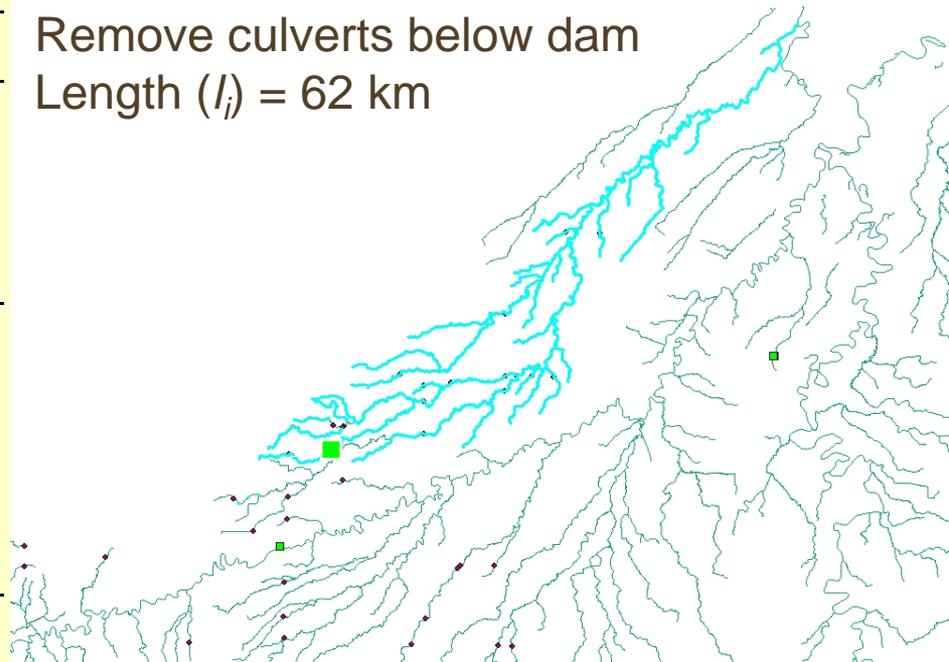
Bear Trap Creek Watershed:  
Total length ( $L$ ) = 73 km



Status quo  
Length ( $l_j$ ) = 23 km



Remove culverts below dam  
Length ( $l_j$ ) = 62 km



**Alternative**

**Objective**

**Status quo**

**Remove culverts below dam**

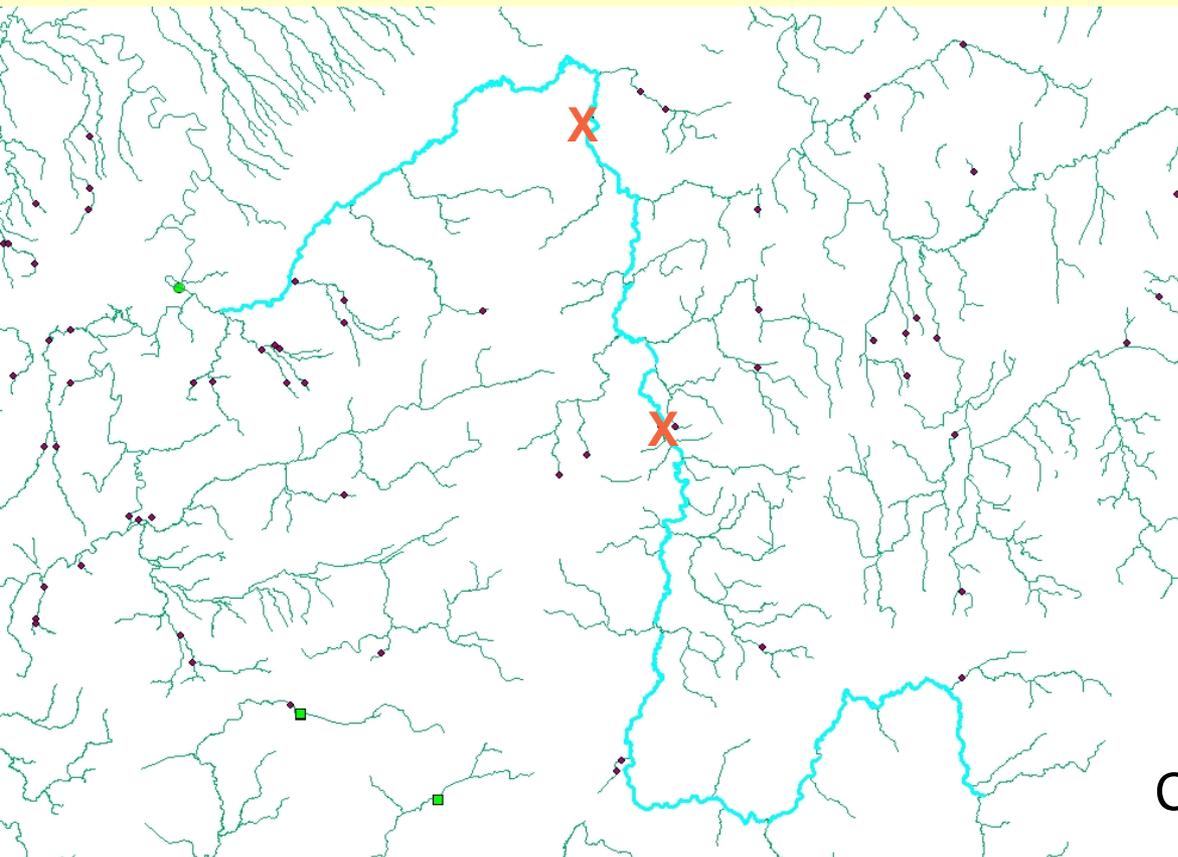
**Anadromous spp fishery**

**Proportion of stream length open to the Lake**

**32%**

**85%**

Cote et al. 2008



Tyler Forks	Section length ( $l_i$ )
Below barrier 1	15.9
Between barrier 1 and 2	13.1
Between barrier 2 and headwater	26.5
<b>Total length</b>	<b>55.5</b>
<b>Mean length</b>	<b>18.5</b>

$$\text{Connectivity index} = \sum_{i=1}^n \left( \frac{l_i}{L} \right)^2 \cdot 100$$

## Tyler Forks

**Objective: brook trout Maximize connectivity**

### Alternatives

	Status quo	Downstream up	Upstream down
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<b>Mean length of stream section (km)</b>	18.5	27.5	27.5
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<b>Connectivity index</b>	37	50	59
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# Next Steps...

- Bad River Watershed – Continue process with stakeholders
- Present to Regional leadership and others interested
- Conduct rapid prototype on Manistique River
- Identify a forum to engage a larger community in the Great Lakes

# Acknowledgements

- Coach: Jean Cochrane
- Apprentice Coach: Dave Smith
- John Young and Nathaniel Hitt
- Observers
- Donna Brewer and Mike Runge