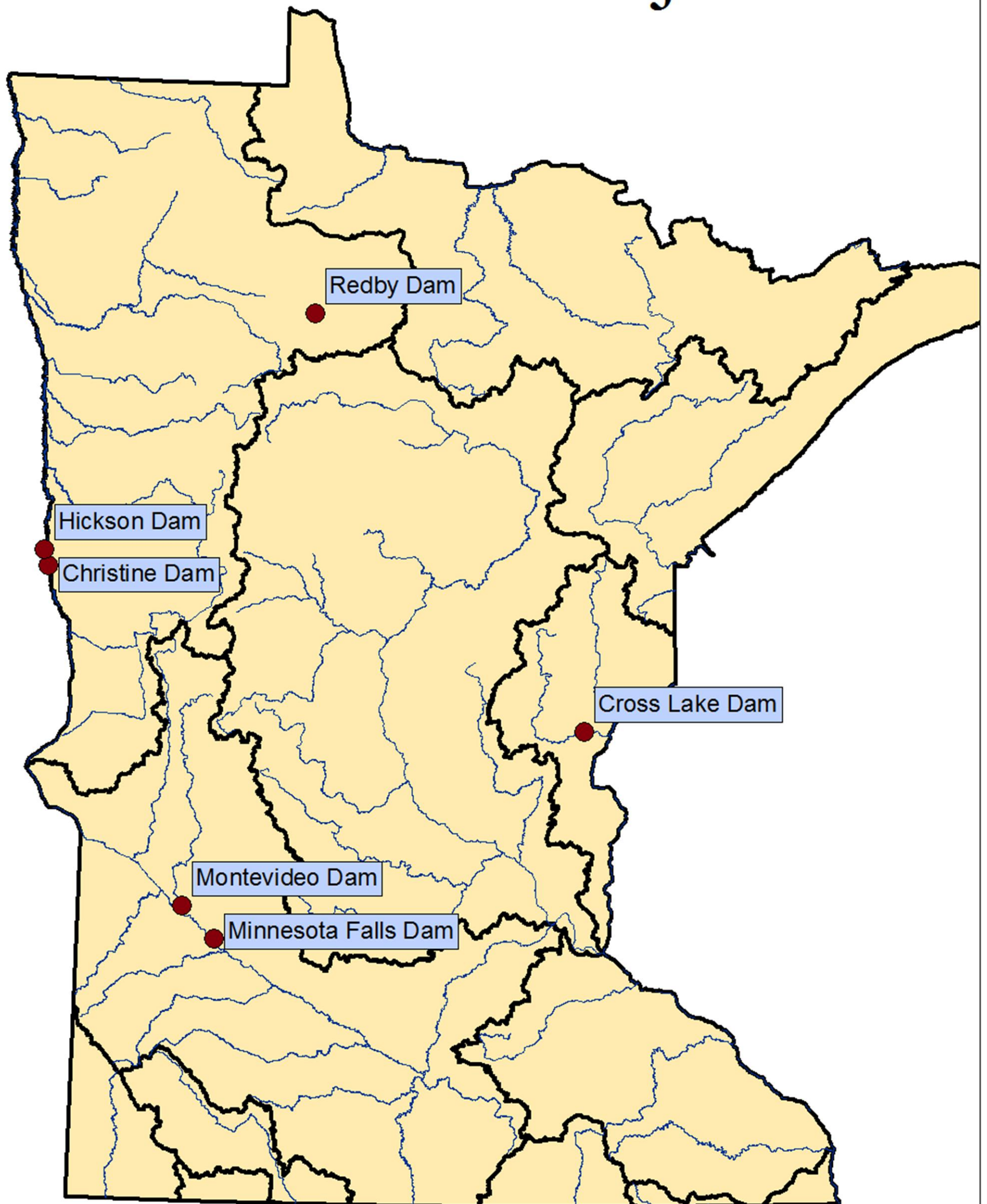
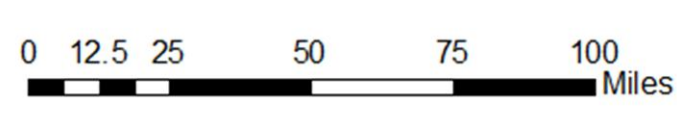


MN DNR Recent Stream Restoration Projects



Legend

- Project Sites
- Major Rivers
- Basins



Minnesota Falls Dam, Minnesota River

Dam Removal

Dam Owner: Xcel Energy

Year Built: 1905

Original Function: Hydropower till 1961

Size: 18 feet tall, 600 feet long

Reason for removal: No longer generating power, too costly to repair, liability to owner, recent drowning of Xcel employee in 2011

Agencies Involved: MN DNR, Pollution Control Agency, Army Corps of Engineers

Project Designers: Tom McDonald (Project Engineer), Barr Engineering; Luther Aadland, MN DNR

Completed: Winter 2012/2013

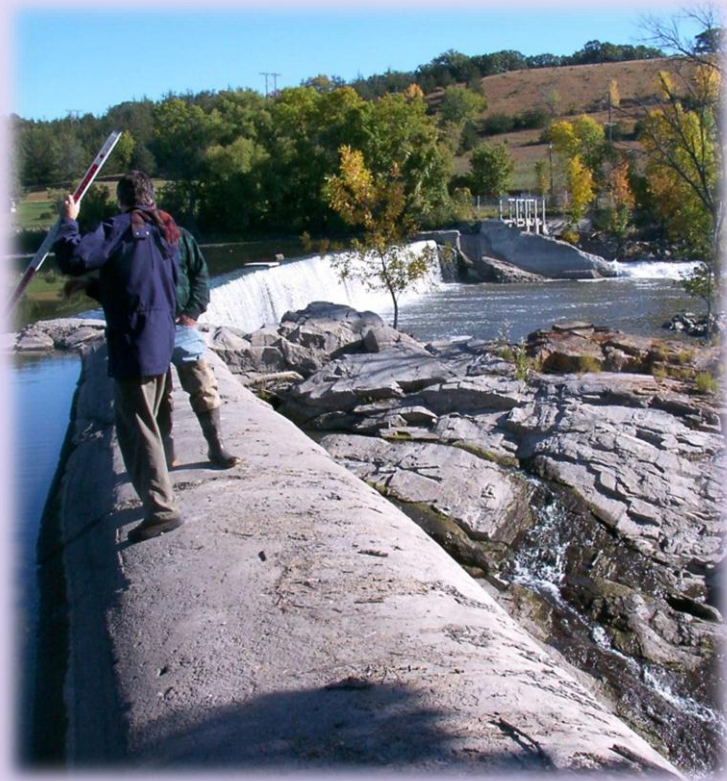
Cost: \$2 million

Funding Sources: Xcel Energy



Background: Xcel Energy proposed removal of the dam in 2009. The dam was no longer generating electricity and the owner had perpetual liability for maintenance and risk. Furthermore, the dam was no longer meeting dam safety requirements where removal (estimated at \$2 million) was much cheaper than repair/replacement (estimated at \$5 to 7 million).

Details: Prior to removal of the dam, the stop logs were removed to incrementally draw down the upstream reservoir. Approximately 10,000 cubic yard of reservoir sediment was excavated upstream of the dam. During low winter flows the dam was methodically chiseled away. The old cement and rock was buried nearby. Final improvements were made to restore riffle and rock outcrop habitat within the footprint of the dam.



Ecological and Recreational Benefits:

- ◆ Removal of the dam drained the almost 3 mile long reservoir which exposed natural waterfalls and rock outcrops and restored significant riffle spawning habitat crucial to many native fish species including: paddlefish, lake sturgeon, shovelnose sturgeon, American eel, blue sucker, flathead catfish, and quillback.
- ◆ Removal reconnected 3 miles of the Minnesota River allowing upstream migration of fish and mussel species.
- ◆ Recreational opportunities such as canoeing, kayaking, and fishing have been greatly improved in this reach of the Minnesota River, which is a designated Wild and Scenic River.

Montevideo Dam, Chippewa River

Dam Removal & Modification with a Rock-Arch-Rapids



Background: MN DNR Fisheries spearheaded this project. Due to the age and condition of the dam, the City of Montevideo fully supported full removal of the dam, especially due to safety concerns and insurance requirements.

Dam Owner: MN DOT

Year Built: 1958

Original Function: To maintain a recreational pond when original dam was removed during road project.

Reason for removal: Dam was obsolete and a liability to the city.

Project Partners: MN DNR, USFWS, MN DOT, City of Montevideo

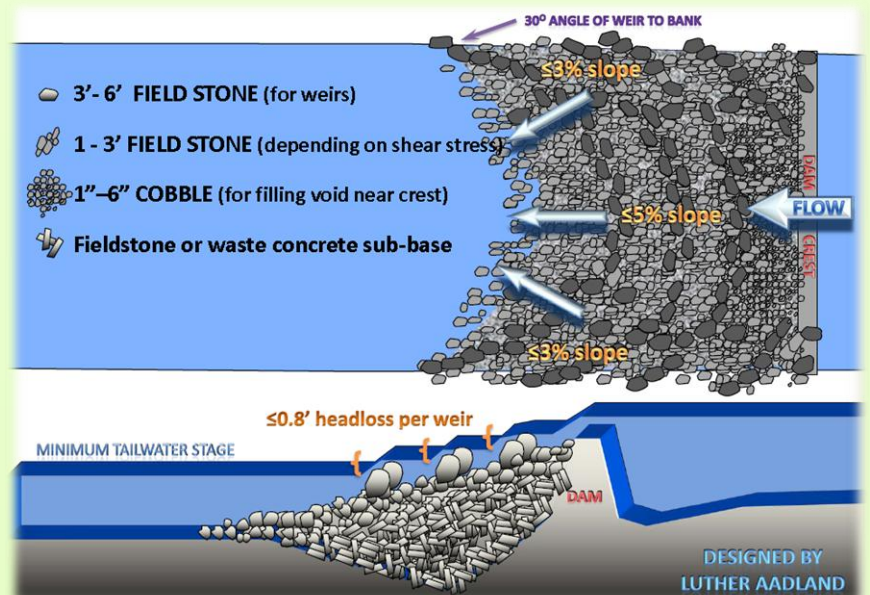
Project Designers: David Berryman (Project Engineer), Rodeberg & Berryman, Inc.; Chris Domeier (Project Manager), MN DNR, Luther Aadland, MN DNR

Completed: Summer 2012

Funding Sources: \$50,000 MN DNR Fisheries Funds
 \$150,000 Dam Safety Bonding
 \$100,000 Conservation Partners Legacy Grant
 \$100,000 USFWS Fish Passage



Details: The dam was notched to let the reservoir drain for several days, then the dam was completely removed, including the abutments. A diversion 12 miles upstream was used to divert flow during construction. A rock-arch-rapids was constructed just upstream of the dam site for grade control and to prevent head cutting. The river carved a new channel through the reservoir sediment. Some work was done upstream, j-hooks and a rock riffle, to provide additional grade control.



Ecological and Recreational Benefits:

- ◆ Removal of the dam reconnected 12 miles upstream on the Chippewa River. The river upstream of the dam is largely a natural channel with high habitat diversity including riffle and gravel habitat.
- ◆ Removal reconnected the main-stem Minnesota River to very valuable upstream habitat for the fish and mussel community.
- ◆ This site is in the city of Montevideo along a city park so is a popular fishing and recreation area.
- ◆ This reach of the Chippewa River is also a popular canoe route and has received rave reviews from canoe and kayak enthusiasts.



Cross Lake Dam, Snake River

Dam Modification with a modified Rock-Arch-Rapids



Dam Owner: MN DNR

Year Built: 1938

Original Function: 1870's grist mill (several dams have been built at this site)

Reason for modification: To restore fish passage and provide spawning habitat.

Project Partners: MN DNR

Project Designers: Jon Hendrickson (Project Engineer) and Luther Aadland, MN DNR

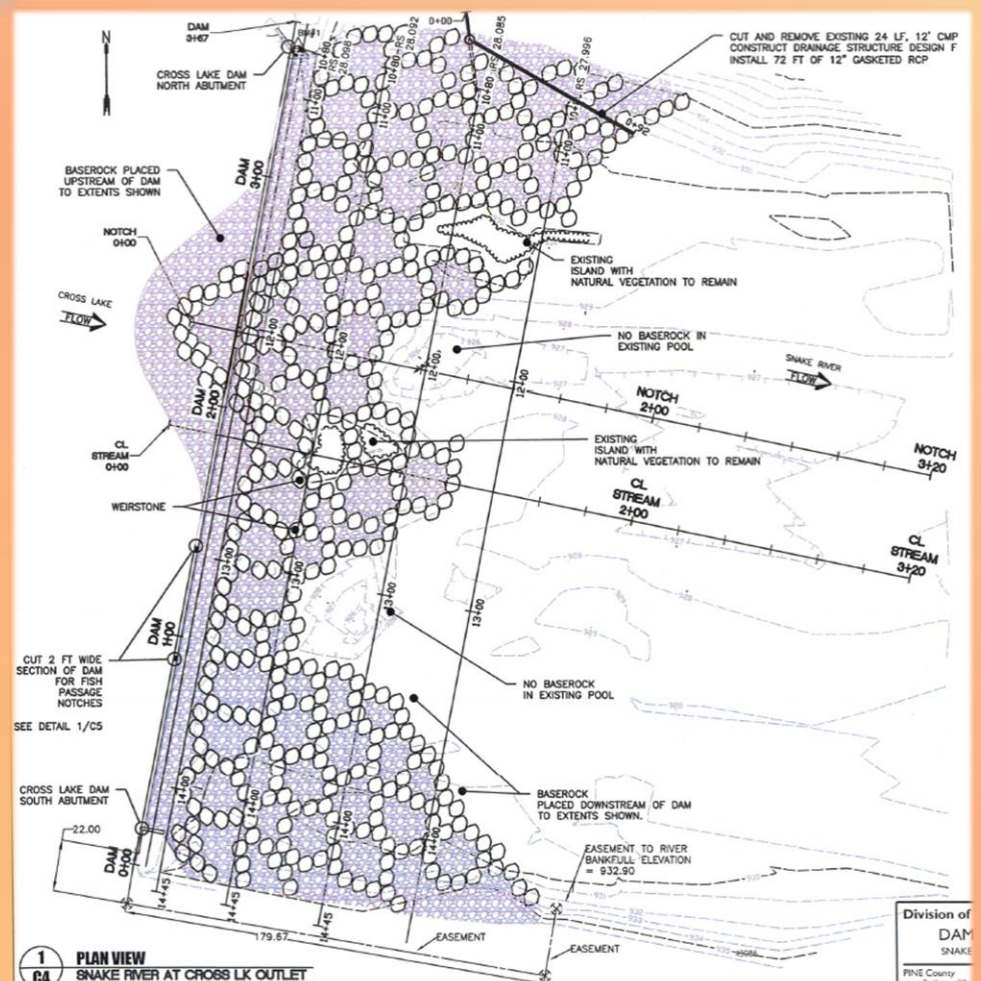
Completed: Winter 2013

Cost: Estimated at \$535,000

Funding Sources: Stream Restoration and Dam Safety Bonding

Background: DNR staff spearheaded this project because it was a barrier along the Snake River blocking upstream migration of sturgeon and other fish species from the St. Croix River. Excellent spawning rapids, especially crucial to sturgeon, are present upstream, but have been blocked for over 100 years by the this and previous dams. Sturgeon have been observed stacking up below the dam.

Details: A ramp or wedge of base rock was constructed below the dam. Over 400 4-6' boulders were placed strategically in a honeycomb design. This design, which incorporates round cells into the rock-arch-rapids design, emulates a natural rapids with a variety of pools, eddies, and cascades. This creates spawning habitat for sturgeon and other fish species.



Ecological and Recreational Benefits:

- ◆ Reconnects critical upstream spawning habitat by providing passage over the dam at all flows.
- ◆ Provides critical spawning rapids for sturgeon and other species.
- ◆ Improves safety of the dam by eliminating the hydraulic roller. This dam is known to have taken the life of one kayaker.



Christine & Hickson Dams, Red River

Dam Modification with a Rock-Arch-Rapids



Christine Dam

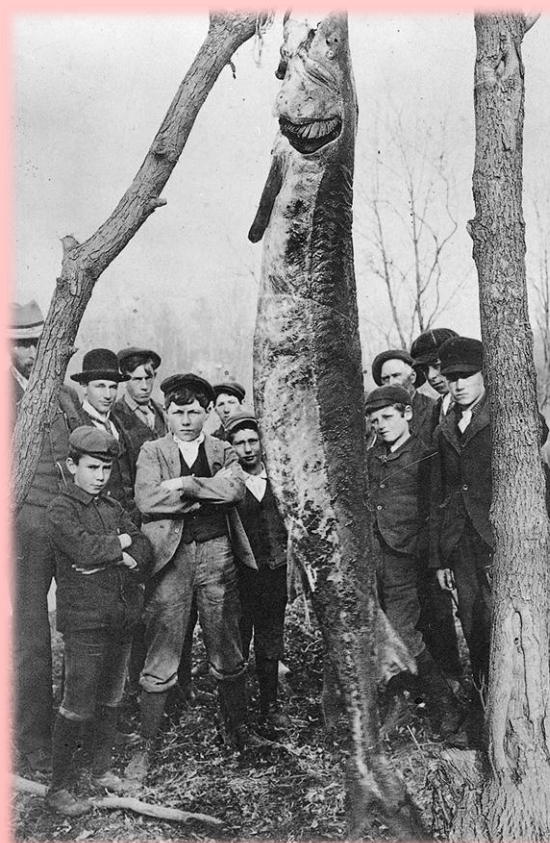


Hickson Dam

Owner of both dams: City of Fargo
Year Built: Hickson in 1933, Christine in 1937
Original Function: City drinking water supply during extended drought of the 1930s
Project Partners & Funding Sources: MN DNR, USFWS, City of Fargo and Moorhead, ND Game & Fish, ND State Water Commission, Buffalo-Red Watershed District, National Fish & Wildlife Foundation, Southeast Cass Watershed District

Reason for modification: To improve safety of the dam and to provide fish passage.
Project Designers: Nathan Boerboom (Project Engineer), City of Fargo; Luther Aadland, MN DNR
Completed: 2012
Cost: \$1.95 million for both

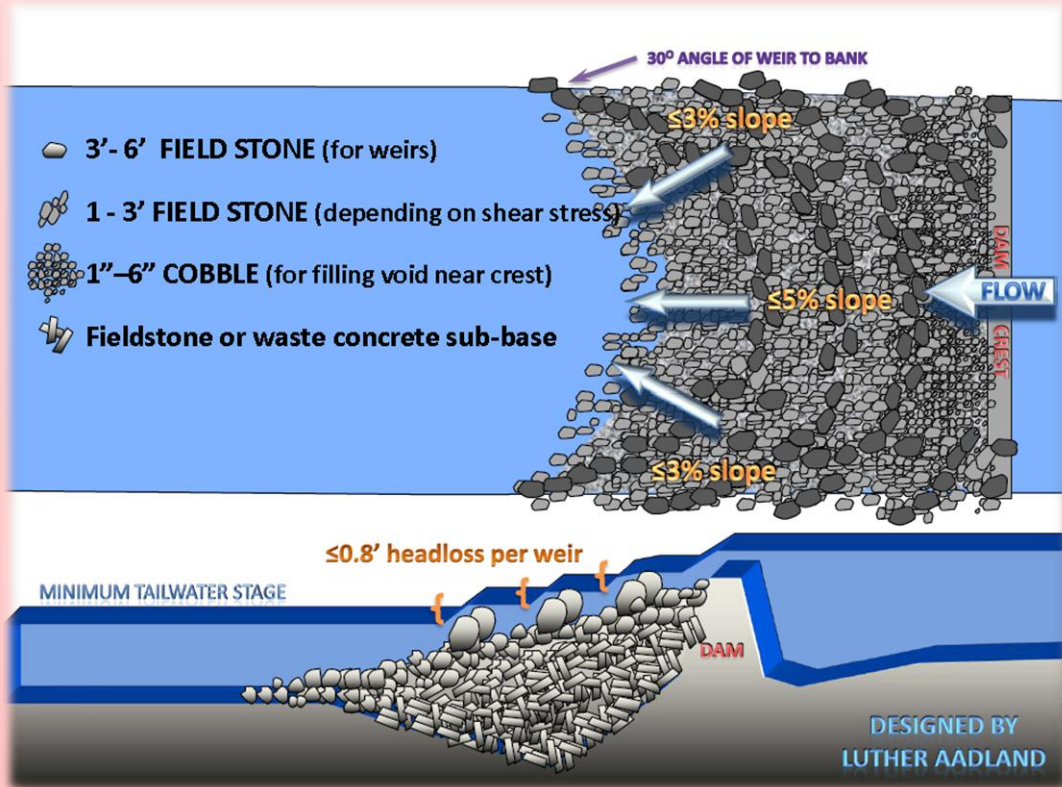
Background: Momentum for removing and modifying dams on the Red River began with Midtown Dam, located in Fargo/Moorhead. This dam was modified in 1999 to improve safety (19 known, as many as 25 people drowned in the hydraulic roller below the dam) and to restore fish passage. Subsequently, four more dams on the Red River were modified (two more in Fargo/Moorhead, one in Wahpeton/Breckenridge, and one in Grand Forks). These dams were no longer serving their original purpose of water supply, so were a safety concern and barriers to fish migration.



Largest lake sturgeon (405 pounds) taken from Roseau River in 1903, before dams fragmented the rivers making migration to high gradient spawning areas impossible.



Reconnect the Red is an effort among numerous agencies, government units, and local communities to restore lake sturgeon populations, enhance other fish populations, and make the river a safer place to fish and boat. To date, 37 barriers to fish migration have been eliminated in the Red River Basin opening hundreds of miles to migrating fish. Stocking of lake sturgeon, which began in 1997, has reintroduced this native species and their survival has been found to be good, so far. Up to two dozen fish species, including walleyes, saugers, northern pike, and channel catfish, have been observed using the artificial rapids to pass upstream. Only two dams remain on the mainstem of the Red River, one in the U.S., in Drayton, and one in Manitoba.



Advantages of this design:

- Creates convergent flow, where much of the energy is dissipated in the center of the rapids and near bank velocities are reduced. This protects the banks.
- Boulders in the weirs buttress against each other adding stability.
- Provides grade control in streams that are entrenched or susceptible to head cutting.
- Provides fish passage by creating low velocity eddies. Fish passage is possible in all flow conditions.
- Provides spawning habitat.
- Provides whitewater boating opportunities.
- Improves safety by eliminating hydraulic roller.

Rock-Arch-Rapids Design: A wedge or ramp is constructed of base rock, with a slope no greater than 5%. Hemi-circular weirs or arches, using properly sized boulders, are constructed on the ramp, with ≤0.8 foot of head loss per weir.



Ecological and Recreational Benefits:

- ◆ Hundreds of miles of the Red River of the North are now reconnected during all flows. Now only two dam remains on the mainstem of the Red River.
- ◆ Over 70 species of fish in the Red River will benefit, including Lake Sturgeon.
- ◆ Provides whitewater boating opportunities.

Redby Dam, Mud River

Dam Removal and Channel Restoration

Dam Owner: Red Lake Band of Chippewa Indians

Year Built: circa 1917

Original Function: To provide source water for fish hatchery.

Reason for removal: Due to accumulation of sediment the water quality and temperatures were not conducive to raising walleye fingerlings. Also the dam was old and obsolete, there were concerns for public safety, and to reconnect the Mud River to Lower Red Lake.

Project Partners: Red Lake DNR, Red Lake Legal Dept., MN DNR, MN DOT, US EPA, NRCS

Project Designers: Mike McFarlane & Terri Odegaard (Project Engineers), Northern Engineering & Consulting, Inc.; Emmons & Olivier Resources, Inc.; Jenilynn Bohm (Project Manager), Red Lake DNR; Luther Aadland, MN DNR

Completed: Channel restoration in Fall 2012, Dam removal scheduled for May 2013

Costs thus far: Engineering Services ~\$35,000 to date, Construction costs \$40,644

Funding Sources: US EPA 319 grant for \$150,000, Red Lake Forestry

Background: Because the dam was part of a bridge crossing, the dam removal and channel restoration became part of a larger project to move the road and replace the bridge. The community and the Red Lake Band supported the project as it will improve safety and reconnect the Mud River, historically a trout stream, to Lower Red Lake. The Red Lake Band anticipates that the removal and restoration will revitalize social and cultural use of the stream.



Details: The stop logs were removed, starting in 2008, to slowly lower the reservoir water level to let the sediment consolidate and to allow the stream to create a river channel. The channel restoration was designed from an upstream reference site and the historic channel. In fall 2012, a 500' meandering channel was excavated. Bank stabilization techniques including, toe wood-sod mats, root wads, and willow plantings, were used to protect some of the outside banks.

Future: A rock-arch-rapids will replace the dam and will be built when the bridge is replaced. The rapids will maintain water slope and prevent erosion of the nine feet of accumulated reservoir sediment. Due to the volume of accumulated sediment and high arsenic levels, it would have been too costly to haul offsite.

Ecological and Recreational Benefits:

- ◆ Reconnected Mud River to Lower Red Lake.
- ◆ Provides fish passage, spawning habitat, and stream habitat.
- ◆ Improves safety by eliminating the hydraulic roller.
- ◆ Improved water quality.

