



Opening the River: Fish Passage Dams on the Cannon

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Presentation Outline

- Introduction and background
- Impact of barriers in river systems
- Strategies for reconnecting rivers
- Past and Present projects
- Questions



Clean River Partners

Our mission is to inspire people and organizations to value, protect, and improve the Cannon River Watershed's land and water.

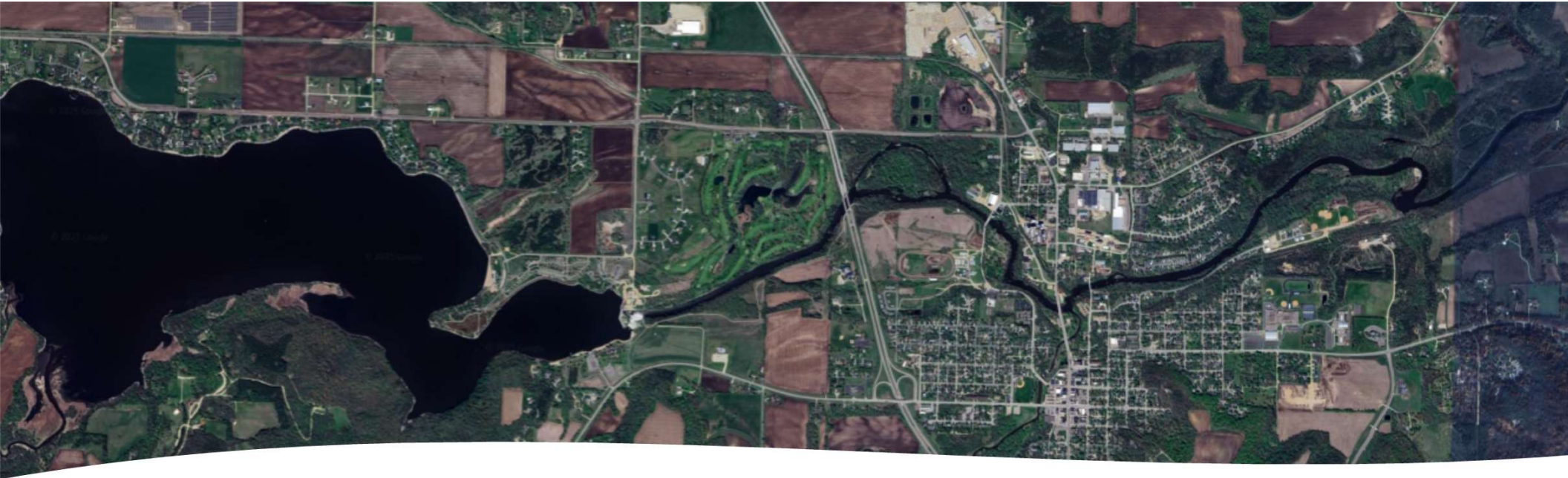
- Habitat Protection and Restoration
- Conservation Agriculture
- Crop Research
- Community Engagement



Habitat Protection and Restoration

- CRP is working with the MN DNR and Bolton & Menk on a dam modification project: The Cannon River Fish Passage Project
- Improving connectivity and facilitating fish passage on the Cannon River





Dams

A structure built across a river or stream to hold back water

- Water supply
- Lake level control
- Mills
- Power generation
- Recreation
- Floodwater retention
- Diversion

Dams

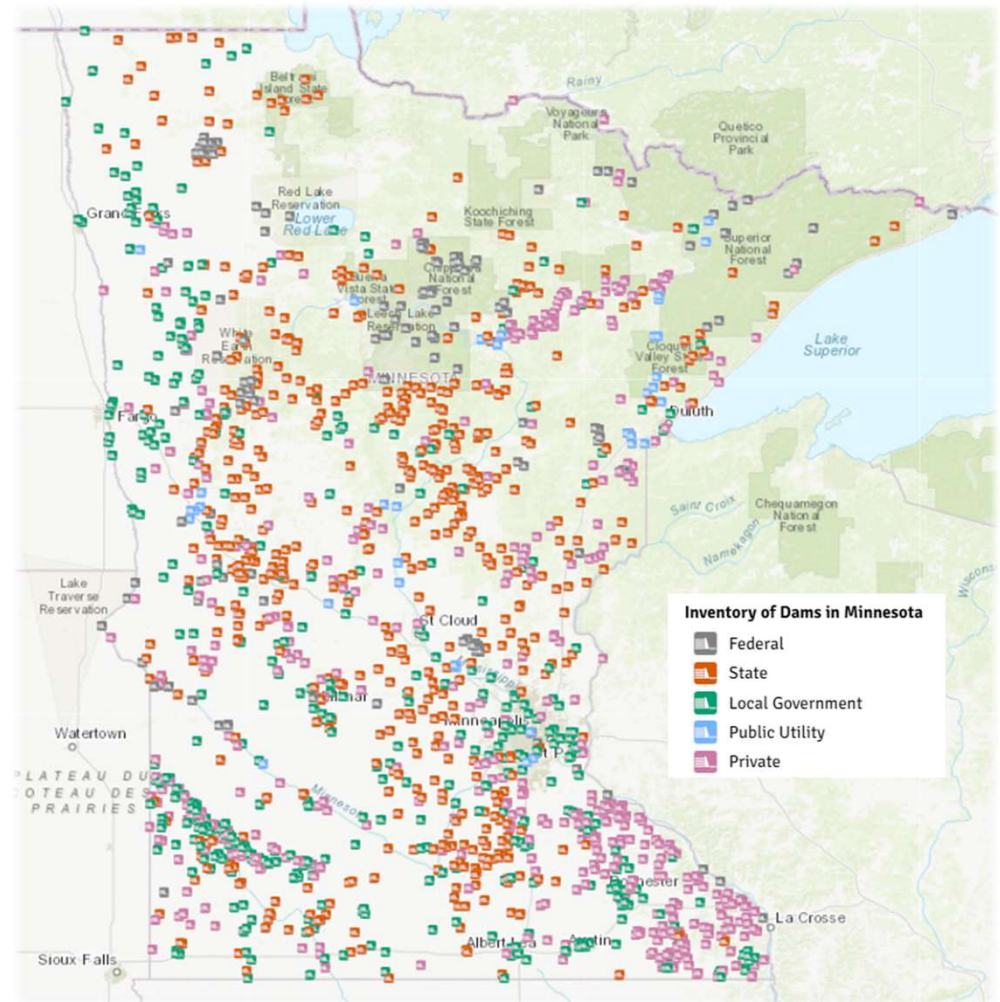
In the United States:

- Over 92,597 total dams
- 6,575 dams at least 49 feet high
- Over 75,000 dams at least 6 feet high

In Minnesota:

- More than 1,150 dams
- 330+ dams over 20 feet tall
- 900+ dams that are several feet tall

https://arcgis.dnr.state.mn.us/ewr/dam_finder/



Dams on the Cannon River

- 9 dams are still in place on the Cannon River
 - Morristown Pond
 - King's Mill
 - Woolen Mill
 - Ames Mill
 - Byllesby
 - Shields Lake
 - Gorman Lake
 - Lower Sakatah Lake
 - Rice Lake



History of dams on the Cannon River

- Several dams were built along the Straight and Cannon Rivers to harness the energy of flowing water for operating mills
- Smaller dams were placed to maintain lake levels and control flooding
- Byllesby Dam – Built in 1911 to impound the Cannon River for hydroelectric power
 - Created the Lake Byllesby Reservoir, a 1,432-acre lake



Concerns with dams

Aging structures:

- Many dams were designed with a 50-year life span in mind.
- The average age of dams in US is 64 years old (NID)
- The average age of dams in MN is 61 years (NID)
- Many dams no longer serve the original purpose they were built for



Concerns with dams

Aging structures:

- 1848-2017, an average of 10 dams per year fail across the United States
- Dam failures are typically due to poor maintenance, inadequate design, unusually large floods, or improper operation

Maintenance:

- As dam structures age, maintenance increases. An estimated \$103 million is needed over the next 20 years to assure public dams remain in safe condition (MN Dam Safety)



Image source: Photo Credit: Stefan Payne-Wardenaar

Dam Failures in the U.S. National Performance of Dams Program
Dept. of Civil & Environmental Engineering Stanford University

Concerns with dams

Safety:

- Water flowing over low-head dams create a dangerous hydraulic roller that can trap and drown swimmers, boaters, and kayakers.

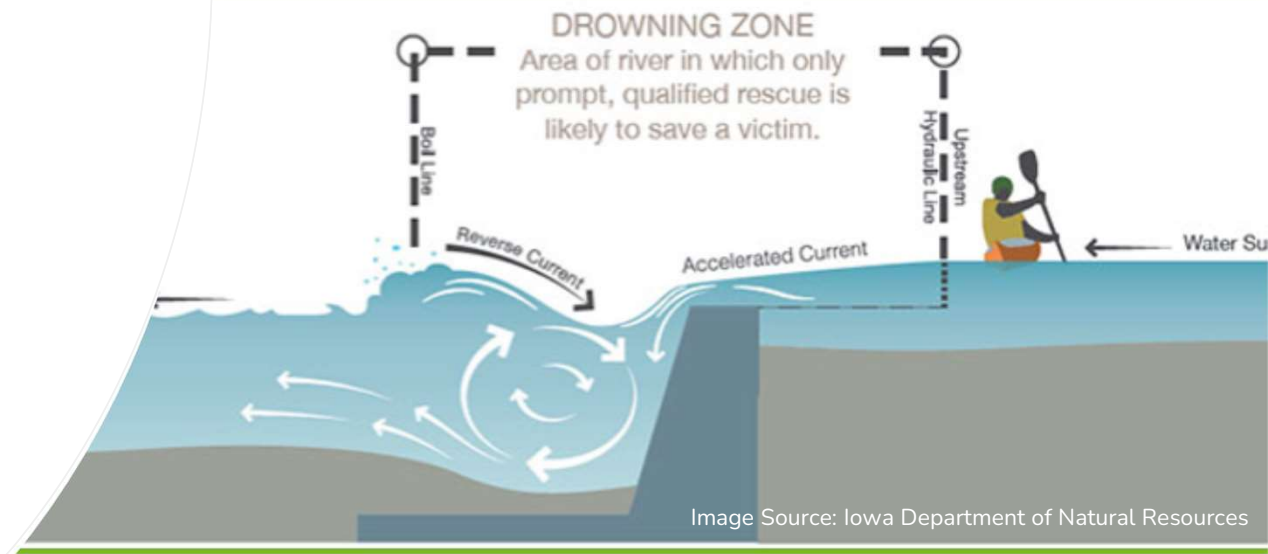


Image Source: Iowa Department of Natural Resources

Concerns with dams

- Dams alter the natural flow of rivers and streams and transform them into static reservoirs
- These impoundments can impact water quality in several ways:
 - Retaining chemical pollutants such as fertilizers
 - Increases temperature
 - Accumulates sediments

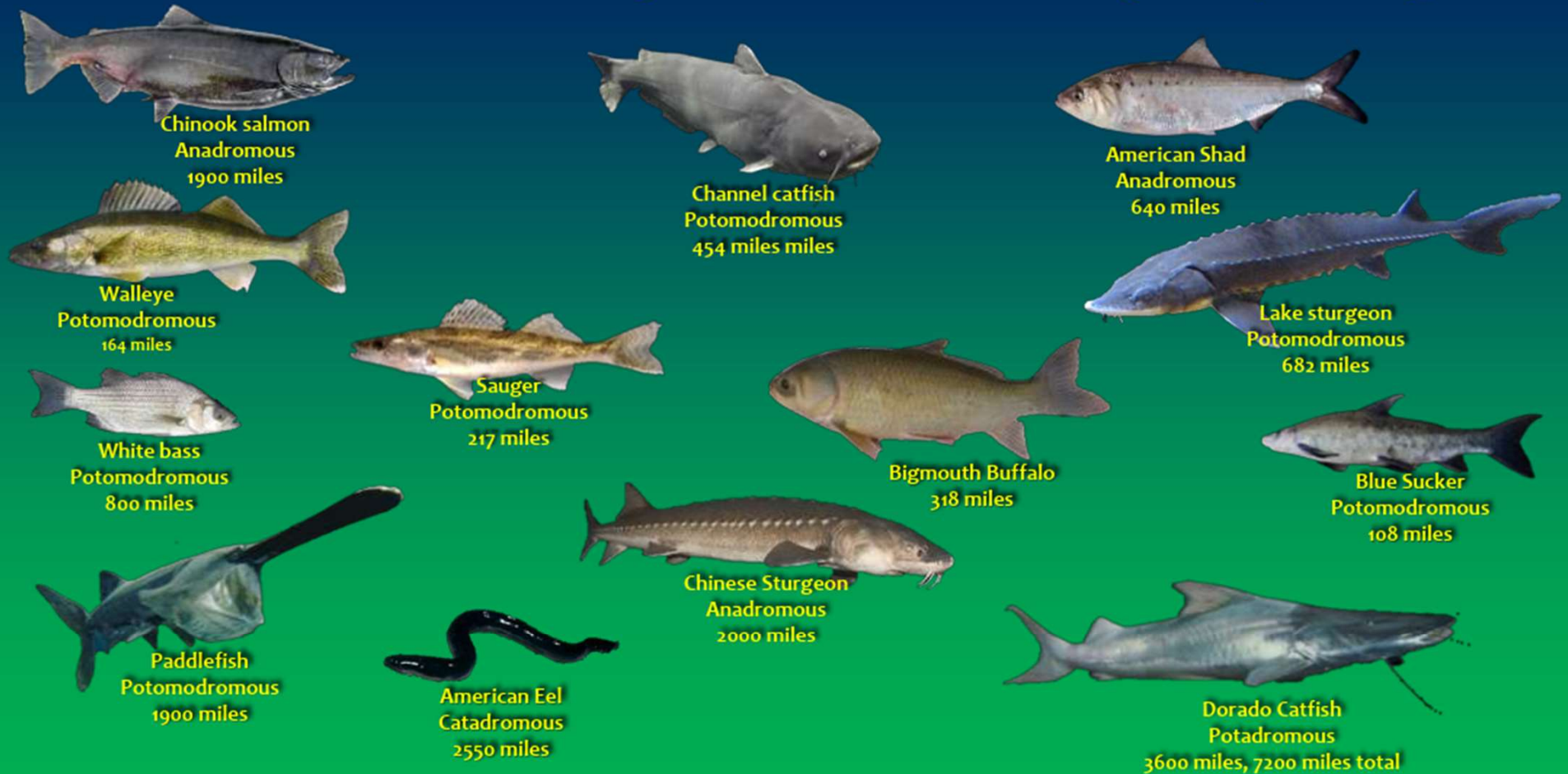


Concerns with dams

- Dams are barriers or partial barriers to fish passage.
- Fish migrate seasonally to reproduce, optimize foraging, and recolonize after droughts, severe winters, and other disturbances.
- Reduces biodiversity and genetic diversity



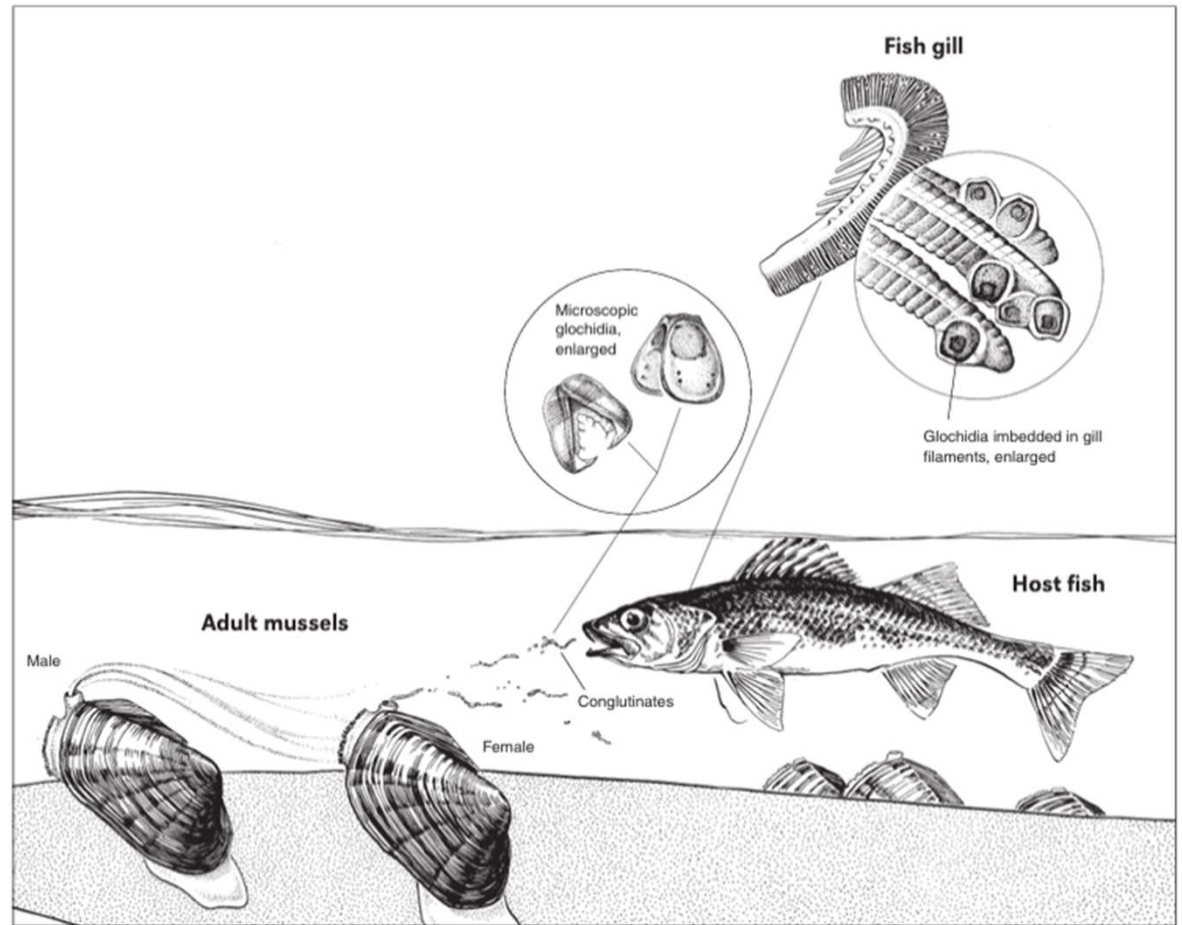
Documented River Migration Distances of Fish Species (one way)



References: Stancille et al. 2002, Mosindy and Rusak 1991, Bellgraph 2006, Ron Bruch, news release, Mike Larson, personal communications, Jaeger 2004, Nick Schloesser, personal communication, Altena 2003, Neely et al. 2009, Finke 1966, Aur 1996, and others

Concerns with dams

- MN mussels have also been impacted by dams. They require fish to reproduce so their populations can not thrive without migrating fish.
- Dams bury mussels and their habitat
- In MN, 28 of our 51 native mussels species are listed as endangered, threatened, or of special concern



Mussel Illustrations by Don Luce



Mussels



Mussels



Strategies for Reconnecting Rivers

Nature-Like Fish Passage



Problem Corrected / Restored	Dam Removal	Rock Arch Rapids	By-pass Fishway
Stream Habitat	★★★★	★★	★*
Safety – dam failure risk	★★★★	★	
Safety – hydraulic undertows	★★★★	★★★★	
Fish & Wildlife Passage	★★★★	★★★★	★★*
Canoe passage, recreational boating	★★★★	★★	★*
Geomorphic and ecological processes (sedimentation, incision, nutrient processes, etc.)	★★★★		

* Size dependent

Strategies for Reconnecting Rivers

Source: MN DNR

Rock Arch Rapid Design

- Each RAR is designed specifically since each river site is unique
- RAR is composed of a rock ramp base that replaces the abrupt drop in water level with a gentle slope
- Each weir has strategically placed gaps to allow for fish passage
- Most MN fish species do not jump
- Resting pools between the weirs allow for recovery

The diagram illustrates the Rock Arch Rapids Concept in two parts: a plan view (top) and a cross-section view (bottom).

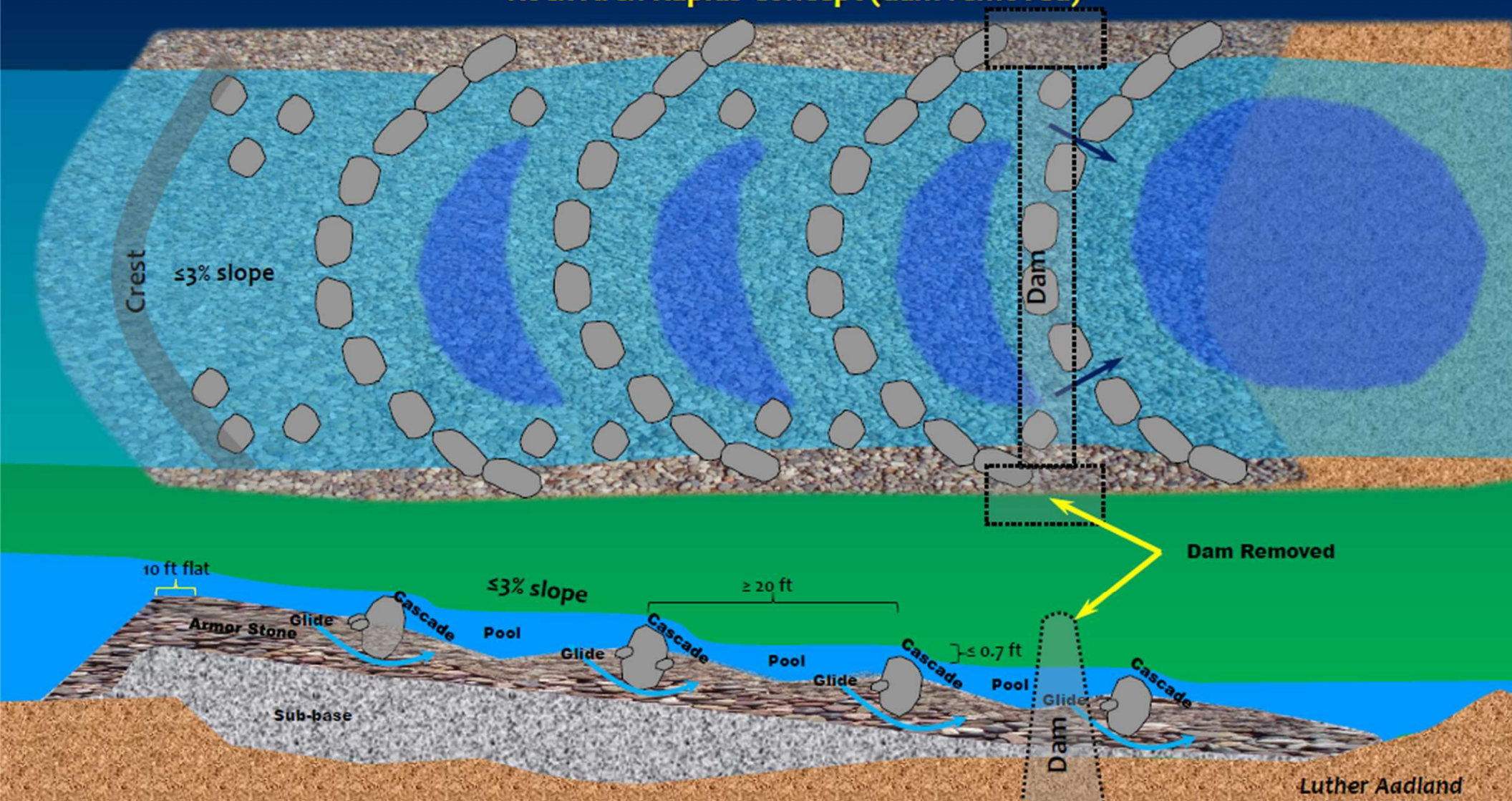
Plan View (Top): Shows a river channel with a $\leq 3\%$ slope. A dam is located on the left. The channel is filled with rocks arranged in a series of arches. Blue shaded areas represent pools of water. Arrows indicate the flow direction downstream.

Cross-section View (Bottom): Shows the riverbed structure. The dam is on the left. The riverbed consists of a **Base Stone** layer and a **Sub-base** layer. The riverbed is sloped at $\leq 3\%$. The structure includes a series of **Cascade** and **Pool** sections. The distance between the first and second cascade is ≥ 20 ft. The height of the cascade is ≤ 0.7 ft. The width of the pool is $\geq 2D_{50}$. The flow direction is indicated by a yellow arrow pointing downstream, labeled **Downstream hydraulic control**.

Labels: Dam, $\leq 3\%$ slope, Cascade, Pool, ≥ 20 ft, ≤ 0.7 ft, $\leq 3\%$ slope, Base Stone, Sub-base, $\geq 2D_{50}$, Downstream hydraulic control, Luther Aadland.

Luther Aadland

Rock Arch Rapids Concept (dam removed)



Construction

- Typically done in the winter
- Minimizes the damage to surrounding ground
- Flows tend to be low facilitating work in the water
- Less likely to have a flood pulse occur during construction

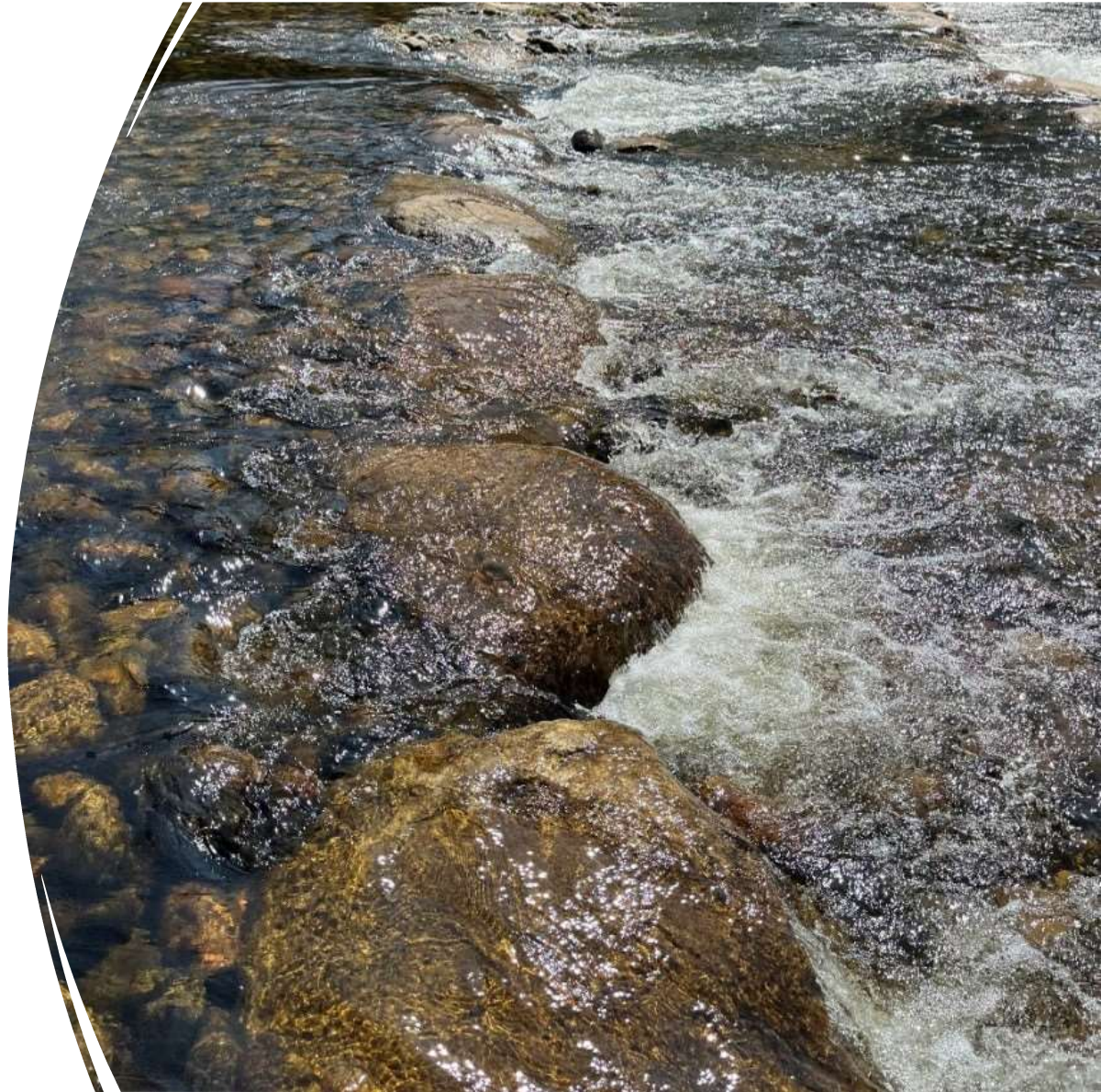
Photo credit: Bolton & Menk



Key Feature: Weir and Resting Pools

- Each weir has strategically placed gaps to allow for fish passage.
- Most Minnesota fish species do not jump but rather burst within the water column to pass high velocity areas.
- Resting pools between the weirs allow for recovery.

Photo credit: Bolton & Menk



Benefits of RAR design

- Requires minimal to no maintenance
- Proactively addresses aging structures
- Improves safety and recreation
- Allows fish passage under all flow conditions
- Fish species return upstream after dams are modified (and mussels!)





Fish Movement on Crest at Fish Lake Outlet

Source: MN DNR REU



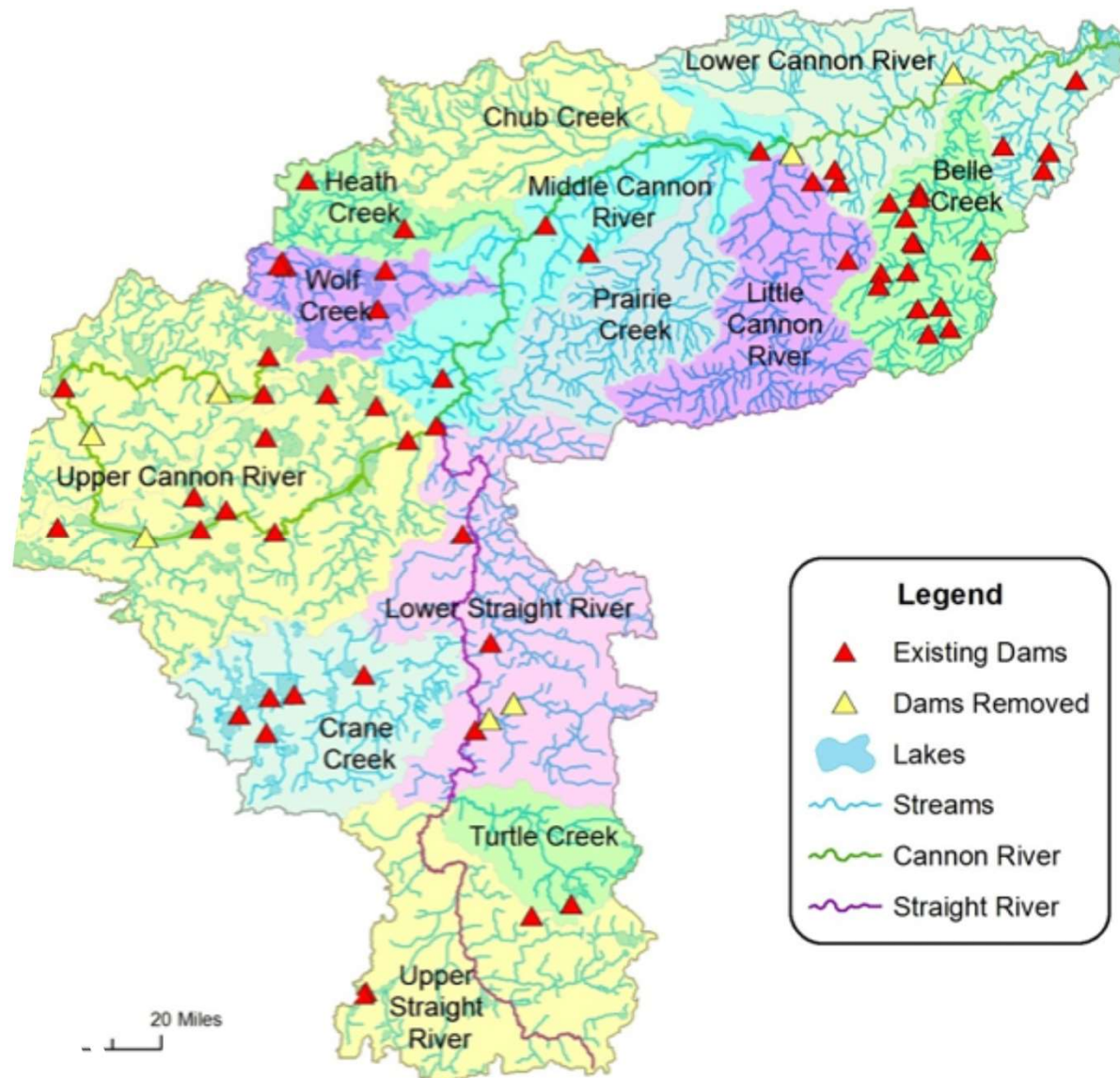
Pelican Rapids – Otter Tail County

Past Projects

Three larger dams have been removed in the watershed

- 1994 - Cannon River at Welch
- 2001 - Little Cannon River dam in Cannon Falls
- 2006 - Morehouse dam on the Straight River in Owatonna (partial removal)

Source: Cannon River Watershed Monitoring and Assessment Report



Welch Dam Removal

- The dam removal opened up an additional 12 miles of the Cannon River to the Lake Byllesby Dam.
- Fish from the Mississippi River can now freely migrate upstream ~26 miles

City/Region

Welch Dam removal hailed as success

By John Weiss
The Post-Bulletin

WELCH — Removal of the small dam on the Cannon River west of Red Wing is one of the success stories behind a national trend to get rid of dams that no longer serve a purpose and are interfering with recreation or natural resources, three national conservation groups say.

American Rivers, Trout Unlimited and Friends of the Earth released a report Monday detailing removal of 465 dams nationally. Included on the list is the dam on the Cannon at Welch and one on the Kettle River in central Minnesota.

"When they hear how successful these dam removals were, we hope more communities, dam owners and natural resource managers will consider removing dams on their local rivers as one reasonable way to restore them to health and revitalize the communities along their banks," said Margaret Bowman, director of the American Rivers' campaign "Rivers Unplugged."

According to the report, the Welch Dam was first built more than a century ago. This dam was apparently taken out or was washed out and a second dam, 9 feet tall and 120 feet wide, was built in the 1920s or 1930s for a mill that ground grain. It also generated some hydropower for Welch until the early 1960s.

The dam was a safety hazard for canoes and people riding down the river on inner tubes. The report states that at least six people drowned there in the 25 years before the dam was removed. Those going over the dam could get caught in undertows that pulled them underwater.

In 1994, the Minnesota Department of Natural Resources took out the dam, allowing boaters and others to use the area and safely go through a riffle that had been hidden by the dam for a century.

Removal also allowed fish species to again move freely up the river.



John Weiss/The Post-Bulletin

The Cannon River at Welch flows over riffles that were covered for a century by a dam that was removed in 1994.

Cannon River Home to New Fish

1994 Fish Population Assessment conducted in the Cannon River between the Lake Byllesby Dam and the town of Welch resulted in the collection of three species of fish never before recorded from that area. A muskellunge, flathead catfish and bowfin (or dogfish) were sampled by DNR Fisheries staff using electrofishing equipment during the assessment.

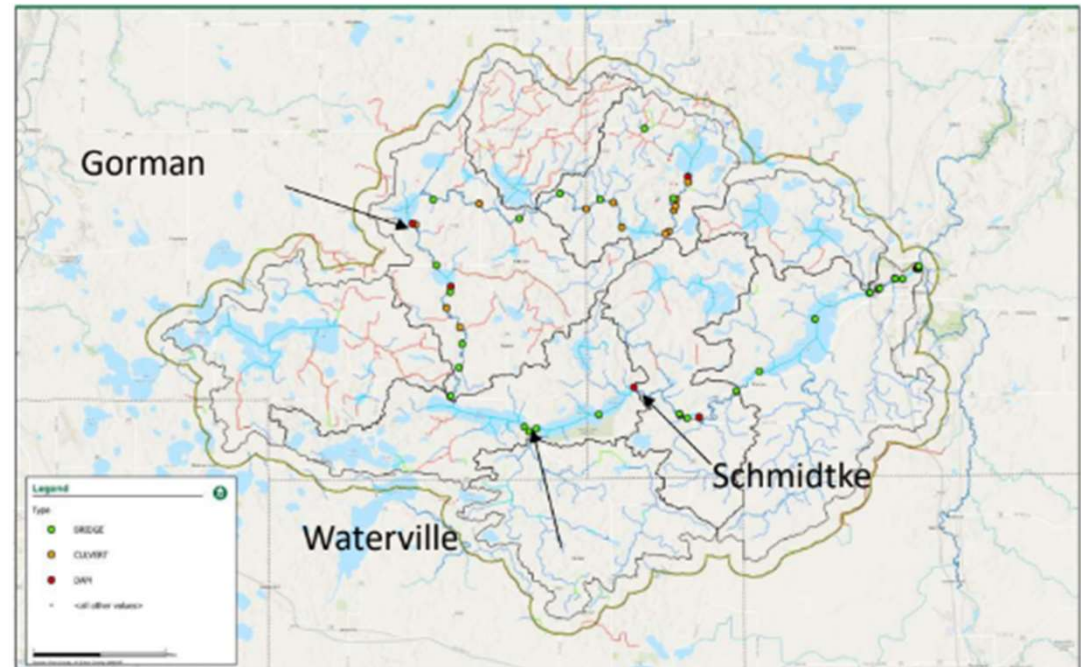
The discovery follows the spring 1994 removal of the Welch Dam, which opened up an additional 12 miles of the Cannon River to the Lake Byllesby Dam. Fish from the Mississippi River can now freely migrate upstream approximately 26 miles.



Cannon River Fish Passage Project

Project Scope

This project involves modifying the Lower Sakatah Lake Dam (Schmidtke) and Gorman Lake Dam to rock arch rapids and replacing the Dodd Rd. culvert to facilitate fish passage in the Cannon River Watershed.



Project Funding

- The Cannon River Fish Passage Project is funded through the MN DNR Get Out MORE (Modernize Outdoor Recreation Experiences) Investments which invests \$150 million in Minnesota's recreation infrastructure.
- \$10 million is for Restoring Streams and Modernizing Water-related Infrastructure Projects, which includes the Cannon River Fish Passage Project.



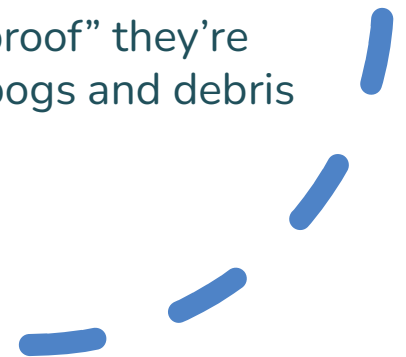
Get Out MORE Restoring Streams and Modernizing Water-related Infrastructure Projects

NOVEMBER 2024



Project Benefits

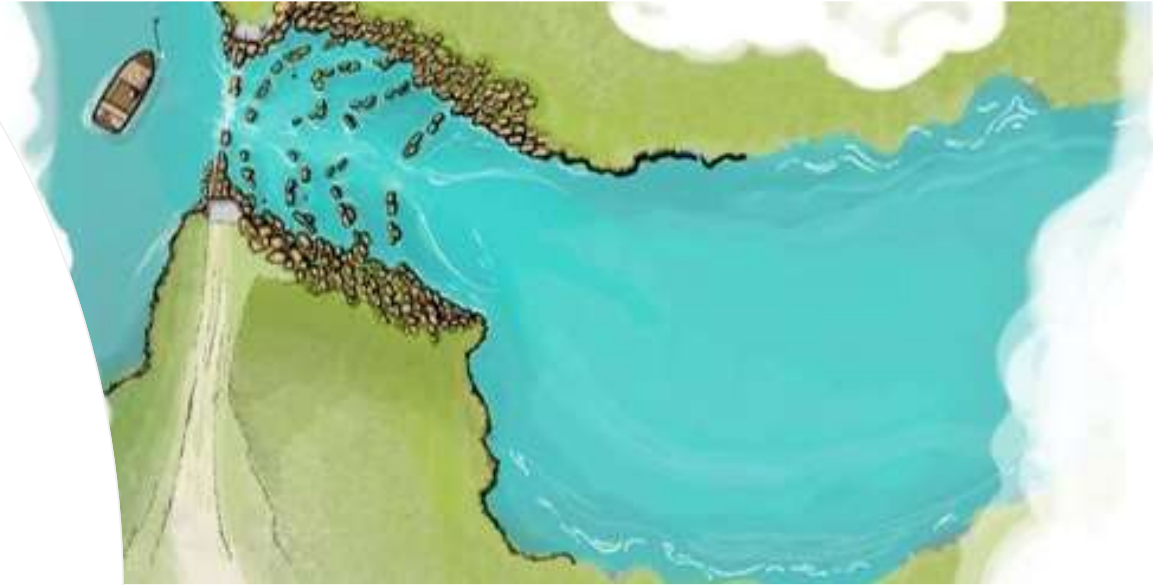
- Modifying the Lower Sakatah Lake Dam will reconnect three miles of the Cannon River
- Modifying the Gorman Lake Dam will reconnect 19 miles of the Cannon River for fish passage
- The new Dodd Rd. Culvert will reconnect one mile of the Cannon River up to the Gorman Lake Dam
- The rapids will improve passage for 28 species of fish, including a genetically rare form of walleye
- Enhanced recreational opportunities
- While the rock arch rapids are not “bog proof” they’re less susceptible to plugging by floating bogs and debris than the existing dams



Gorman Lake Dam Modification

- Original structure built in 1936
- Retain concrete sill at current elevation
- Install rock and boulder rapids downstream
- Dam and Dodd Road culvert downstream are both fish barriers during specific flows

Image Credit: Bolton & Menk

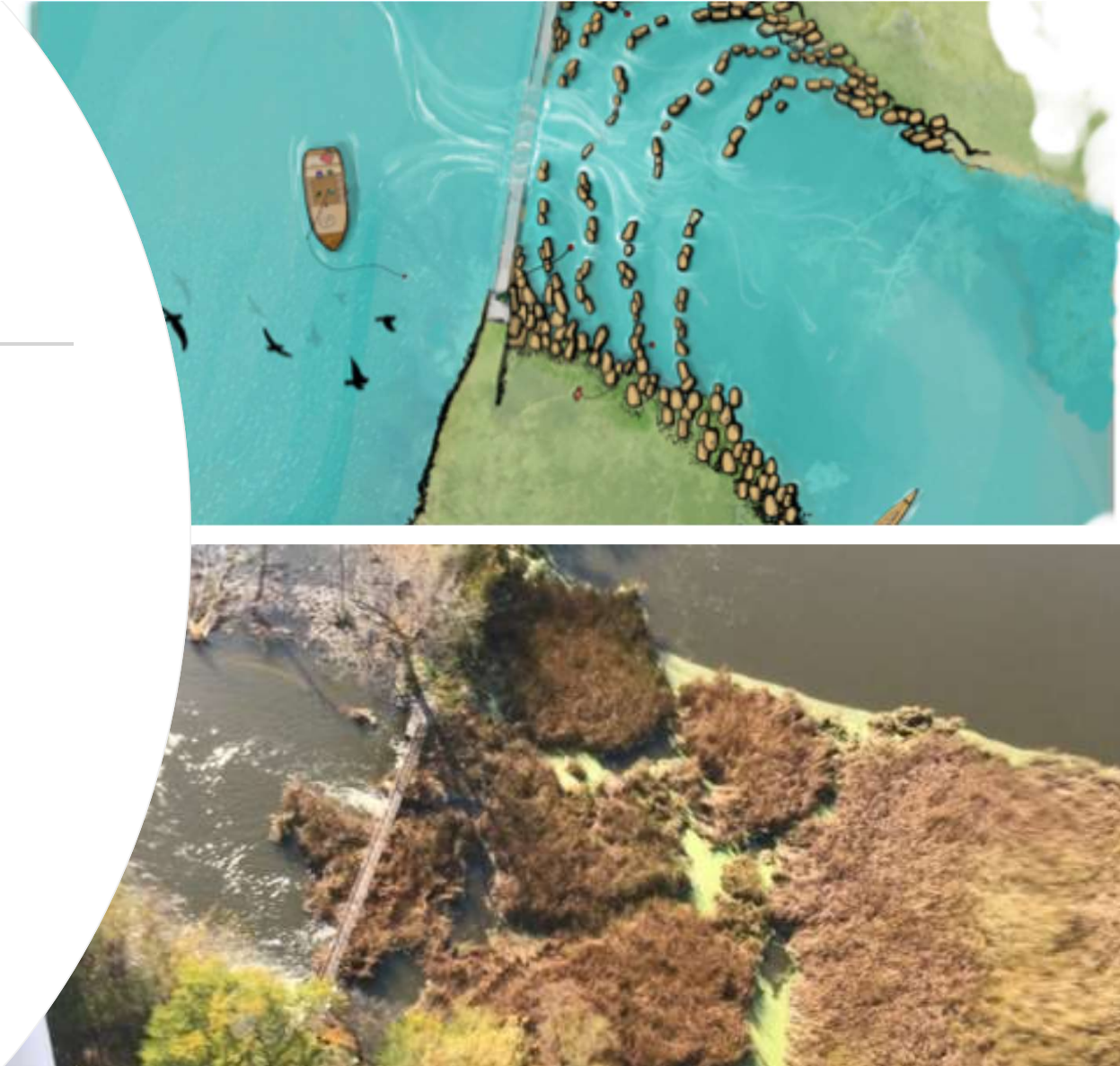


Lower Sakatah Lake Dam

- Original structure built in 1938, modified in 1994
- Piers, railing, and bridge removed.
- Retaining concrete sill at current elevation and installing rock and boulder rapids downstream
- Flows deeper in the center of the outlet improve debris movement

Top Image Credit: Bolton & Menk

Bottom Image Credit: MN DNR



Design Approach

- Maintain lake runout elevation (required by statute)
- The proposed rock arch rapids will have a cross section and profile that closely matches the hydraulic function of the existing dams through the range of expected flows
 - Use hydraulic modeling to verify
- Project is currently in final design and permitting phase



Woolen Mills Dam

- Constructed in 1865
- The 2024 flood resulted in damage to the northern wall of the Woolen Mill Dam
- City is considering other alternatives and engaged Barr Engineering to evaluate both the repair as well as the possibility of the replacement of both the south and north dam, and related costs and benefits.



Ames Mill Dam

- Built in 1918
- Owned and managed by Post Consumer Brands
- Range of concepts are explored in the City of Northfield's Riverfront Enhancement Action Plan
- The City has conducted a dam study and explored ideas and options including preserve and repair existing dam or removing and reconstructing the area
- Feasibility study can be found on City of Northfield's website



Additional Resources

- MN DNR River Ecology Unit:
<https://www.dnr.state.mn.us/eco/streamhab/index.html>
- MN DNR Get Out MORE:
<https://www.dnr.state.mn.us/aboutdnr/get-out-more/index.html>
- Upper Cannon River Flood Study:
<https://www.lesueurcounty.gov/769/Upper-Cannon-River-Watershed-Flood-Risk->
- Ames Mill Dam:
<https://www.northfieldmn.gov/1604/Ames-Mill-Dam>
- Cannon River Fish Passage Project:
<https://www.cleanriverpartners.org/fishpassage>

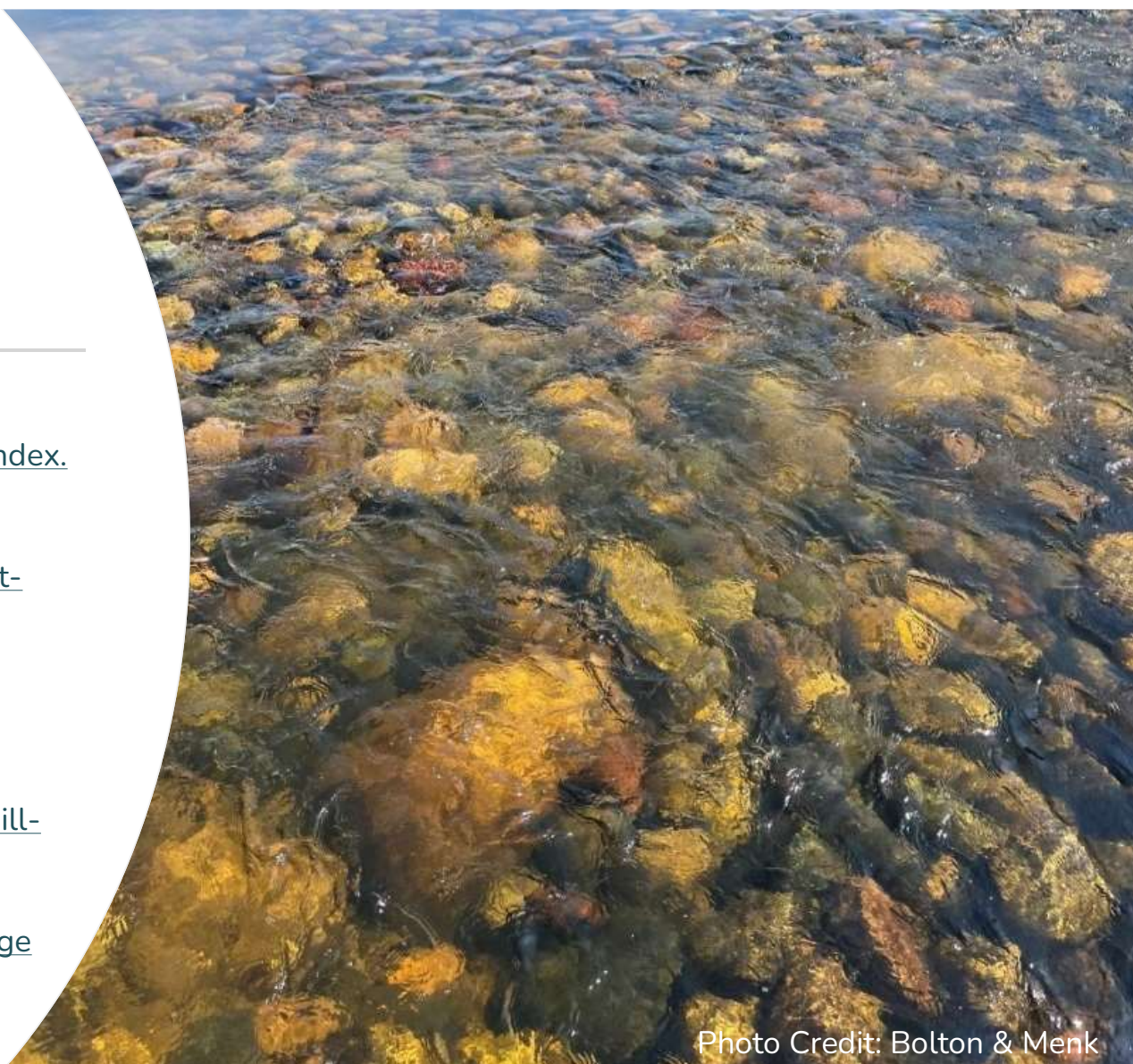


Photo Credit: Bolton & Menk

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