

Project Briefs

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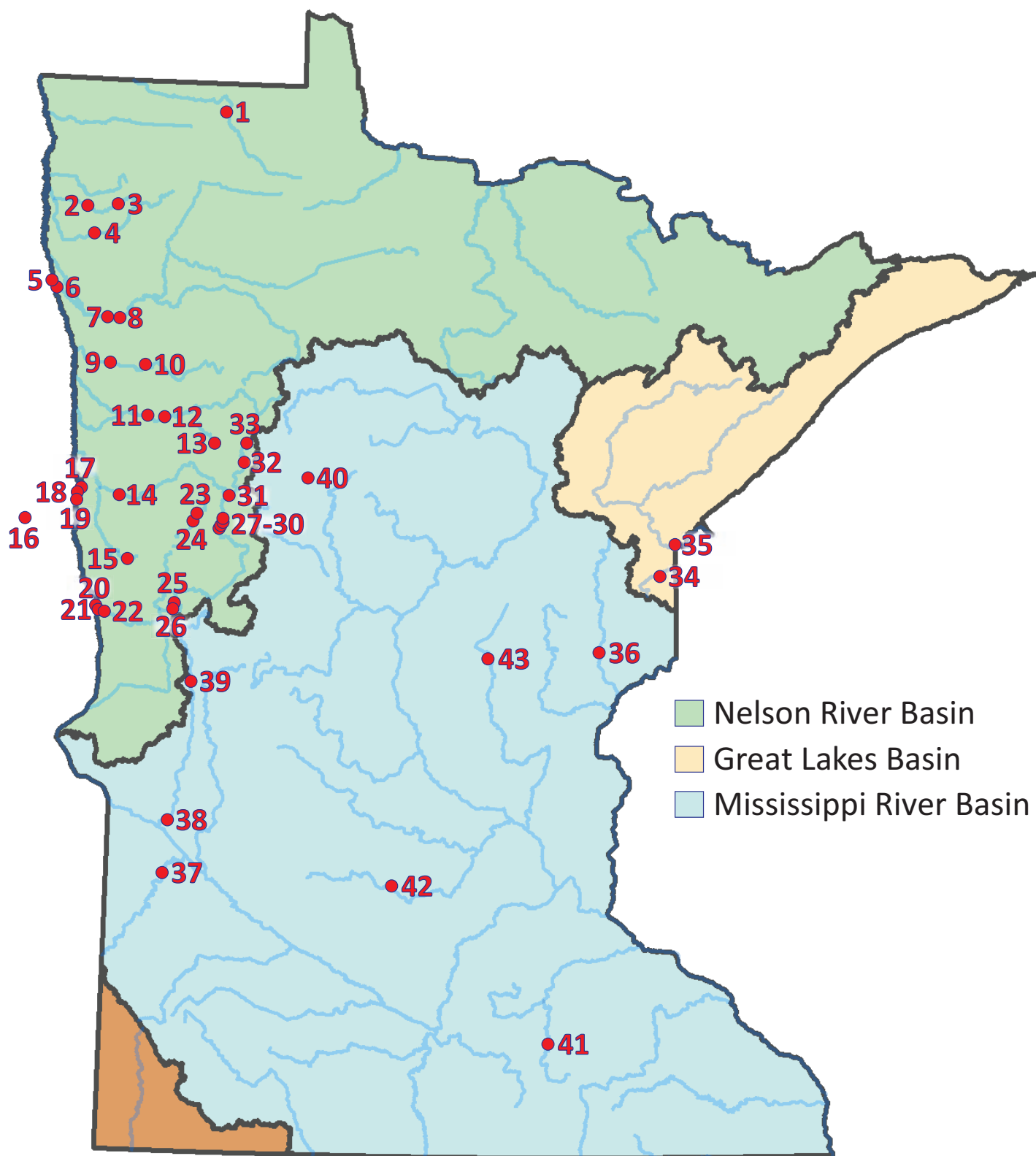
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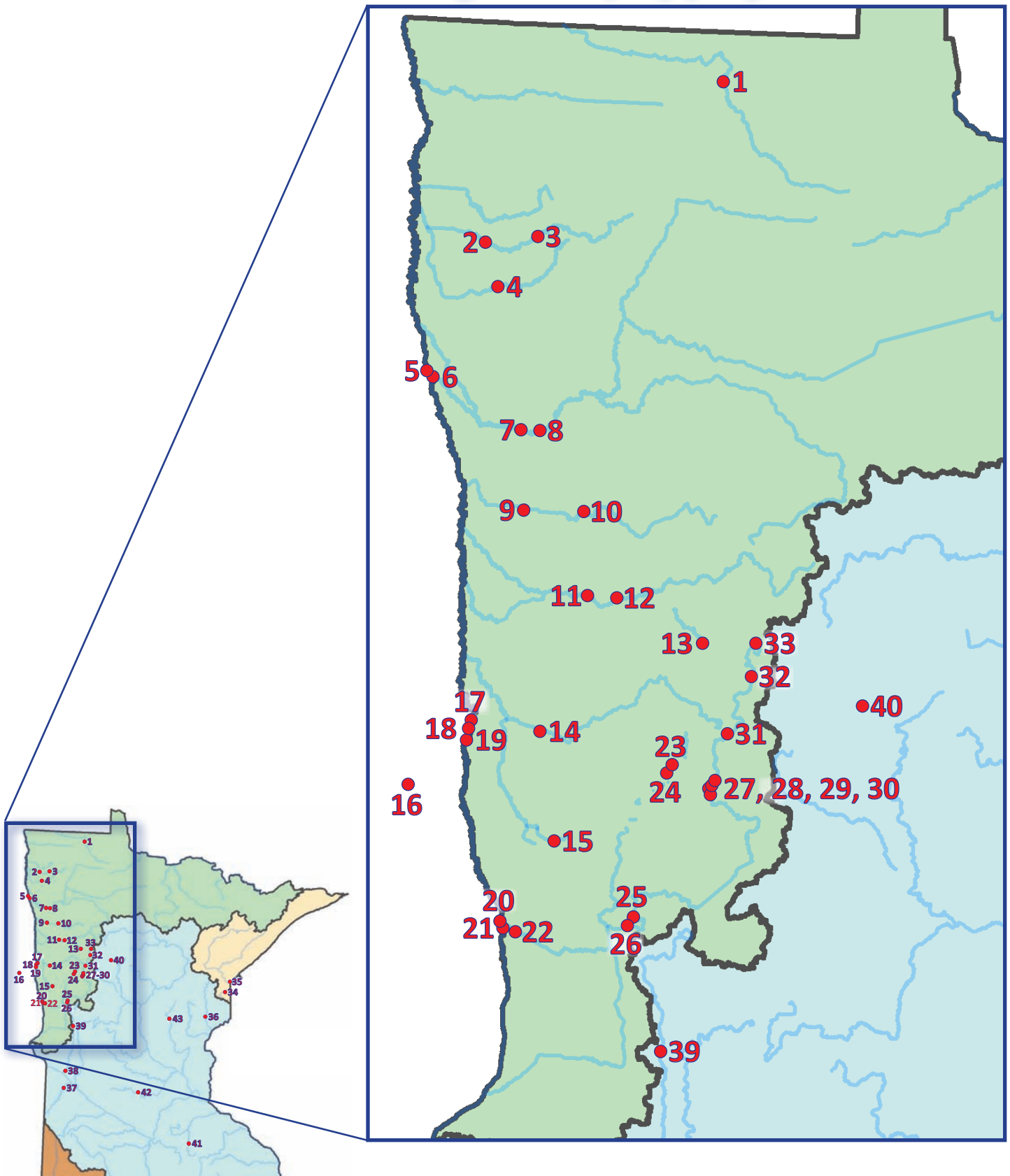
» Projects are listed in increasing distance from the mouth of the river basin.

» **Dam height** is defined as **maximum head loss**, which is the elevation difference between the crest of the dam and the first downstream riffle (hydraulic control), unless noted otherwise.

Statewide map of projects



Northwest region map of projects



ROSEAU DAM

Roseau River

Nelson River Basin

Dam Facts

Mean flow: 143 cfs at Malung gage (430 m² DA)

Record flow: 16,000 cfs

Drainage area: 474 mi²

Dam height: 5 feet

Crest width: 80 feet

Crest elevation: 1,031.8 MSL

Year built: 1930s

Original dam function: water supply

Drowning deaths: 1 known

Location: Roseau, MN

48° 51' 05.24° N

95° 45' 41.90° W

River network:

■ Roseau River: 136.8 miles upstream of confluence with...

↳ Red River of the North in Canada: 140.37 upstream of Lake Winnipeg,

≈ A total of 920.54 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ river restoration
- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide spawning habitat for sturgeon, walleye, and other species
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Slope: 5% (3% near banks due to weirs)

Project designers:

Charlie Anderson (Project Engineer), JOR

Dennis Topp, Mike Larson, & Luther Aadland, MN DNR

Builder/Contractor: Wright Construction

Materials: 1,022 tons fieldstone
700 tons waste concrete

Cost: \$40,000

Year completed: 2001

Connectivity

Upstream river miles connected:

41 miles to next barrier (small partial barriers 12.8 and 14.7 miles upstream)

Upstream barriers:

Hayes Lake at river mile 177.9

Flood storage impoundment at river mile 200.38

Headwaters (Lost Lake) at river mile 205.89

Downstream barriers:

None to confluence with the Red River of the North

Before

Side view of dam from left bank during low flow



The largest lake sturgeon ever recorded (405 pounds) taken from this river in October 1903 in Dominion City, Manitoba (river mile 16.8). Bankfull river width is about 90 feet at this location.

During

DNR

1/23/2001

Construction of rapids base



DNR

1/30/2001

Construction of weirs

After

DNR

5/16/2001

Downstream view of completed rapids

ARGYLE DAM

Middle (Snake) River

Nelson River Basin

Dam Facts

Mean flow: 52.4 cfs at Argyle gage

Record flow: 5,020 cfs

Drainage area: 255 mi²

Dam height: 7.9 feet

Crest width: 48 feet

with a 16 x 1 foot center notch

Crest elevation: 839 MSL

Year built: 1934

Original dam function: mill

Drowning deaths: unknown

Location:

48° 20' 16.35° N

96° 48' 43.00° W

River network:

■ Middle River: 17.3 miles upstream of confluence with...

➔ Snake River: 10.6 miles upstream of confluence with...

➔ Red River of the North: 230.2 miles upstream of Lake Winnipeg,

≈ A total of 901.47 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam removal & river restoration

Project goals:

- ☆ river restoration
- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ eliminate dam maintenance
- ☆ maintain fishing pool below dam

Design concept:

Dam was removed and a single arching boulder weir was built for maintenance of downstream scour pool and grade control.

Project designers:

Jeffrey Erickson (Project Engineer)

Dennis Topp and Luther Aadland, MN DNR

Builder/Contractor: Spruce Valley Construction

Materials: 280 yards class III riprap
120 yards class IV fieldstone
50 3-5' boulders

Cost: \$50,000

Year completed: 2007

Connectivity

Upstream barriers:

None - open to the headwaters since the removal of Old Mill (next brief)

Downstream barriers:

None to confluence with the Red River of the North

Before

Upstream view of dam from left bank

After

Downstream view of site after dam removal

During

Stockpiled boulders



Construction of boulder weir

#3

OLD MILL DAM

Middle (Snake) River

Nelson River Basin

Dam Facts

Mean flow: 52.4 cfs at Argyle gage
Record flow: 5,020 cfs

Drainage area: 225 mi²

Dam height: 8.5 feet

Crest width: 48 feet

Year built: Original dam built in 1886, replaced in 1938

Original dam function: mill

Drowning deaths: unknown

Location:

48° 21' 44.54° N
96° 34' 22.03° W

River network:

- Middle River: 44.09 miles upstream of confluence with...
- ➔ Snake River: 10.6 miles upstream of confluence with...
- ➔ Red River of the North: 230.2 miles upstream of Lake Winnipeg,
- ≈ A total of 928.26 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam removal & river restoration

Project goals:

- ☆ river restoration
- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ eliminate failure potential

Project description:
Dam abutments were historically significant and were left in place. Three boulder weirs were built for grade control and habitat.

Project designers:

Memos P. Katsoulis (Project Engineer)
Dennis Topp and Luther Aadland, MN DNR

Builder/Contractor:

Materials: 30 yards riprap
240 yards of 3' boulders

Cost: \$51,000

Year completed: 2001

Connectivity

Upstream barriers:
None to the headwaters

Downstream barriers:
None - open to the Red River of the North since the removal of Argyle Dam (previous brief)

Before

Upstream view of dam during high flow

After

Upstream view of removed dam and constructed boulder weir



Weir for grade control and habitat

#4

SNAKE RIVER PL566 PROJECT MITIGATION

Snake River

Nelson River Basin

Dam Facts

Mean flow: Approximately 12 cfs
Drainage area: 59.6 mi²
Dam height: 5.5 feet
Crest width: 50 feet
Crest elevation: 963.5 MSL
Diversion function: floodwater retention
Year built: 2005

Location:
 48° 15' 0.782° N
 96° 31' 48.38° W
River network:
 ■ Snake River: 79.4 miles upstream of confluence with...
 ➔ Red River of the North: 230.2 miles upstream of Lake Winnipeg,
 ≈ A total of 952.97 miles upstream of Hudson Bay.

Restoration Design

Project type: Installation of rock ramp upstream of intake
Project goals:
 ☆ river restoration through grade control
Design concept:
 Rock Arch Rapids with a maximum head loss of 5.5 feet
Slope: 2.5%
Project description:
 Snake River PL566 is an off-channel storage project that diverts flows at 75 cfs (bankfull is 249 cfs) for flood storage. The steeper energy slope of the intake weir caused a headcut of the Snake River degrading the channel bed 3.1 feet at a cross-section 661 feet upstream of the intake. The rapids were designed for grade control and to provide fish passage. An additional riffle was built upstream of the headcut.

Project designers:
 Dave Jones (Project Engineer) and Sonia Jacobson, NRCS
 Dennis Topp, Nicholas Schlessler, and Luther Aadland, MN DNR
Builder/Contractor: Steven Olson
Materials: 284 tons riffle boulders
 1,806 tons type A riprap
 356 tons bedding material
Cost: \$92,100 for rock
Year completed: 2008

Before



Flood storage intake



Upstream incised channel

After



Rapids looking upstream



Rapids side view

Red River

Nelson River Basin

Dam Facts

Mean flow: 3,029 cfs at Grand Forks gage
Record flow: 137,000 cfs

Drainage area: 30,100 mi²

Dam height: 13 feet

Crest width: 320 feet
rapids 400 ft

Crest elevation: 793.3 MSL

Year built: Original dam built in 1922,
replaced in 1989

Original dam function: water supply

Location: Grand Forks, ND, East Grand Forks, MN
47° 56' 31.19° N

97° 2' 53.59° W

River network:

- Red River of the North: 296.1 miles upstream of Lake Winnipeg,
- ≈ A total of 939.5 miles upstream of Hudson Bay.

Drowning deaths: 1 known at current site, several below previous dam

Additional dam problems:

Severe downstream bank erosion threatened the dam and stability of flood dikes.

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ erosion control
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide fish passage and habitat
- ☆ provide spawning habitat for lake sturgeon and othe species
- ☆ provide whitewater boating opportunity

Design concept:

Rock Arch Rapids. Weirs were truncated to reduce slope compensation. This is the world's largest full width rock ramp fishway in terms of tonnage and height.

Slope: 5% (3% near banks)

Project designers:

Mike Leshner (Project Engineer), U. S. Army Corps of Engineers
Luther Aadland, MN DNR

Contractor: Park Construction

Materials: 80,000 tons fieldstone
1,200 5-7' boulders

Cost: \$4.7 million

Year completed: 2001

Connectivity

Upstream main-stem barriers:

Hickson Dam (river mile 482.9) and Christine Dam (river mile 496.5) are passable during floods but are barriers during most of the year.
Orwell Dam (Otter Tail River) at river mile 587.4 is a complete barrier.

Downstream barriers:

Drayton Dam (river mile 203.4) and St. Andrews Dam at Lockport, Manitoba (river mile 27.1) are passable during floods but are barriers during most of the year.

Assessment:

Northern pike and channel catfish have been observed passing the rapids.

Before

Downstream view of dam from left bank

After

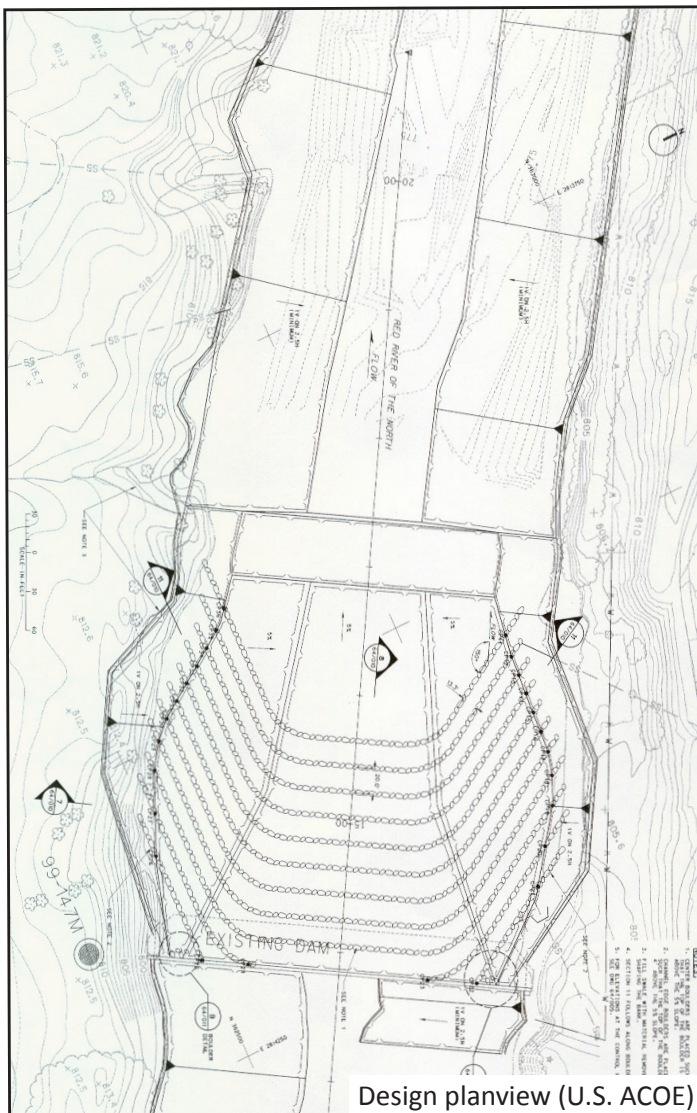
Rapids side view from left bank



Rapids looking upstream



Upstream view of boulder weirs



Design planview (U.S. ACOE)

Red Lake River

Nelson River Basin

Dam Facts

Mean flow: 1,210 cfs at Crookston gage
Record flow: 28,400 cfs

Drainage area: 5,760 mi²

Dam height: 2.4 feet due to
downstream Riverside Dam

Crest width: 121.3 feet

Crest elevation: 795.7 MSL

Year built: 1937

Original dam function: water supply

Location: East Grand Forks, MN

47° 55' 22.83° N

97° 01' 06.07° W

River network:

- Red Lake River: 0.15 miles upstream of confluence with...
- ➔ Red River of the North: 296.1 miles upstream of Lake Winnipeg,
- ≈ A total of 939.6 miles upstream of Hudson Bay.

Drowning deaths: none known

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide lake sturgeon spawning habitat
- ☆ provide whitewater boating opportunity

Design concept:

Rock Arch Rapids

Slope: 5% (3% near banks due to weirs)

Project description:

Clean waste concrete was used as a sub-base and covered with fieldstone.

Project designers:

Greg Boppre (Project Engineer), Floan-Sanders
Luther Aadland, MN DNR

Contractor: Spruce Valley

Materials: 16,653 tons fieldstone and waste concrete

Cost: \$170,000

Year completed: 2003

Connectivity

Upstream barriers:

Thief River Falls Dam (river mile 125) is a complete barrier. Weir at river mile 180.9 and Red Lake Dam at river mile 193 are complete barriers for most species.

The removal of Crookston Dam in 2005 and Crookston Dam #2 in 2006 provided passage to historic sturgeon spawning habitat at Red Lake Falls (next two briefs).



Red River catfish caught below rapids. Photo courtesy of Brad Dokken, Outdoors Editor Grand Forks Herald.

Before

Upstream view of dam from right bank during high flow

After

View of completed rapids from right bank

During

Placing waste concrete sub-base



Building boulder weirs

CROOKSTON DAM

Red Lake River

Nelson River Basin

Dam Facts

Mean flow: 1,210 cfs at Crookston gage
Record flow: 28,400 cfs

Drainage area: 5,270 mi²

Dam height: 12 feet (reduced to 9 feet with downstream riffles)

Crest width: 192 feet

Crest elevation: 846.3 MSL

Year built: 1883 (original structure)

Original dam function: Mill converted to hydropower in 1905 with two turbines (176 and 200 KW). The hydropower facility was retired in 1970.

Location: Crookston MN
47° 46' 28.43° N
96° 31' 38.18° W

River network:

- Red Lake River: 53.6 miles upstream of confluence with...
- ➔ Red River of the North: 296.1 miles upstream of Lake Winnipeg,
- ≈ A total of 993.1 miles upstream of Hudson Bay.

Drowning deaths: 9 to as many as 27

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ improve safety by eliminating hydraulic roller
- ☆ provide fish passage and habitat
- ☆ provide lake sturgeon spawning habitat
- ☆ river bank stabilization
- ☆ provide whitewater boating opportunity

Design concept:
Rock Arch Rapids

Slope: graduated from 2.5% near crest to 5% at downstream end

Project designers:

Dave Kildahl (Project Engineer), Widseth Smith Nolting Inc.
Luther Aadland, MN DNR

Builders/Contractor: Davidson (rapids)
Spruce Valley (downstream riffles)

Materials: 48,527 tons including:
18,515 tons fieldstone
1,098 tons 5-7' boulders
7,909 tons filter material
5,238 tons waste concrete

Cost: \$1.4 million

Year completed: 2005

Connectivity

Upstream barriers:
Thief River Falls Dam (river mile 125) is a complete barrier. Weir at river mile 180.9 and Red Lake Dam at river mile 193 are complete barriers for most species.

Downstream barriers:
None to Red River of the North confluence.

Observed passage:
Sand shiners were observed passing during construction. Fisheries stream surveys documented the return of channel catfish and sauger upstream following project completion.

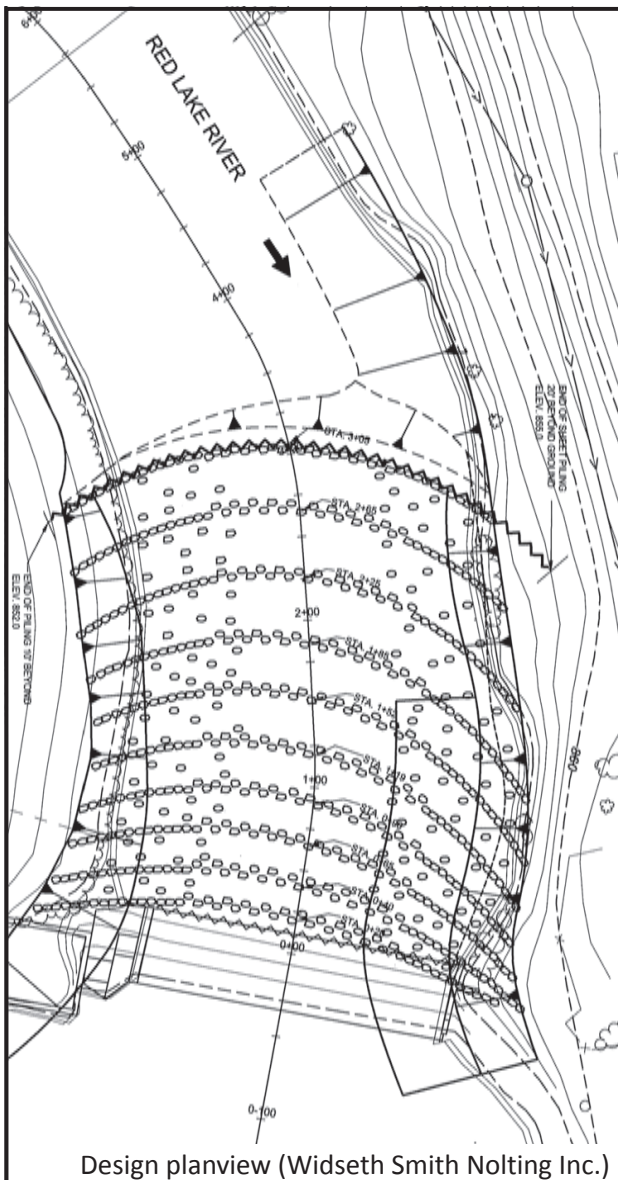
** This project is discussed in detail in Chapter 2.*

Before

View of dam from right bank

After

Upstream view of completed rapids



Design planview (Widseth Smith Nolting Inc.)



One of two downstream riffles constructed for grade control and to raise tailwater elevation below rapids

CROOKSTON DAM #2

Red Lake River

Nelson River Basin

Dam Facts

Mean flow: 1,210 cfs at Crookston gage
Record flow: 28,400 cfs

Drainage area: 5,255 mi²

Maximum head loss: 4 feet (Original dam height was about 20 ft. Dam failed in 1950 but sheet-piling weir was retained.)

Crest width: 147 feet

Crest elevation: approximately 860 MSL

Year built: 1916 (original structure)

Original dam function: hydropower (two turbines of 500 and 1000 KW) retired in 1949.

Location: Crookston MN

47° 46' 21.45° N

96° 31' 38.18° W

River network:

- Red Lake River: 62.8 miles upstream of confluence with...
- ➔ Red River of the North: 298 miles upstream of Lake Winnipeg,
- ≈ A total of 1,004.17 miles upstream of Hudson Bay.

Drowning deaths: unknown

Restoration Design

Project type: Dam removal

Project goals:

- ☆ river restoration
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide fish passage

Project description:

A 200' x 15' x 3' fieldstone causeway was constructed upstream of the sheet-piling crest for access. This was retained as a riffle grade control. Underwater divers were used for cutting sheet piling. An excavator was then able to peel and remove the cut piling.

Project designers:

Luther Aadland & Chad Konickson, MN DNR

Builders/Contractor: Spruce Valley

Materials: 300 yards 0.5-2' fieldstone

Cost: \$27,000

Year completed: 2006

Connectivity

Upstream barriers:

Thief River Falls Dam (river mile 125) is a complete barrier. Weir at river mile 180.9 and Red Lake Dam at river mile 193 are complete barriers for most species.

Downstream barriers:

None to Red River of the North confluence.

Before



Aerial upstream view of dam



Sideview of dam showing sheet piling crest



Upstream view of dam

During



Divers cutting sheet piling

After



After spillway removal

SANDHILL CROSSING

Sandhill River

Nelson River Basin

Dam Facts

Mean flow: 86.6 cfs at Climax gage

Record flow: 4,560 cfs

Drainage area: 314 mi²

Location:

47° 32' 6.901° N

96° 34' 47.38° W

River network:

- Sandhill River: 23.16 miles upstream of confluence with...
- ➔ Red River of the North: 346.4 miles upstream of Lake Winnipeg,
- ≈ A total of 1,012.9 miles upstream of Hudson Bay.

Restoration Design

Project type: Replacement of barrier crossing with passable culverts

Project purpose:

- ☆ provide fish passage - low water crossing had undersized culverts that created high velocity barriers.

Project description:

Replacement culverts matched bankfull width and were set below streambed. Crossing maintained passable velocities over full range of flow conditions.

Project designers:

Eric Jones (Project Engineer), Houston Engineering

Builders/Contractor:

Davidson Corporation

Materials:

three 10' x 4' x 36' box culverts

Cost:

\$122,702

Year completed:

2006

Connectivity

Upstream barriers:

Check dams at river miles 28.65, 29.61, 30.4, and 31.52 are complete barriers. Funding is currently being pursued to convert these to Rock Arch Rapids.

Downstream barriers:

None to Red River of the North confluence

Before

Upstream view of high velocity culverts

After

Upstream view of new culverts

#10

WEST MILL DAM SITE

Sandhill River

Nelson River Basin

Dam Facts

Mean flow: 86.6 cfs at Climax gage
Record flow: 4,560 cfs

Drainage area: 232 mi²

Maximum head loss: 6.3 feet elevation difference between upstream and downstream culvert inverts over 56 feet length

Crest elevation: 1,043.8 MSL

Original dam function: mill

Drowning deaths: unknown

Location:
47° 30' 41.649° N
96° 21' 57.29° W

River network:

- Sandhill River: 36.42 miles upstream of confluence with...
- ↳ Red River of the North: 346.4 miles upstream of Lake Winnipeg,
- ≈ A total of 1,026.2 miles upstream of Hudson Bay.

Restoration Design

Project type: Barrier removal and river restoration

Project goals:

- ☆ river restoration
- ☆ provide fish passage and habitat

Project description:
The original culverts replaced a milldam and were placed at a steep slope (10%) presumably for grade control. This created a barrier to fish passage. The project involved replacing the sloped culverts with culverts set at the downstream riverbed and constructing 7 fieldstone riffles for grade control.

Slope: 0.45% (5% for each of the 7 individual riffles)

Project designers:
Eric Jones (Project Engineer), Houston Engineering
Luther Aadland, MN DNR

Builders/Contractor: Davidson Corporation

Materials: 3,210 yards class V fieldstone

Cost: \$272,237

Year completed: 2006

Connectivity

Downstream barriers:
Check dams at river miles 28.7, 29.6, 30.4, and 31.5 are complete barriers.

Before

Upstream view of perched culverts

After

Upstream view of reset culverts



1939 aerial photo of the West Mill Dam Reservoir



2008 aerial photo of former reservoir



Riffle grade control

Dam Facts

Mean flow: 207 cfs at Twin Valley gage
Record flow: 20,300 cfs

Drainage area: 930 mi²

Dam height: 8 feet

Crest width: 155 feet

Crest elevation: 1,000 MSL

Year built: 1875 (original structure)

Original dam function: flour milldam which was later retrofitted for hydropower that functioned until the 1950s. The dam failed in 1965 and was rebuilt for ice control in 1975.

Location:
47° 16' 58.372° N
96° 16' 37.08° W

River network:

- Wild Rice River: 57.6 miles upstream of confluence with...
- ➔ Red River of the North: 380.4 miles upstream of Lake Winnipeg,
- ≈ A total of 1,081.37 miles upstream of Hudson Bay.

Drowning deaths: none known

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ restoration of cutoff reach and inundated habitat
- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ retention of ice control function

Project description:
Dam failed in 2002 flood by cutting through embankment into a tributary channel and cut off 1.5 miles of river initiating a headcut that nearly undermined the MN 32 bridge. Project involved plugging gully to restore flows to the cut-off meander and largely removing the dam. Design had to maintain ice break function – shark-fin structures compensated for head-loss reduction. Crest was lowered 6 feet in center 72 feet and 4 feet on sides to match river bankfull width. Maximum head-loss was reduced to 2 feet.

Project designers:
Jerry Bents (Project Engineer), Houston Engineering
Luther Aadland, MN DNR (fishway rapids)

Builders/Contractor: Landwehr Construction

Design concept: Rock Arch Rapids

Slope: 5% (3% near banks due to boulder weirs)

Materials: 1,670 yards 12"-30" fieldstone
600 yards 36"-60" boulders

Year completed: 2006

Funding: Federal Emergency Management Agency, U.S. Fish and Wildlife Service, White Earth Band of Ojibwa, MN DNR

Connectivity

Barriers: Open downstream to Red River of the North and upstream to headwaters.

Assessment: 2003 Fisheries and Ecological Resources surveys found channel catfish, smallmouth bass, sauger, walleye, freshwater drum, shorthead redhorse, pumpkinseed sunfish, goldeye, spotfin shiner, and pearl dace, had returned to upstream reaches as far as 75 miles upstream a year after the dam failure where they were absent in surveys prior to the dam failure.

Before

Upstream view of dam from left bank

After

Upstream view of completed rapids



Dam failing in 2002 flood



Aerial upstream view of rapids



Channel cut off by dam failure

#12

MARSH CREEK CULVERT

Marsh Creek

Nelson River Basin

Dam Facts

Location: Crossing at Norman County Rd 29
47° 16' 53.48° N
96° 9' 6.046° W
Year built: 2003

River network:

- Marsh Creek: 1.3 miles upstream of confluence with...
- ↳ Wild Rice River: 70.91 miles upstream of confluence with...
- ↳ Red River of the North: 380.4 miles upstream of Lake Winnipeg,
- ≈ A total of 1,096 miles upstream of Hudson Bay.

Restoration Design

Project type: Culvert passage

Project purpose:

- ☆ provide fish passage

Project description:

A riffle was constructed to raise tailwater on a perched culvert. A group of poorly designed culverts created a barrier.

Project designers:

Dave Friedl, MN DNR

Materials: 150 yards of 18-24" fieldstone

Cost: \$5,828.16

Year completed: 2005

Connectivity

Assessment:

The project reduced velocities and raised tailwater in the lowest culvert providing fish passage. The site likely remains a barrier at high flows and will likely continue to have erosion problems due to the odd array of culverts.

Before

Perched culvert array

After

View of culverts showing tailwater pooling into lower culvert following riffle construction



Lowest perched culvert as a barrier to fish passage



Dowstream view of constructed riffle

During

Construction of riffle

#13

WHITE EARTH LAKE DAM

White Earth River

Nelson River Basin

Dam Facts

Mean flow: Approximately 24 cfs

Drainage area: 108 mi²

Dam height: 3 feet

Crest width: 20 feet

Crest elevation: 1,451 MSL

Year built: 1937

Original dam function: lake level control

Drowning deaths: unknown

Location:

47° 8' 58.373° N

95° 45' 50.47° W

River network:

- White Earth River: 49.3 miles upstream of confluence with...
- ➔ Wild Rice River: 99.67 miles upstream of confluence with...
- ➔ Red River of the North: 380.4 miles upstream of Lake Winnipeg,
- ≈ A total of 1,172.74 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp

Project purpose:

- ☆ provide fish passage
- ☆ provide spawning habitat for lake sturgeon and other species

Design concept:

Rock Arch Rapids

Slope: 5% center, 3% near banks due to boulder weirs

Project designers:

Luther Aadland, MN DNR

Builders/Contractor: Gordon Construction of Mahnomon, Inc.

Materials: 200 yards of fieldstone

Cost: \$50,000

Year completed: 2003

Funding: Fish and Wildlife Service, White Earth Band of Ojibwa

Connectivity

Assessment:

Bluegills were observed passing the rapids. Lake sturgeon have been reintroduced to White Earth Lake but are not yet mature.

Before

Upstream view of dam

After

Upstream view of completed rapids (2003)



Upstream view of completed rapids (spring 2009)

#14

BUFFALO STATE PARK DAM

Buffalo River

Nelson River Basin

Dam Facts

Mean flow: 85.6 cfs at Hawley gage

Record flow: 2,360 cfs

Drainage area: 359 mi²

Dam height: 3.5 feet

Crest width: 80 feet

Crest elevation: 978 MSL

Year built: 1937 (a milldam near this site was mentioned in an 1893 U.S. Fisheries survey by Albert Wolman)

Original dam function: diversion into swimming pond

Location: Buffalo State Park

46° 51' 50.39° N

96° 27' 59.04° W

River network:

■ Buffalo River: 59.7 miles upstream of confluence with...

➔ Red River of the North: 417.1 miles upstream of Lake Winnipeg,

≈ A total of 1,120.2 miles upstream of Hudson Bay.

Drowning deaths: 2

Restoration Design

Project type: Dam removal and river restoration

Project goals:

- ☆ river restoration
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide fish passage and habitat

Project description:

Two rock riffles were used for grade control, bank protection and habitat, and two boulder vanes were built to replace rock filled gabions and provide bank protection. Historically significant abutments were retained.

Slope: 0.5%

Project designers:

Dave Sobania (Project Engineer), MN DNR

Tom McDonald (Project Engineer), Barr Engineering

Luther Aadland, MN DNR

Contractor: Moorhead Construction Company Inc.

Materials: approximately 60 4'+ boulders
400 yards fieldstone

Cost: \$60,000

Year completed: 2002

Funding: MN DNR

Connectivity

Barriers:

Open downstream to Red River of the North and upstream to headwaters

Before

Upstream view of dam from right bank

After

Upstream view of removed dam and completed rapids

During

Placing boulders



Upstream constructed riffles

#15

LAWNDALE CULVERT

Lawndale Creek

Nelson River Basin

Dam Facts

Location:

46° 32' 22.86° N

96° 23' 10.24° W

Mean flow: 2 cfs

Drainage area: 9.4 mi²

Head-loss: 2 feet

Bankfull channel width: 8-10 feet

River network:

- Lawndale Creek: 6.2 miles upstream of confluence with...
- ➔ Deerhorn Creek: 4.6 miles upstream of confluence with...
- ➔ South Branch Buffalo: 49.3 miles upstream of confluence with...
- ➔ Red River of the North: 417.1 miles upstream of Lake Winnipeg,
- ≈ A total of 1,120.6 miles upstream of Hudson Bay.

Restoration Design

Project type: Culvert passage

Project purpose:

- ☆ provide fish passage

Design concept: Arch riffles

Project description:

Five constructed riffles were used to raise stage through a perched culvert for passage of brook trout and other species.

Project designers:

Howard Fullhart and Luther Aadland, MN DNR

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: approximately 50 yards fieldstone

Cost: \$5,257.14

Year completed: 2008

Connectivity

Barriers:

Open downstream to South Branch Buffalo River and upstream to headwaters

After

Downstream view of culvert after riffle construction. Prior to the project the culvert had over two feet of fall.



Downstream view of riffle



Constructed riffle



Constructed riffle

#16

ENDERLIN DAM

Maple River

Nelson River Basin

Dam Facts

Location: Enderlin, ND
 46° 37' 39.58° N
 97° 36' 02.16° W
Mean flow: 58.6 cfs
Drainage area: 843 mi²
Dam height: 4 feet

River network:

- Maple River: 102.1 miles upstream of confluence with...
- ↳ Sheyenne Creek: 21.1 miles upstream of confluence with...
- ↳ Red River of the North: 427.5 miles upstream of Lake Winnipeg,
- ≈ A total of 1,194.07 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp
Project purpose:
 ☆ provide fish passage and habitat
 ☆ provide whitewater boating opportunity
Slope: 5%

Project designers:

Jonathan Kelsch, ND State Water Commission

Year completed: 2006

Connectivity

Barriers:
 Numerous dams upstream and downstream fragment the Maple and Sheyenne Rivers

Before

Sheet piling crest of rock ramp

After

Upstream view of completed ramp

During

Constructed rock ramp base



Upstream view of rock ramp

Red River of the North

Nelson River Basin

Dam Facts

Mean flow: 694 cfs at Fargo gage
Record flow: 28,000 cfs

Drainage area: 6,802 mi²

Dam height: ~ 5 feet

Crest width: 108 feet

Crest elevation: 870.38 MSL

Year built: 1933

Original dam function: water supply

Location: Fargo, ND

46° 53' 26.75° N

96° 46' 12.81° W

River network:

■ Red River of the North: 448.9 miles upstream of Lake Winnipeg,

≈ A total of 1,092.3 miles upstream of Hudson Bay.

Drowning deaths: 3 known

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide lake sturgeon spawning habitat
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Slope: 5% (3% near banks due to weirs)

Project designers:

Doug Crum, Richard Sunberg, Jeff Stanek, and Jim Murphy (Project Engineers), U.S. Army Corps of Engineers
Luther Aadland, MN DNR

Builders/Contractor: United Construction and Supply

Materials: 2500 yards (3500 tons) fieldstone

Year completed: 2002

Cost: \$117,871.50

Funding: U.S. Army Corps of Engineers Section 206 funds, City of Fargo, City of Moorhead, Fargo Park District, MN DNR, North Dakota Game and Fish, Buffalo-Red Watershed District, Southeast Cass Water Resource District, ND State Water Commission

Connectivity

Upstream barriers:

Hickson Dam at river mile 482.5 and Christine Dam at river mile 496.5

Downstream barriers:

Drayton Dam at river mile 206.7

Assessment:

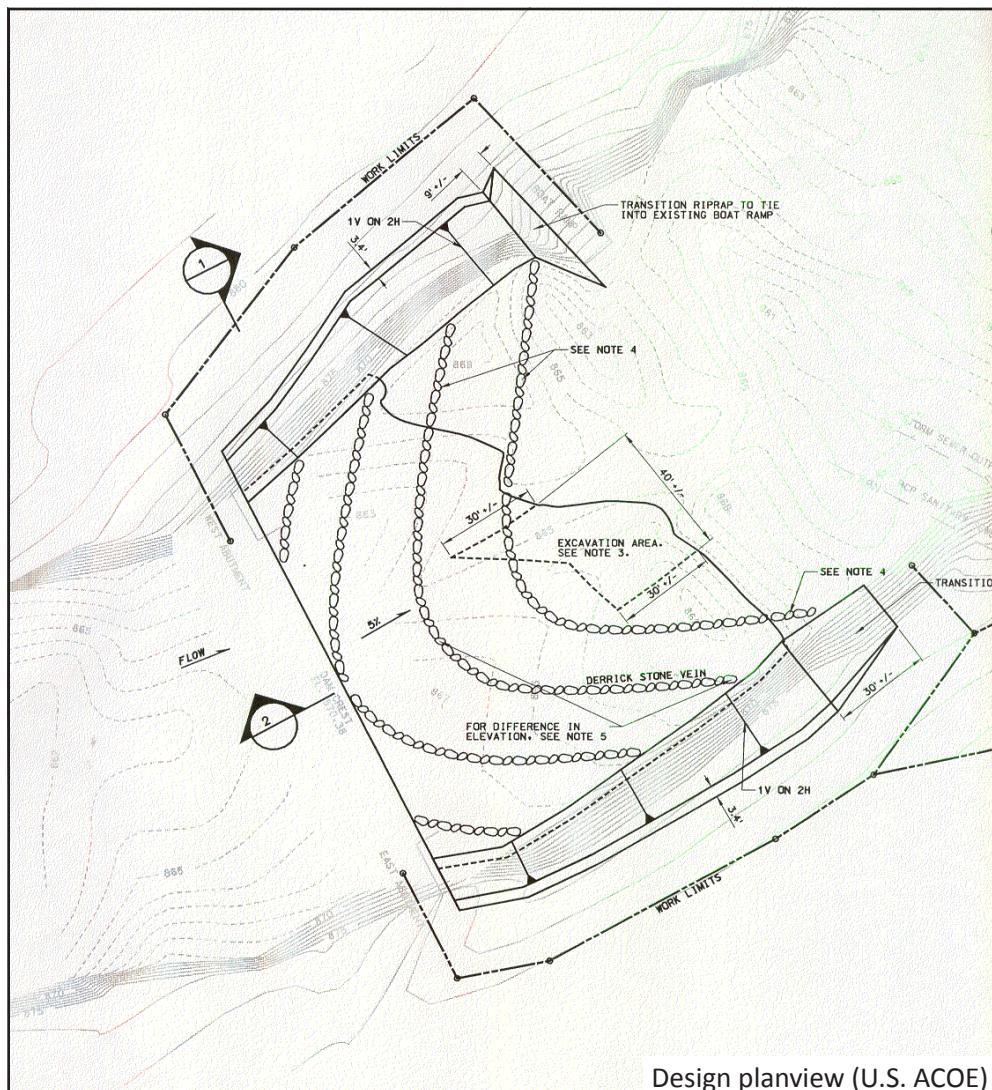
Unidentified fish have been observed passing the rapids, freshwater drum were observed spawning in the upstream (glide) part of the rapids.

Before

Upstream view of dam

After

Upstream view of completed rapids



Design planview (U.S. ACOE)

Red River of the North

Nelson River Basin

Dam Facts

Mean flow: 694 cfs at Fargo gage
Record flow: 28,000 cfs

Drainage area: 6,800 mi²

Dam height: 5.3 feet

Crest width: 120 feet at 875.7 sloping to 190 feet at 877

Crest elevation: 875.7 MSL

Year built: 1929 (rebuilt in 1961)

Original dam function: water supply

Location: Fargo, ND; Moorhead, MN
46° 52' 16.09° N
96° 46' 55.55° W

River network:

- Red River of the North: 452.2 miles upstream of Lake Winnipeg,
- ≈ A total of 1,095.6 miles upstream of Hudson Bay.

Drowning deaths: 19 known, as many as 25 total

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ improve safety by eliminating hydraulic roller
- ☆ provide fish passage and habitat
- ☆ provide lake sturgeon spawning habitat
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids (this was the first project to use this design)

Slope: 5% (3% near banks due to weirs)

Project designers:

Roger Less (Project Engineer), U.S. Army Corps of Engineers,
Mark Bitner and Vern Tomanack (Project Engineers), City of Fargo
Luther Aadland, MN DNR

Builders/Contractor: Industrial Builders

Materials: 4,345 yds fieldstone

Year completed: 1998-1999

Cost: \$235,000

Funding: City of Fargo, City of Moorhead, Fargo Park District, MN DNR, North Dakota Game and Fish, Buffalo-Red Watershed District, Southeast Cass Water Resource District, ND State Water Commission

Connectivity

Upstream barriers:
Hickson Dam at river mile 482.5 and Christine Dam at river mile 496.5

Downstream barriers:
Drayton Dam at river mile 206.7

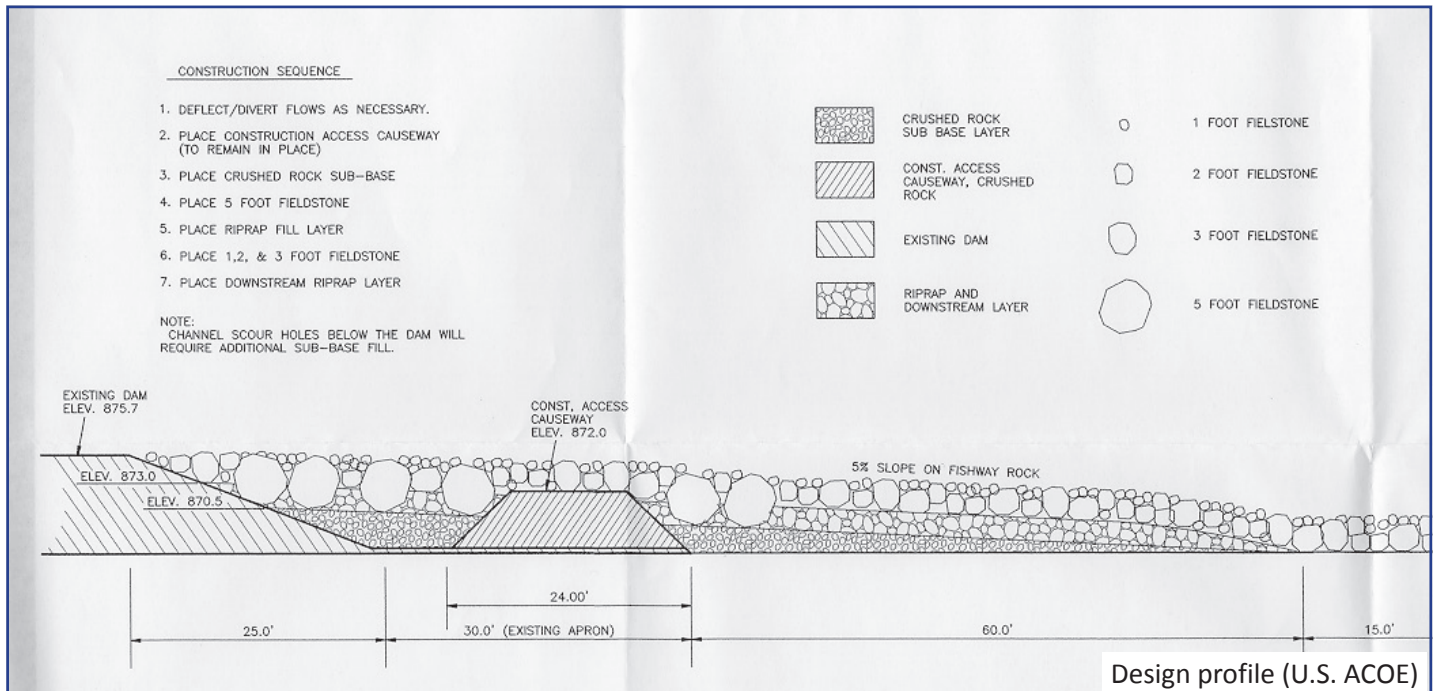
** This project is discussed in detail in Chapter 2.*

Before

View of dam from left bank during low flow

After

Upstream view of completed rapids



Dam Facts

Mean flow: 694 cfs at Fargo gage
Record flow: 28,000 cfs

Drainage area: 6,789 mi²

Watershed area: 6,800 mi²

Dam height: 4 feet due to downstream Midtown Dam

Crest width: 150 feet

Crest elevation: 879.7 MSL

Year built: 1933

Original dam function: water supply

Location: Fargo, ND; Moorhead, MN
46° 49' 54.13° N
96° 47' 29.18° W

River network:

- Red River of the North: 458.1 miles upstream of Lake Winnipeg,
- ≈ A total of 1,101.5 miles upstream of Hudson Bay.

Drowning deaths: 3 known

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ improve safety by eliminating hydraulic roller
- ☆ provide fish passage and habitat
- ☆ provide lake sturgeon spawning habitat
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Slope: 5% (3% near banks due to weirs)

Project designers:
Aaron Busing, Jeff Stanek, and Brian Johnson (Project Engineers), U.S. Army Corps of Engineers
Luther Aadland, MN DNR

Builders/Contractor: Rising Sun

Materials: 23,650 tons fieldstone

Year completed: 2003

Cost: \$916,260

Funding: U.S. Army Corps of Engineers Section 206 funds, City of Fargo, City of Moorhead, Fargo Park District, MN DNR, North Dakota Game and Fish, Buffalo-Red Watershed District, Southeast Cass Water Resource District, ND State Water Commission, U.S. Fish and Wildlife Service

Connectivity

Upstream barriers:
Hickson Dam at river mile 482.5 and Christine Dam at river mile 496.5

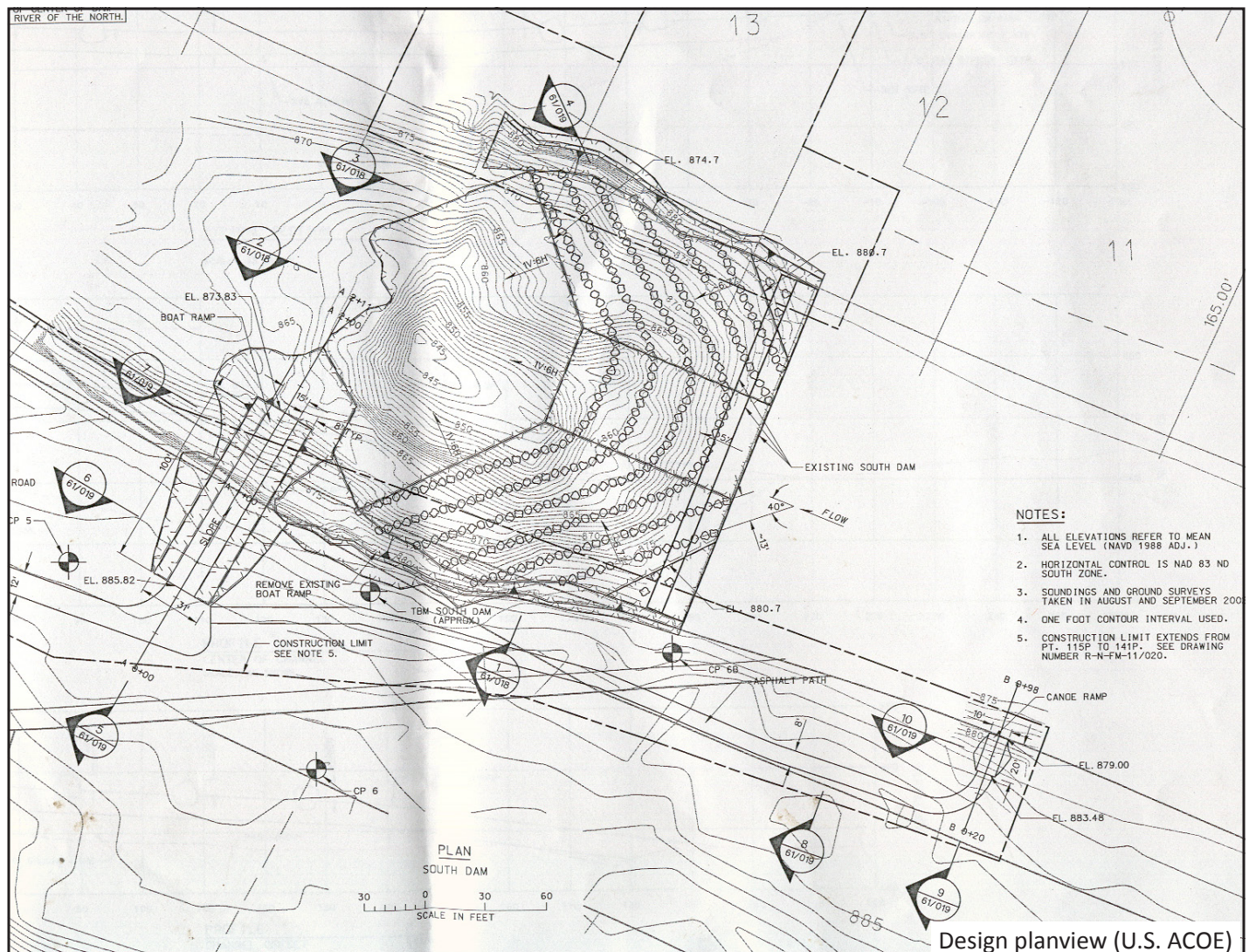
Downstream barriers:
Drayton Dam at river mile 206.7

Before

View of dam from left bank

After

View of completed rapids from left bank



Red River of the North

Nelson River Basin

Dam Facts

Mean flow: 670 cfs
Drainage area: 4,012 mi²
Dam height: ~ 5 feet
Crest width: 80 feet
Crest elevation: 945 MSL
Year built: 1927
Original dam function: water supply for coal plant

Location: Wahpeton, ND; Breckenridge, MN
 46° 16' 05.25° N
 96° 35' 19.58° W

River network:

- Red River of the North: 546.5 miles upstream of Lake Winnipeg,
- ≈ A total of 1,189.9 miles upstream of Hudson Bay.

Drowning deaths: none known

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide lake sturgeon spawning habitat
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Slope: 5% (3% near banks due to weirs)

Project description: Two rock vanes were buildt to protect banks and infrastructure.

Project designers:

Luther Aadland, MN DNR

Builders/Contractor: Sheryl's Construction

Materials: 2,700 yards fieldstone

Year completed: 2000

Cost: \$95,000

Funding: MN DNR – Fisheries, North Dakota Game and Fish, North Dakota Water Commission

Connectivity

Upstream barriers:

Orwell Dam on the Otter Tail River
 Mud Lake Dam on the Bois de Sioux River

Downstream barriers:

Hickson Dam at river mile 482.5
 Christine Dam at river mile 496.5
 Drayton Dam at river mile 206.7

Before

View of dam from left bank

After

View of completed rapids from left bank



#21

BRECKENRIDGE WATER PLANT DAM

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow: Approximately 434 cfs
Drainage area: 1,984 mi²
Dam height: 2 feet
Crest width: 80 feet
Original dam function: water supply
Drowning deaths: unknown

Location: Breckenridge, MN
 46° 16' 5.362 N
 96° 35' 20.17° W

River network:

- Otter Tail River: 2 miles upstream of confluence with...
- ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,194.07 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp
Project goals:
 ☆ provide fish passage and habitat
 ☆ improve safety by eliminating hydraulic roller
 ☆ provide lake sturgeon spawning habitat
 ☆ provide whitewater boating opportunity
Design concept: Rock Arch Rapids
Slope: 5% (3% near banks due to weirs)

Project designers:
 Luther Aadland, MN DNR
 Tor Hanson (Project Engineer), Barr Engineering
Builders/Contractor: Industrial Builders
Materials: 504 tons fieldstone
Year completed: 2000
Cost: \$50,000

Connectivity

Upstream barriers:
 Orwell Dam on the Otter Tail River
Downstream barriers:
 Christine Dam on the Red River of the North at river mile 496.5

Before

Sideview of dam during high flow

After

Completed rapids



Completed rapids in winter



Closeup view of rapids in winter

#22a

BRECKENRIDGE LAKE DAM

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow: Approximately 434 cfs
Drainage area: 1,976 mi²
Dam height: 8 feet with stop logs, 4 feet without
Crest width: 48 feet combined bay width and 3' x 3' gated orifice
Crest elevation: approximately 963 MSL
Year built: 1935
Original dam function: water supply
Drowning deaths: 1 known

Location:
 46° 15' 26.88° N
 96° 32' 10.04° W
River network:
 ■ Otter Tail River: 7.7 miles upstream of confluence with...
 ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
 ≈ A total of 1,199.8 miles upstream of Hudson Bay.

Restoration Design

Project type: Bypass fishway
Project goals:
 ☆ provide fish passage and habitat
Design concept: Bypass fishway
Slope: 2%

Project designers:
 Tom Rickles (Project Engineer), Wilkin County
 Luther Aadland, MN DNR
Builders/Contractor: Wilkin County Highway Department
Materials: 350 tons fieldstone
 600 yards clay
 4' x 6' used cattle crossing culvert
Year completed: 1996
Cost: \$20,000

Connectivity

Upstream barriers:
 Orwell Dam is 31 river miles upstream on the Otter Tail River
Downstream barriers:
 Christine Dam on the Red River of the North at river mile 496.5
Assessment:

A trap-net set at the reservoir end of the fishway has confirmed passage of 34 species of fish. These ranged in size from shiners as small as a couple of inches to a 48.5 inch muskellunge. Species passed included: walleye, sauger, blackside darter, northern pike, muskellunge, goldeye, mooneye, silver lamprey, chestnut lamprey, channel catfish, black bullhead, brown bullhead, stonecat, shorthead redhorse, golden redhorse, greater redhorse, silver redhorse, white sucker, quillback, bigmouth buffalo, bluntnose minnow, emerald shiner, spottail shiner, sand shiner, spotfin shiner, common shiner, common carp, bluegill, pumpkinseed sunfish, black crappie, smallmouth bass, white bass, and freshwater drum.

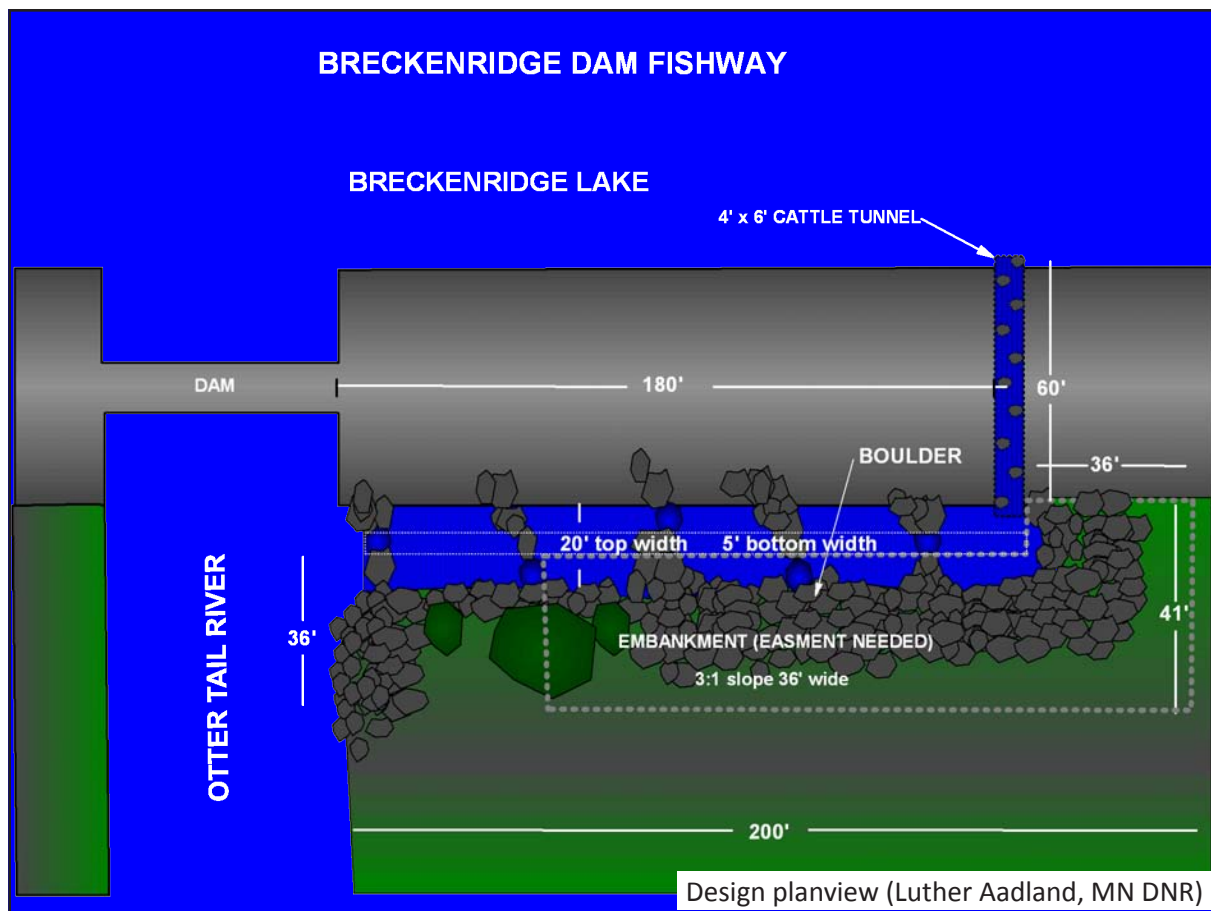
** This project is discussed in detail in Chapter 2.*

Before

Upstream view of dam

After

Upstream view of completed fishway



#22b

BRECKENRIDGE LAKE DAM

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow: Approximately 434 cfs
Drainage area: 1,976 mi²
Dam height: 8 feet with stop logs, 4 feet without
Crest width: 48 feet combined bay width and 3x3 foot gated orifice
Crest elevation: approximately 963 MSL
Year built: 1935
Original dam function: water supply
Drowning deaths: 1 known

Location:
 46° 15' 26.88° N
 96° 32' 10.04° W
River network:
 ■ Otter Tail River: 7.7 miles upstream of confluence with...
 ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
 ≈ A total of 1,199.8 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp
Project goals:
 ☆ river restoration
 ☆ provide fish passage and habitat
 ☆ improve safety by eliminating hydraulic roller
 ☆ provide whitewater boating opportunity
Design concept: Rock Arch Rapids
Slope: 2%

Project description:

The dam embankment failed in floods of 1989, 1997, 2001, 2006, and 2007. Stop-log bays and gate were inoperable after the 1997 flood. The reservoir was filled with sand but the river had re-meandered within these sediments. The dam was removed to the bottom of the stop-log bays. Rock Arch Rapids were built to provide grade control, fish passage and habitat. A 10' deep pool, popular with anglers, was retained within the rapids. Bypass fishway was retained.

Project designers:
 Tom Rickles (Project Engineer), Wilkin County
 Luther Aadland and Kevin Zytkevich, MN DNR
Builders/Contractor: Wilkin County Highway Department
Materials: 1,500 yards fieldstone
Year completed: 2007
Cost: \$100,000

Connectivity

Upstream barriers:
 Orwell Dam is 31 river miles upstream on the Otter Tail River
Downstream barriers:
 Christine Dam on the Red River of the North at river mile 496.5

** This project is discussed in detail in Chapter 2.*

Before



Side view of dam during high flow

After



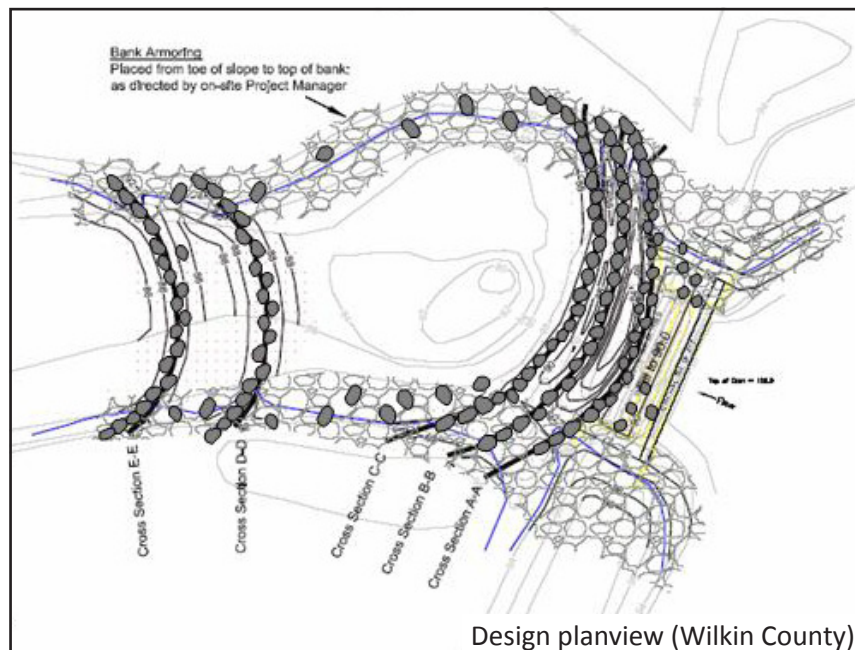
Aerial view of completed rapids



Removing dam



Constructed rapids



Design planview (Wilkin County)

#23

SHOREHAM DAM

Pelican River

Nelson River Basin

Dam Facts

Mean flow: Approximately 20 cfs

Drainage area: 90.5 mi²

Dam height: 1 foot

Crest width: 40 feet

Crest elevation: ~ 1,329 MSL

Original dam function: lake level control

Drowning deaths: unknown

Location: Shoreham, MN

46° 45' 21.131° N

95° 54' 0.534° W

River network:

- Pelican River: 59.7 miles upstream of confluence with...
- ➔ Otter Tail River: 47.1 miles upstream of confluence with...
- ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,298.87 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Slope: 5%

Project designers:

Dave Friedl, MN DNR

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: 322 tons fieldstone

Year completed: 2004

Cost: \$12,358.39

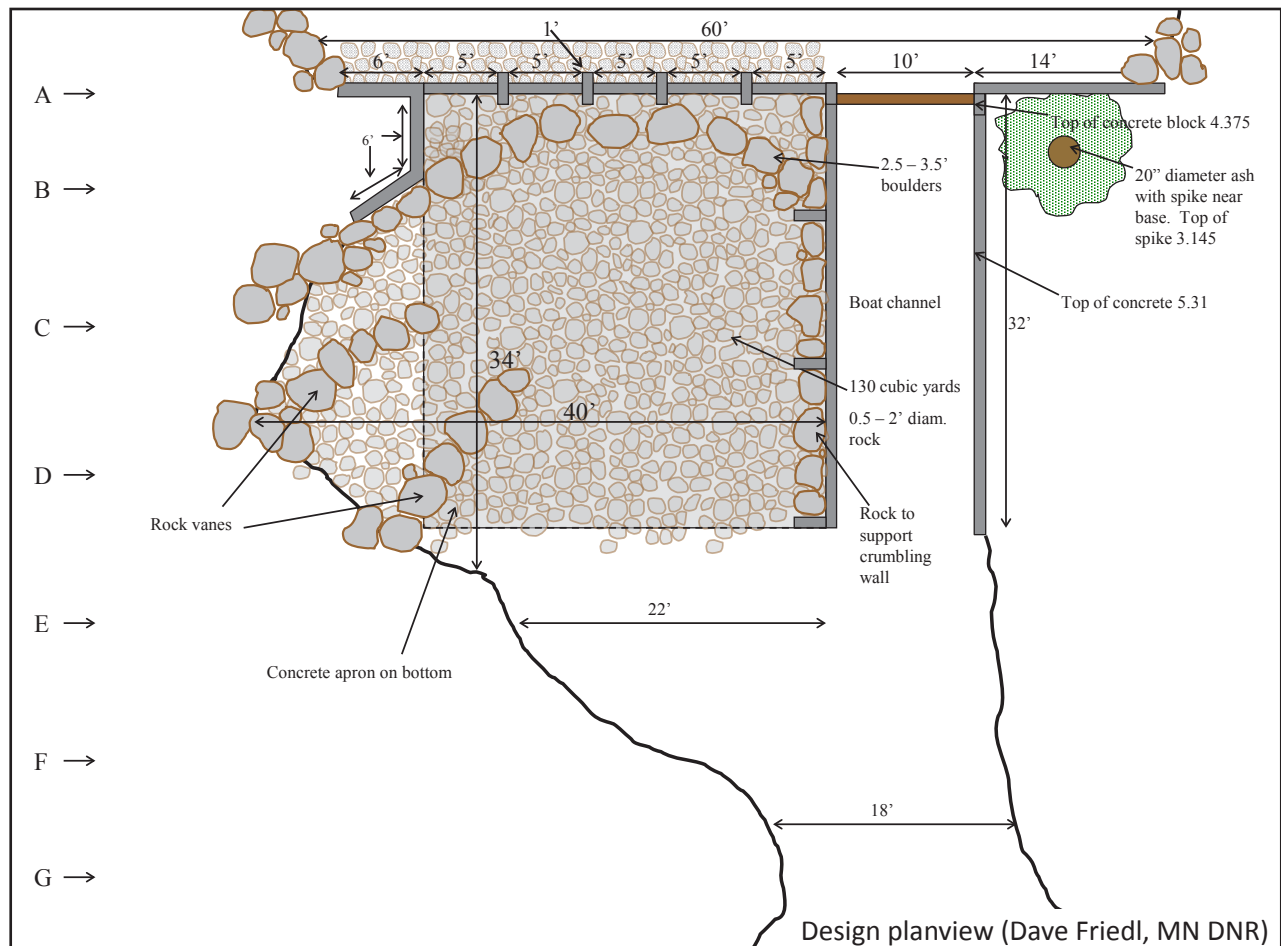
After



Side view of boulder weir



Upstream view of completed ramp



Pelican River

Nelson River Basin

Dam Facts

Mean flow: Approximately 19 cfs
Drainage area: 84.5 mi²
Dam height: 5 feet
Crest width: 40 feet
Crest elevation: 1,334 MSL
Year built: 1889
Original dam function: lake level control and boat lockage
Drowning deaths: unknown

Location:
 46° 46' 49.92° N
 95° 38' 15.59° W
River network:
 ■ Pelican River: 61.7 miles upstream of confluence with...
 ➔ Otter Tail River: 47.1 miles upstream of confluence with...
 ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
 ≈ A total of 1,300.87 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp
Project goals:
 ☆ provide fish passage and habitat
Design concept: Rock Arch Rapids
Slope: 6% (only 80 feet of land separates Muskrat Lake and Lake Sallie limiting use of a more gradual slope)

Project designers:
 Matt Zimmerman and John Filardo (Project Engineers), MN DNR
 Dave Friedl and Luther Aadland, MN DNR
Builders/Contractor: Gary Korby Construction
Materials: 22 yards aggregate base
 310 yards class III riprap
 50 2-3' boulders
Year completed: 2001

Connectivity

Assessment:
 Walleye, white sucker, bluegill, muskellunge, northern pike, spottail shiners, yellow perch, log perch, and lake sturgeon have been observed passing the rapids. White sucker have been observed spawning in the rapids. The steep slope of these rapids is marginal and the project could be improved with an additional boulder weir.

Before

Sideview of Dunton Locks



Upstream view of right spillway



Upstream view of left spillway

During

Construction of weirs

After

Completed rapids



Closer view of rapids showing boulder weir

#25a OTTER TAIL POWER STEAM PLANT DAM

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow:

Approximately 280 cfs during natural flows, up to 250 cfs are diverted for hydropower
Seasonal protected flows are:

30 cfs from September through March,

110 cfs in April and May, and

60 cfs from June through Labor Day for the 12 river miles upstream of this point.

Drainage area: 1,281 mi²

Dam height: 7 feet

Crest width: 50 feet

Crest elevation: 1,189 MSL, lowered to 1,187 MSL

Year built: 1972

Location: Fergus Falls, MN

46° 45' 21.131° N

96° 02' 38.81° W

River network:

■ Otter Tail River: 53.7 miles upstream of confluence with...

➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,

≈ A total of 1,245.8 miles upstream of Hudson Bay.

Original dam function: water supply

Drowning deaths: none known

Restoration Design

Project type: Partial removal and rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ river restoration
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide whitewater boating opportunity

Slope: 10% (designed to be 6%)

Project description:

Partial removal and conversion to a rapids. Due to the lack of adequate equipment to break the hardened concrete, the dam was not lowered to design elevation causing a steeper slope.

Project designers:

Luther Aadland, MN DNR

Builders/Contractor: Delzer Construction

Materials: 174 tons of fieldstone

Year completed: 1994

Cost: \$2,580

Connectivity

Upstream barriers:

Diversion Dam is 12 river miles upstream

Downstream barriers:

Central Dam is 1.9 river miles downstream

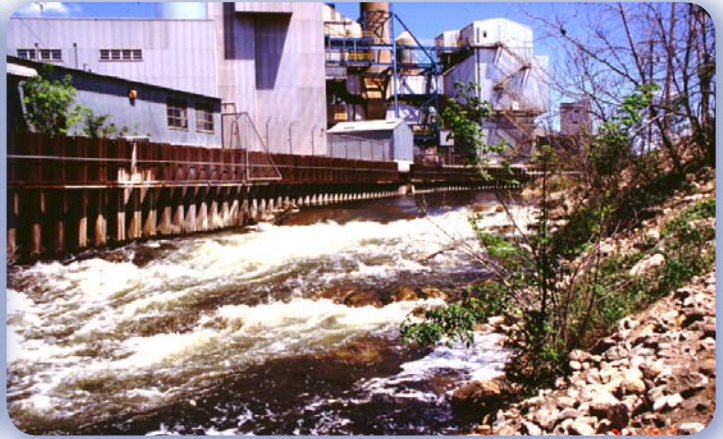
Assessment:

While fish passage was observed, the steep slope likely limited its effectiveness. Kayakers used the rapids but canoeists were prone to taking in water. The fishway was improved in 2005 (next brief).

** This project is discussed in detail in Chapter 2.*

Before

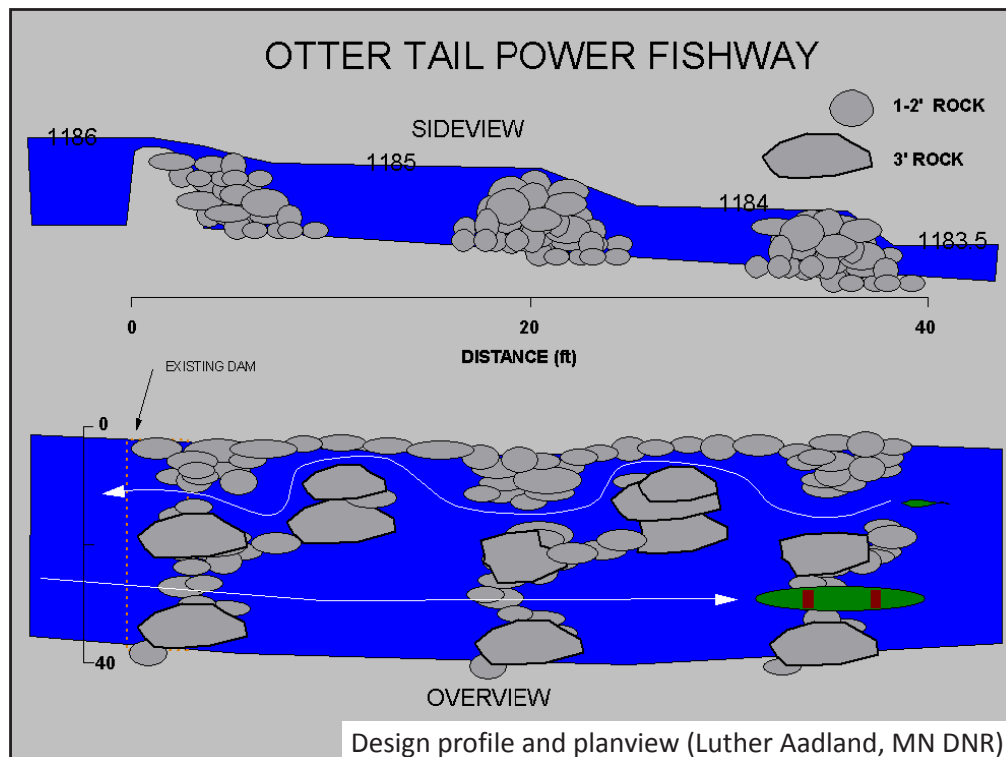
Upstream view of dam

After

Upstream view of completed ramp during high flow



Upstream view of completed ramp and fishway during low flow



#25b OTTER TAIL POWER STEAM PLANT DAM

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow:

Approximately 280 cfs during natural flows, up to 250 cfs are diverted for hydropower
Seasonal protected flows are:
30 cfs from September through March,
110 cfs in April and May, and
60 cfs from June through Labor Day
for the 12 river miles upstream of this point.

Drainage area: 1,281 mi²

Dam height: 7 feet

Crest width: 50 feet

Crest elevation: 1,189 MSL, lowered to 1,187 MSL

Year built: 1972

Location: Fergus Falls, MN

46° 45' 21.131° N

96° 02' 38.81° W

River network:

- Otter Tail River: 53.7 miles upstream of confluence with...
- ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,245.8 miles upstream of Hudson Bay.

Original dam function: water supply

Drowning deaths: none known

Restoration Design

Project type: Partial removal and rock ramp - modification

Project goals:

- ☆ provide fish passage and habitat
- ☆ river restoration
- ☆ provide whitewater boating opportunity

Slope: 1.2%

Project description:

Dam was lowered and converted to a rapids in 1994 but was not lowered to design elevation causing a steeper slope. In 2005, two riffles were built at 200 and 330 feet downstream of the dam crest to raise tail-water and reduce head-loss through the rapids at the dam. Two boulder weirs were also added at 20 and 40 feet downstream of the dam crest to equalize head-loss through each weir.

Project designers:

Luther Aadland, MN DNR

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: 1,260 tons fieldstone
100 three-foot plus boulders

Year completed: 2005 (initial project was 1994)

Cost: approximately \$30,000

Connectivity

Upstream barriers:

Diversion Dam is 12 river miles upstream

Downstream barriers:

Central Dam is 1.9 river miles downstream

Assessment:

The lower slope appeared to improve passage considerably and juvenile smallmouth bass were observed swimming through the rapids.

** This project is discussed in detail in Chapter 2.*

Before

Upstream view of ramp before modications were made

After

Upstream view of completed lower riffle



Kayakers in the rapids



Design planview (Luther Aadland, MN DNR)

Dam Facts

Mean flow:

Approximately 280 cfs during natural flows, up to 250 cfs are diverted for hydropower. Seasonal protected flows are 30 cfs from September through March, 110 cfs in April and May, and 60 cfs from June through Labor Day for the 12 river miles upstream of this point.

Drainage area: 1,241 mi²

Dam height: 8 feet

Crest elevation: 1,252 MSL

Year built: 1913

Original dam function: water diversion for hydropower

Location: Fergus Falls, MN

46° 19' 01.46° N

96° 01' 27.03° W

River network:

- Otter Tail River: 64.7 miles upstream of confluence with...
- ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,256.8 miles upstream of Hudson Bay.

Drowning deaths: none known

Restoration Design

Project type: Bypass nature-like step-pool channel

Project goals:

- ☆ provide fish passage and habitat
- ☆ river restoration

Slope: 4%

Project designers:

Luther Aadland, MN DNR

Geoff Griffin, GGG Inc.

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: 714 yards clay
66 yards top soil
710 tons fieldstone

Year completed: 2002

Cost: \$42,000

Connectivity

Assessment:

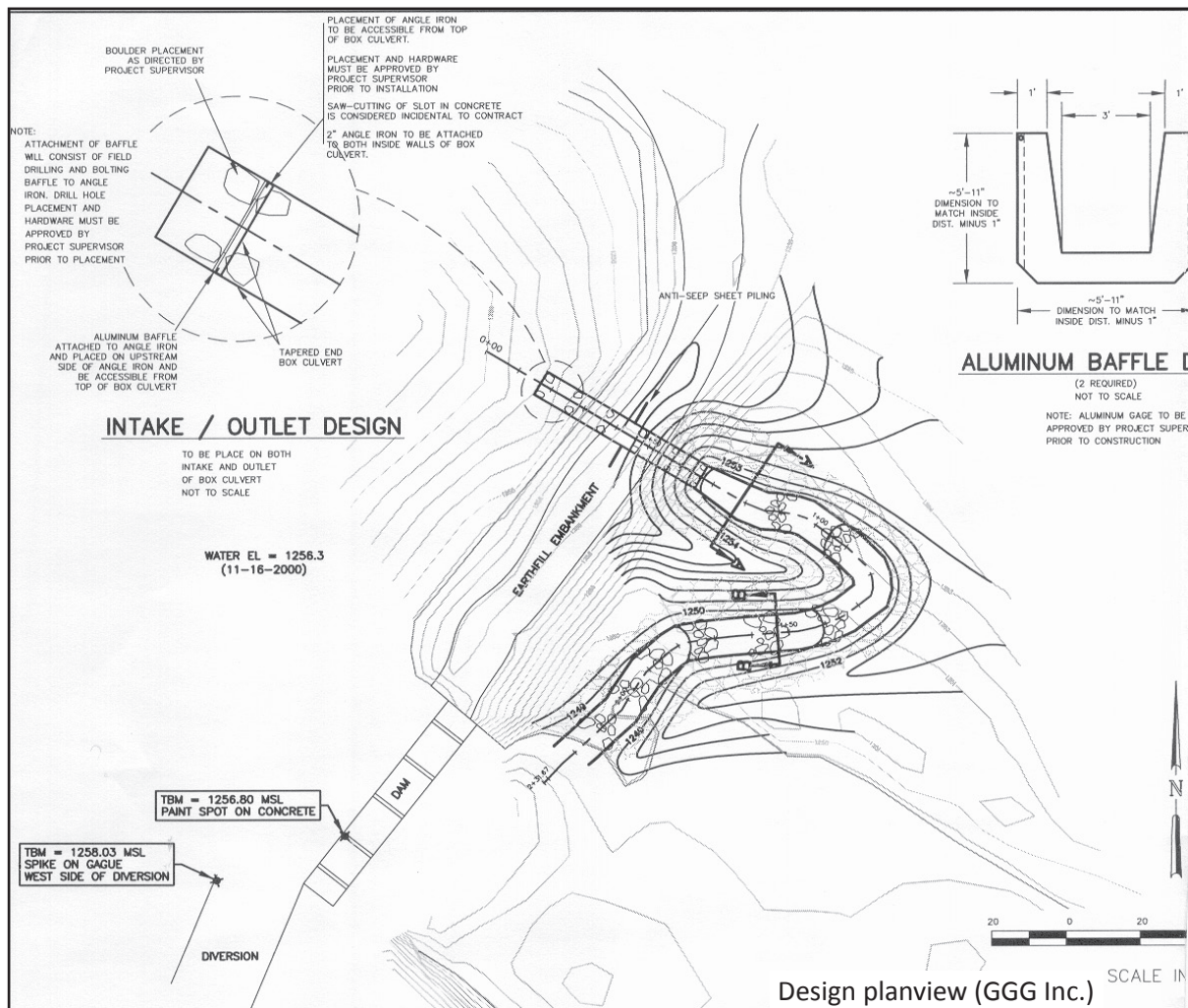
A trap-net set in the reservoir end of the fishway documented passage of 30 fish species including: smallmouth bass, walleye, rainbow darter, Iowa darter, blackside darter, northern pike, northern hog sucker, white sucker, shorthead redhorse, silver redhorse, golden redhorse, greater redhorse, black bullhead, yellow bullhead, bowfin, hornyhead chub, common shiner, sand shiner, bluntnose minnow, fathead minnow, spottail shiner, spotfin shiner, creek chub, central stoneroller, common carp, longnose dace, bluegill, pumpkinseed sunfish, rock bass, and yellow perch. A mudpuppy and snapping turtle were also observed passing the fishway.

Before

Side view of dam

After

View of bottom portion of completed fishway



Dam Facts

Mean flow: Approximately 74 cfs

Drainage area: 337 mi²

Invert elevation: 1,351.3 MSL

Location: Fergus Falls, MN

46° 43' 14.57° N

95° 41' 55.19° W

River network:

- Otter Tail River: 139.6 miles upstream of confluence with...
- ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,331.7 miles upstream of Hudson Bay.

Restoration Design

Project type: Culvert modification

Project goals:

- ☆ provide fish passage

Project description:

A 12' x 12' x 260' box culvert under U.S. highway 10 created a velocity barrier for migrating fish. The bankfull width of the channel is 50 to 60 feet. A boulder weir at downstream end of the culvert and a fieldstone riffle were constructed to increase flow depth and decrease velocities.

Project designers:

Dave Friedl and Luther Aadland, MN DNR

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: 713 tons fieldstone including 125 3-6' boulders

Year completed: 2007

Cost: \$29,508.68

Connectivity

Assessment:

Walleye and white sucker were observed passing the culvert. Passage is still limited during larger floods due to narrow dimensions of the culvert.

Before

Box culvert

After

Boulder weir at downstream end of culvert



Constructed riffle

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow: Approximately 74 cfs

Drainage area: 336 mi²

Dam height: 5 feet

Crest width: 80 feet

Crest elevation: ≈ 1,360 MSL

Original dam function: water level

Drowning deaths: none known

Location: near Frazee, MN

46° 43' 16.88° N

95° 42' 29.31° W

River network:

■ Otter Tail River: 139.9 miles upstream of confluence with...

➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,

≈ A total of 1,332 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide spawning habitat for lake sturgeon and other species
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Slope: 5% (3% near banks due to weirs)

Project designers:

Dave Friedl and Luther Aadland, MN DNR

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: 1,260 tons fieldstone

Year completed: 2003

Cost: \$38,005

Connectivity

Assessment:

Walleye and white sucker have been observed passing and spawning in the rapids.



Walleye passing weir

Before

Upstream view of dam during low flow

After

Upstream view of completed ramp



Closer view of rapids showing boulder weirs

Dam Facts

Mean flow: Approximately 65 cfs

Drainage area: 296.6 mi²

Dam height: ~ 9 feet

Crest width: 20 feet

Crest elevation: 1,368.5 MSL

Year built: 1881

Original dam function: milldam

Drowning deaths: none known

Location: Frazee, MN

46° 43' 30.79° N

95° 41' 50.30° W

River network:

■ Otter Tail River: 141.1 miles upstream of confluence with...

➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,

≈ A total of 1,333.2 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam removal and river restoration

Project goals:

- ☆ river restoration
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide fish passage and habitat

Design concept: Natural Channel Design

Project description:

The reservoir had accumulated up to 7 feet of sediment (predominantly silt and peat) resulting in an incising channel after removal of the dam. Channel restoration included installation of 9 rock riffles for grade control, root wads, boulder vanes, and willow stakes for bank protection, and excavation of 1,200 feet of channel to stabilize the sediments and stream. The restored channel's dimension and pattern were based on nearby reference reaches.

Project designers:

Luther Aadland, MN DNR (river restoration)
Marty Rye (Project Engineer), Short Elliot Hendrickson Inc. (dam removal),
Eugene Redka and Shane Rustin (Project Engineers), MN DNR (restoration)

Builders/Contractor: Gothman Excavating Inc. (dam removal), Chuck Minge Backhoe Services Inc. (river restoration)

Materials: 2,000 yards fieldstone (riffles)
50 root wads

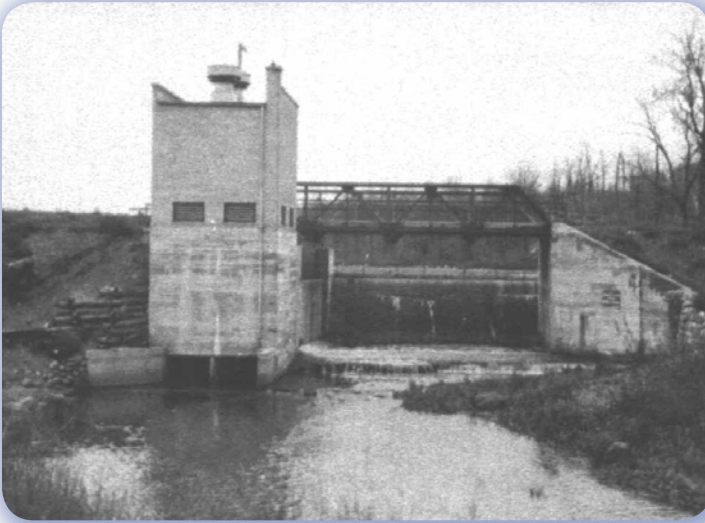
Year completed: dam removal in 1999
restoration in 2001

Cost: \$107,725.50 Removal
\$59,952.00 Engineering for removal
\$395.84 Miscellaneous costs

Connectivity

Assessment:

The restored channel has been stable since completion. Gravel bedload moved into the reach and covered much of the streambed that was previously silt.

Before

Frazee Dam



Frazee Reservoir in 1991

During

Driving root wad into bank

After

Otter Tail River after dam removal



Otter Tail River after restoration



Otter Tail River after restoration showing riffle

#30

FRAZEE BOX CULVERT

Otter Tail River

Nelson River Basin

Dam Facts

Location: Frazee, MN
 46° 43' 49.12° N
 95° 41' 40.85° W
Mean flow: Approximately 65 cfs
Drainage area: 296.5 mi²
Head loss: 2.5 feet
Invert elevation: 1,364.5 MSL

River network:

- Otter Tail River: 141.6 miles upstream of confluence with...
- ↳ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,333.7 miles upstream of Hudson Bay.

Restoration Design

Project type: Culvert passage
Project goals:
 ☆ provide fish passage and habitat
 ☆ provide whitewater boating opportunity
Design concept: Rock Arch Rapids
Slope: 5% (3% near banks due to weirs)
Project description:
 The culvert became perched when the dam discussed above was removed and the channel headcut through the accumulated sediment.

Project designers:

Marty Rye (Project Engineer), Short Elliot Hendrickson Inc.
 Luther Aadland, MN DNR

Builders/Contractor: Gothman Excavating Inc.

Materials: 350 tons fieldstone

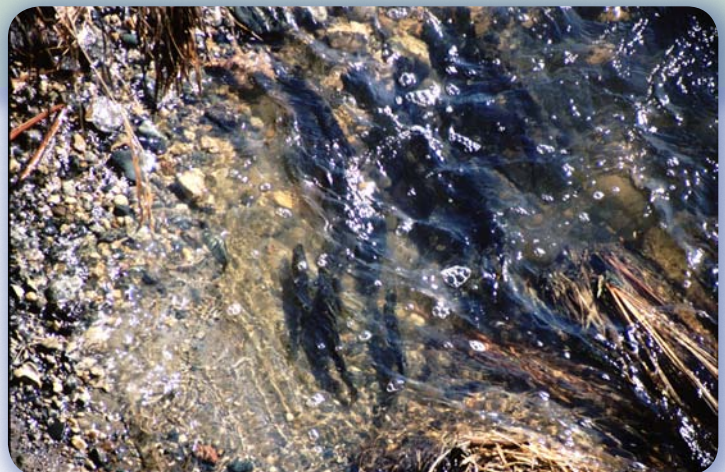
Year completed: 1999

Cost: part of removal cost listed in previous brief

Connectivity

Assessment:

White suckers were observed passing the rapids immediately following construction. Head-loss through the rapids was reduced when the river downstream was restored and grade control riffles were constructed.



Northern pike concentrated below the impassable culverts

Before

Upstream view of perched culverts

After

Upstream view of the modified culverts



Downstream view of the rapids from road grade



Upstream view of a riffle downstream of the culverts following river restoration in the former reservoir

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow: Approximately 65 cfs

Dam height: 2 feet

Crest width: 30 feet

Crest elevation: ≈ 1,453 MSL

Year built: 1938

Original dam function: lake level control

Drowning deaths: none known

Location:

46° 52' 50.48° N

95° 38' 15.79° W

River network:

■ Otter Tail River: 159.6 miles upstream of confluence with...

➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,

≈ A total of 1,351.7 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Project description:

Dam was a partial barrier due to supercritical flows over concrete crest.

Project involved the use of a boulder weir to create sub-critical velocities.

Project designers:

Dave Friedl and Luther Aadland, MN DNR

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: 75.6 tons fieldstone including 20 2.5 to 3' boulders

Year completed: 2003

Cost: \$3,800

Connectivity

Upstream barriers:

Round Lake Dam is 11 river miles upstream

Downstream barriers:

Hubbel Pond WMA Dam is 3.2 river miles downstream

Before

Dam viewed from the road grade

After

Constructed riffle viewed from embankment



Dam viewed from under road grade



Riffle viewed from under road grade

During

Riffle construction

Otter Tail River

Nelson River Basin

Dam Facts

Mean flow: Approximately 14 cfs
Drainage area: 64.3 mi²
Dam height: 2 feet
Crest width: 30 feet
Crest elevation: 1,496.3 MSL
Year built: 1937
Original dam function: lake level control
Drowning deaths: unknown

Location: White Earth Indian Reservation
 47° 3' 18.52° N
 95° 32' 35.91° W

River network:

- Otter Tail River: 185.21 miles upstream of confluence with...
- ➔ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,377.3 miles upstream of Hudson Bay.

Restoration Design

Project type: Dam replaced with rock ramp
Project goals:
 ☆ provide fish passage and habitat
 ☆ improve safety by eliminating hydraulic roller
 ☆ provide lake sturgeon spawning habitat
 ☆ provide whitewater boating opportunity
Design concept: Rock Arch Rapids
Slope: 4%
Project description:
 Dam was a barrier to fish migration. The White Earth Band of Ojibwa is reintroducing lake sturgeon in several of the lakes of the upper chain.

Project designers:

Luther Aadland, MN DNR
 Dave Friedl and Neil Haugerud, MN DNR (oversaw construction)

Builders/Contractor: Racer Construction, Inc.

Materials: 100 yards clay
 150 yards 6-15" fieldstone
 150 yards 15-24" fieldstone
 50 2-3' boulders
 20 yards 0.25-2" gravel
 20 yards topsoil
 12' x 100' coconut blanket

Year completed: 2008

Cost: \$58,750

Connectivity

Downstream barriers:

An outlet dam 2 miles downstream at Round Lake will be modified in 2010.

Before

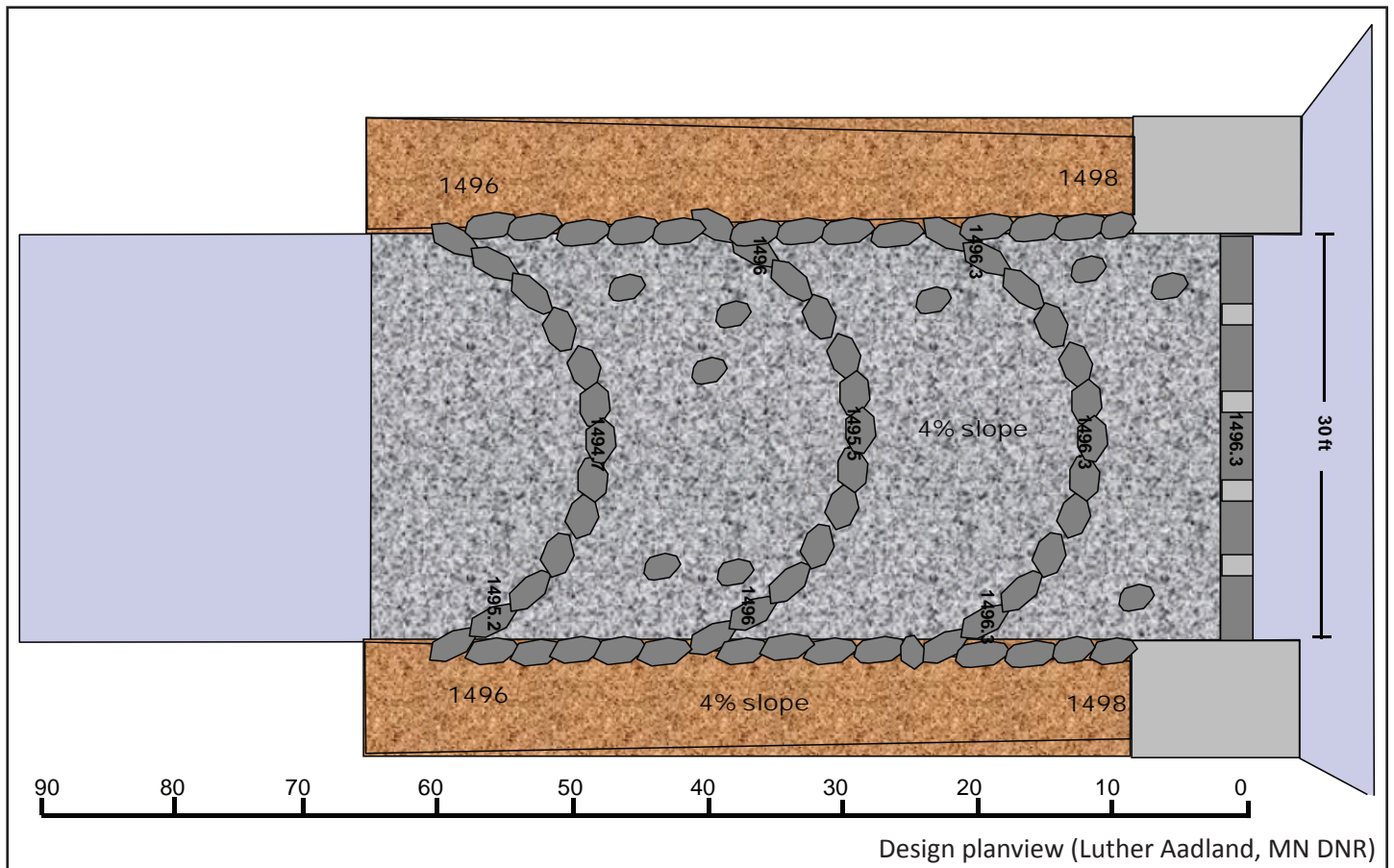


Upstream view of dam

After



Upstream view of completed rapids



#33

SOLID BOTTOM CREEK CULVERT

Solid Bottom Creek

Nelson River Basin

Dam Facts

Location: Becker County Road 113 crossing
47° 9' 8.838° N

95° 31' 50.51° W

Mean flow: Approximately 3.5 cfs

Drainage area: 15.9 mi²

Head loss: 1.03 feet

Culvert elevation: 1,540 MSL

River network:

- Solid Bottom Creek: 0.6 miles upstream of confluence with..
- ↳ Otter Tail River headwaters: 194.4 miles upstream of confluence with...
- ↳ Bois de Sioux at Red River of the North headwaters: 548.7 miles upstream of Lake Winnipeg,
- ≈ A total of 1,387.1 miles upstream of Hudson Bay.

Restoration Design

Project type: Culvert passage

Project goals:

- ☆ provide fish passage

Project description:

A riffle was built to raise tailwater below a perched culvert. The riffle raised the stream bed 2.1 feet and the tailwater 1.8 feet to reduce velocities and provide fish passage through the culvert.

Project designers:

Dave Friedl, MN DNR

Builders/Contractor: MN DNR Fisheries Construction Crew

Materials: 90 yards fieldstone

Year completed: 2005

Cost: \$3,500

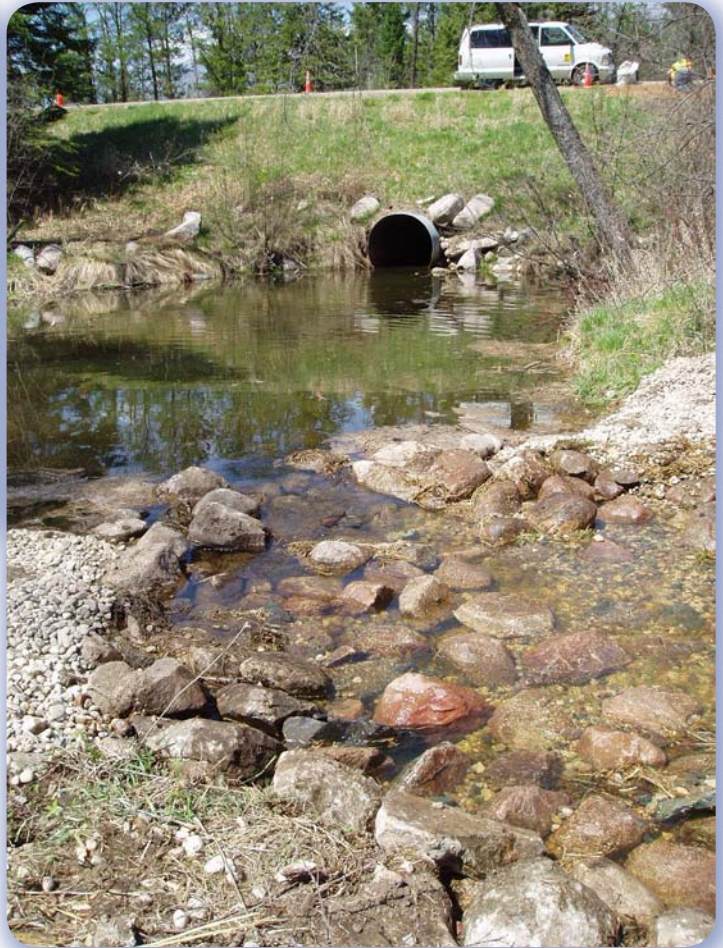
Connectivity

River miles connected:

Reconnected 1.25 miles of coldwater stream.

Before

Upstream view of perched culvert

After

View of culvert showing tailwater pooling following riffle construction

#34

HIGHWAY 23 BOX CULVERT

South Fork Nemadji River

Great Lakes Basin

Dam Facts

Mean flow: Approximately 18 cfs

Drainage area: 19.4 mi²

Head loss: 4 feet

Width: 20 feet (two 10' x 10' box culverts)

Invert elevation: 819 MSL

Location: near Holyoke, MN

46° 29' 37.18° N

92° 24' 35.38° W

River network:

- South Fork Nemadji River: 12.6 miles upstream of confluence with..
- ➔ North Fork Nemadji to form the Nemadji River: 20 miles upstream of Lake Superior,
- ≈ A total of 32.6 miles upstream of Lake Superior.

Restoration Design

Project type: Culvert passage

Project goals:

- ☆ provide fish passage (especially for steelhead)
- ☆ provide spawning habitat
- ☆ erosion control

Design concept: Rock Arch Rapids

Slope: 5%

Width: 40 feet

Project description:

Six boulder weirs were installed to create a step pool channel and provide fish passage. Boulder weirs were used to address downstream bank erosion.

Project designers:

Jon Bergstrand (Project Engineer), MN DOT
Luther Aadland, MN DNR

Materials: 1,770 tons quarried granite (includes riprap placed on highway embankment and two J-hook vanes downstream of rapids.

Year completed: 2003

Cost: \$55,000

Before

Upstream view of perched culverts

After

View of completed rapids

Dam Facts

Mean flow: 2,491 cfs

Drainage area: 3,594 mi²

Dam height: 85 feet

Crest width: 600 feet

Year built: 1924

Original dam function: hydropower - owned by Allete Inc. (Minnesota Power) generates 10 MW power.

Drowning deaths: unknown

Location:

46° 39' 57.08° N

92° 17' 49.70° W

River network:

- St. Louis River: 21.3 miles upstream of Lake Superior.

Restoration Design

Project type: Tailwater river restoration

Project goals:

- ☆ restore flows to the width of the river channel
- ☆ provide spawning habitat for lake sturgeon, walleye, and other species

Reach slope: 1%

Cost: \$136,006

Project description:

The site had been altered by construction of a berm that confined flows to the channel center causing high velocity and bed scour. The berm was removed and three arch-shaped rapids were built to redistribute flows and provide spawning habitat. The arching rapids used a series of honeycomb shaped boulder cells that buttress the weirs and provide semi-protected spawning areas for lake sturgeon. The rapids provide glides, cascades, and eddies that are consistent with natural spawning areas identified in Minnesota rivers that have wild sturgeon populations. Sturgeon were extirpated from the Western Lake Superior Basin by the early 1900s by over-harvest, and fragmentation due to Fond du Lac and other dams that blocked access to natural rapids upstream. Lake sturgeon fry and fingerlings have been stocked since 1983 by the Minnesota and Wisconsin Departments of Natural Resources.

Project designers:

Kevin Zytkevich and Luther Aadland, MN DNR

Builders/Contractor: RJS Construction and the MN DNR Fisheries Construction Crew

Materials: 203 tons 4-10" boulders
176 tons 12-36" boulders
456 36-60" boulders

Year completed: 2009

Connectivity

Downstream barriers:

none

Assessment:

Lake sturgeon were observed in the rapids immediately after its construction. Surveys will be conducted in spring 2010.



View from dam crest at 200 cfs before construction



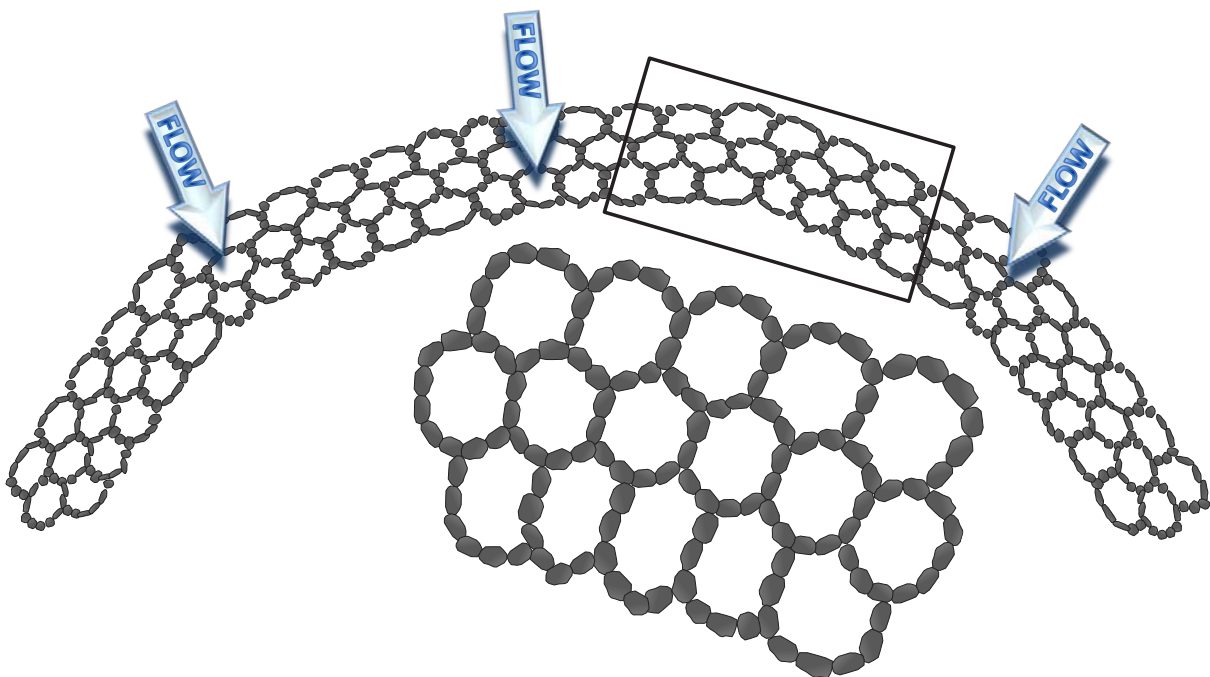
View of completed rapids from dam crest at 200 cfs



View of completed boulder cells at 1,600 cfs



View of completed rapids from dam crest at 1,600 cfs



Honeycomb shaped boulder cells planview (Luther Aadland, MN DNR)

Dam Facts

Mean flow: 693 cfs

Drainage area: 868 mi²

Dam height: 16.1 feet

Crest elevation: 956.6 MSL

Year built: 1908

Original dam function: hydropower - retired in 1963

Drowning deaths: 1 known

Location:

46° 6' 27.97° N

92° 51' 47.47° W

River network:

- Kettle River 22.4 miles upstream of confluence with...
- ➔ St. Croix River: 106 miles upstream of confluence with...
- ➔ Mississippi River: 811.5 miles upstream of confluence with the Ohio River
- ≈ A total of 1898.7 miles upstream of the Gulf of Mexico.

Restoration Design

Project type: Dam removal

Project goals:

- ☆ river restoration
- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ improve safety by eliminating dam failure potential

Project description: The dam was removed, no river restoration was done.

Project designers:

Tim Petersen (Project Engineer) and Joseph Beck, MN DNR (design)

Jerry Fabian (Project Engineer) and Dave Nelson, MN DNR (dam removal)

Builders/Contractor: Mills Concrete Restoration, Inc.

Year completed: 1995

Cost: \$208,000

Connectivity

Downstream barriers:

- None to confluence with St. Croix River
- Taylor's Falls Dam on St. Croix River

Assessment:

Tagged lake sturgeon have moved upstream through the former dam site and submerged falls. Significant sedimentation occurred in the downstream channel causing reductions in mussel density. A large pool that had filled with sediment following removal is getting progressively deeper. Upstream benefits to mussels due to the restored passage have not been assessed.

** This project is discussed in detail in Chapter 1.*

Before

Upstream view of dam from left bank

After

View of Big Spring Falls which had been inundated by the reservoir for 87 years

DAWSON DAM

West Branch Lac qui Parle River

Mississippi River Basin

Dam Facts

Location: Dawson, MN

44° 55' 47.15° N

96° 03' 1.754° W

Mean flow: Approximately 78 cfs

Drainage area: 472 mi²

Dam height: 8 feet

Crest width: 55 feet

Crest elevation: 1132.9 MSL

Year built: 1913

Original dam function: water supply

River network:

- West Branch Lac qui Parle River 1.5 miles upstream of confluence with...
- ➔ Lac qui Parle River 29.4 miles upstream of confluence with...
- ➔ Minnesota River: 285.8 miles upstream of confluence with...
- ➔ Mississippi River: 844 miles upstream of confluence with the Ohio River
- ≈ A total of 2,119.5 miles upstream of the Gulf of Mexico.

Drowning deaths: none known

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller

Design concept: Rock Arch Rapids

Slope: 4%

Width: 120 feet

Year completed: 2009

Cost: \$650,000

Project description:

The community wanted to retain the pool level and downstream fishing hole. The rapids was built to the same elevation as the dam and entirely of loose rock and aggregate with no sheet piling or artificial leakage barrier. The river is subject to low flows so voids in the rock base were filled with 6" and smaller aggregate to minimize leakage. Discharge measurements taken during construction were 132.2 cfs at the crest of the rapids and 135.0 cfs at a river cross-section 433 feet downstream indicating minimal leakage since measurement error was ±2.7 cfs. It is anticipated that the rapids will be further sealed by organic matter and sediment carried by the river.

Project designers:

Shane Rustin (Project Engineer), Chris Domeier, and Luther Aadland, MN DNR

Builders/Contractor: Park Construction

Materials: 2,920 tons granular filter

6,020 tons fieldstone

550 4'+ boulders

1,820 tons quarry stone (for banks)

1,810 tons 3-6" filler stone

1,010 tons 0.5-3" filler stone

Connectivity

Upstream barriers:

None within the 50 river miles to headwaters

Downstream barriers:

Lac qui Parle Lake dam is 31 miles downstream on the Minnesota River. Further downstream is Granite Falls and Minnesota Falls below which the Minnesota River is free flowing to its confluence with the Mississippi River.

Assessment:

Post-project fisheries surveys will be conducted in 2010. Pre-project surveys indicated that channel catfish and several other species present downstream of the dam were absent upstream of the dam.

Before

Upstream view of dam from right bank during low winter flows

During

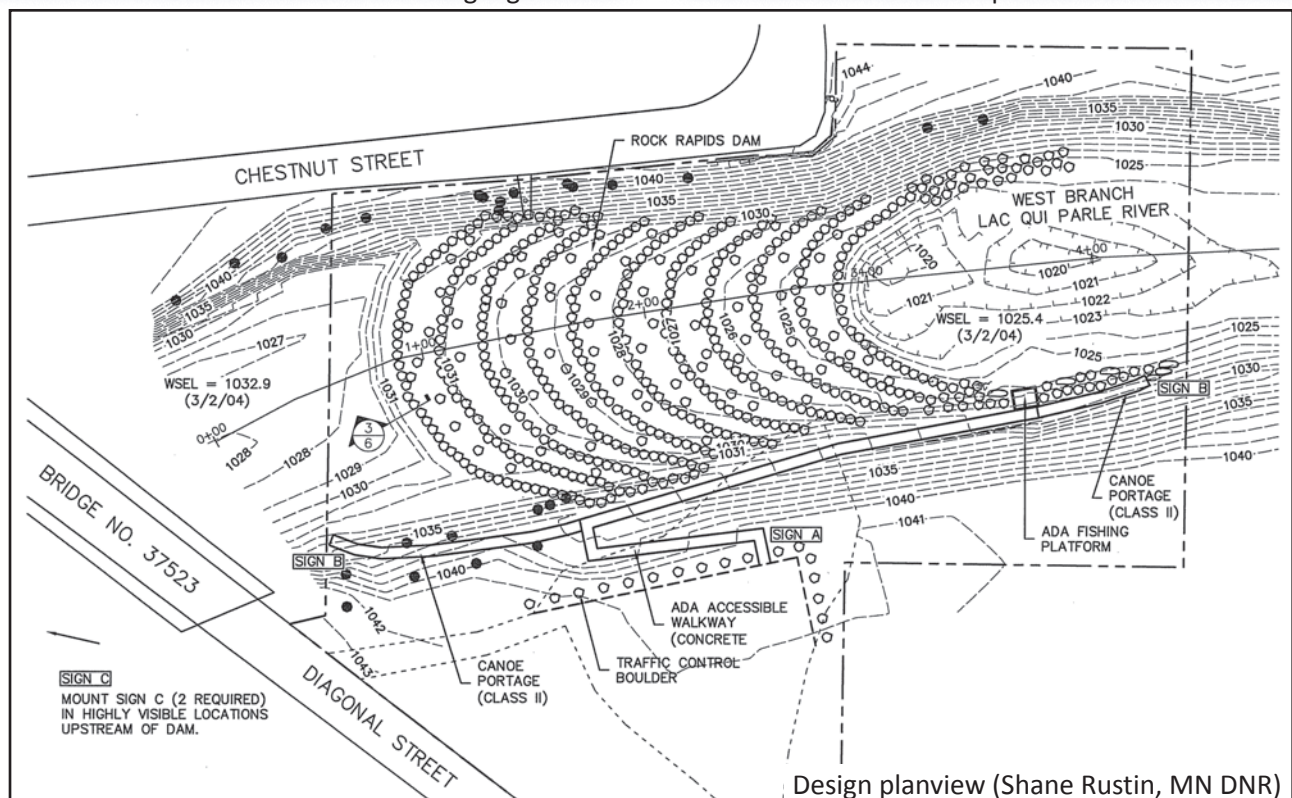
Upstream view of dam showing notch to lower pool during construction



Upstream view of dam from left bank during high flows



Construction of weirs in rapids



Design planview (Shane Rustin, MN DNR)

Dam Facts

Mean flow: 136 cfs

Record flow: 8,890 cfs in 1997

Drainage area: 905 mi²

Dam height: 12.8 feet (may have historically been as much as 16 feet with flashboards)

Crest width: 130 feet

Crest elevation: 994 MSL

Year built: 1872

Original dam function: mill

Drowning deaths: unknown

Location: Appleton, MN

45° 12' 14.51° N

96° 1' 9.007° W

River network:

- Pomme de Terre River 9.2 miles upstream of confluence with...
- ➔ Minnesota River: 302 miles upstream of confluence with...
- ➔ Mississippi River: 844 miles upstream of confluence with the Ohio River
- ≈ A total of 2,114 miles upstream of the Gulf of Mexico.

Restoration Design

Project type: Dam removal and river restoration

Project goals:

- ☆ provide fish passage and habitat
- ☆ river restoration
- ☆ improve safety by eliminating hydraulic roller

Project description:

The dam partly failed in 1997 and was removed and replaced with a Rock Arch Rapids. 2,500 feet of channel was excavated to re-meander the river in the old reservoir. Nine rock riffles were installed for grade control in addition to root wads, boulder vanes, and willow stakes for bank protection. Channel dimensions and pattern was based on upstream and downstream reference channels.

Project designers:

Luther Aadland, MN DNR (restoration)
Eugene Redka, and Shane Rustin (Project Engineers for restoration), MN DNR,
Marty Rye (Project Engineer for dam removal),
Short Elliot Hendrickson Inc.

Builders/Contractor: D&C Dozing for dam breach;
Landwehr Construction for dam removal; and
Sheryl's Construction for river restoration

Excavation: 24,410 yards

Year completed: Dam was breached on July 9, 1998,
removed and replaced with rapids on March 6,
1999, river restoration was completed in February,
2001

Cost: \$117,000 for dam removal,
\$250,000 for river restoration

Connectivity

Upstream river miles connected:

45.1 (including subsequent removal of a dam at river mile 15)

Assessment:

The restored channel has become a quality walleye fishery. A number of species including walleye, yellow perch, channel catfish, stonecat, freshwater drum, golden redhorse, silver redhorse, blackside darter, and white bass were sampled in the restored channel that were not collected in reservoir surveys or upstream river reaches prior to dam removal.

** This project is discussed in detail in Chapter 1.*

Before

Reservoir in 1997

After

River after dam removal, 1999



Upstream view of failed dam showing eroded left embankment and breach near right bank



River after restoration, 2003



Dam site after restoration, 2007

BARRETT LAKE DAM

Pomme de Terre River

Mississippi River Basin

Dam Facts

Mean flow: Approximately 50 cfs
Drainage area: 332 mi²
Dam height: 4 feet
Crest width: Original dam: 56 feet
 New dam: 110 feet graduated crest
Crest elevation: 1,146 MSL
Year built: 1937 (previous dam; original dam unknown)
Original dam function: mill
Drowning deaths: unknown

Location: Barrett, MN
 45° 54' 43.14° N
 95° 52' 57.85° W

River network:

- Pomme de Terre River 88.71 miles upstream of confluence with...
- ➔ Minnesota River: 302 miles upstream of confluence with...
- ➔ Mississippi River: 844 miles upstream of confluence with the Ohio River,
- ≈ A total of 2,193.5 miles upstream of the Gulf of Mexico.

Restoration Design

Project type: Dam replacement/modification
Project goals:
 ☆ provide fish passage and habitat
 ☆ improve safety by eliminating hydraulic roller
Design concept: modified Rock Arch Rapids
Slope: 5%

Project designers:

Pete Sarberg (Project Engineer), Widseth Smith Nolting Inc.
 Luther Aadland, MN DNR

Builders/Contractor:

Materials: 125 yards fieldstone base, 100 3' to 5' boulders

Year completed:

Cost: \$9,000 for rapids
 (\$240,264 for dam replacement)

Funding: City of Barrett (population 388) and boulder donations by area farmers

Connectivity

Evaluation:

Northern pike, walleye, bluntnose minnow, smallmouth bass, Iowa darter and common carp were observed passing the rapids. Iowa darters were observed spawning in the boulder weirs. Overall slope and head-loss per weir is excessive and passage may be limited for some species. Passing northern pike and smallmouth bass were observed jumping the weirs.

Before

Dam viewed from under road grade

After

Completed rapids



Pelicans fishing below lower weir during shiner migration

POTATO LAKE DAM

Potato River

Mississippi River Basin

Dam Facts

Mean flow: Approximately 83 cfs
Drainage area: 179 mi²
Dam height: 4 feet
Crest width: original dam: 55 feet,
 new dam: 120 feet graduated crest
Crest elevation: 1,439 MSL
Year built: 1939 (original dam)
Original dam function: lake level control
Drowning deaths: unknown

Location: Potato Lake, MN
 46° 58' 41.59° N
 95° 2' 47.78° W

River network:

- Potato River 3.23 miles upstream of confluence with...
- ➔ Fishhook River: 8.1 miles upstream of confluence with...
- ➔ Shell River: 12.13 miles upstream of confluence with...
- ➔ Crow Wing River: 86 miles upstream of confluence with...
- ➔ Mississippi River: 993 miles upstream of confluence with the Ohio River,
- ≈ A total of 2,061.3 miles upstream of the Gulf of Mexico.

Restoration Design

Project type: Dam replacement/modification
Project goals:
 ☆ provide fish passage and spawning habitat
 ☆ improve safety by eliminating hydraulic roller
Design concept: modified Rock Arch Rapids
Slope: 5%

Project designers:

Pete Sarberg (Project Engineer), Widseth Smith
 Nolting Inc.
 Luther Aadland, MN DNR

Builders/Contractor:

Materials: 320 yards Class III riprap
 89 yards Class I riprap
 36 4' boulders

Year completed:

Cost: \$27,380

Connectivity

River miles reconnected:
 16.23 miles to tributary headwaters including lakes

Before

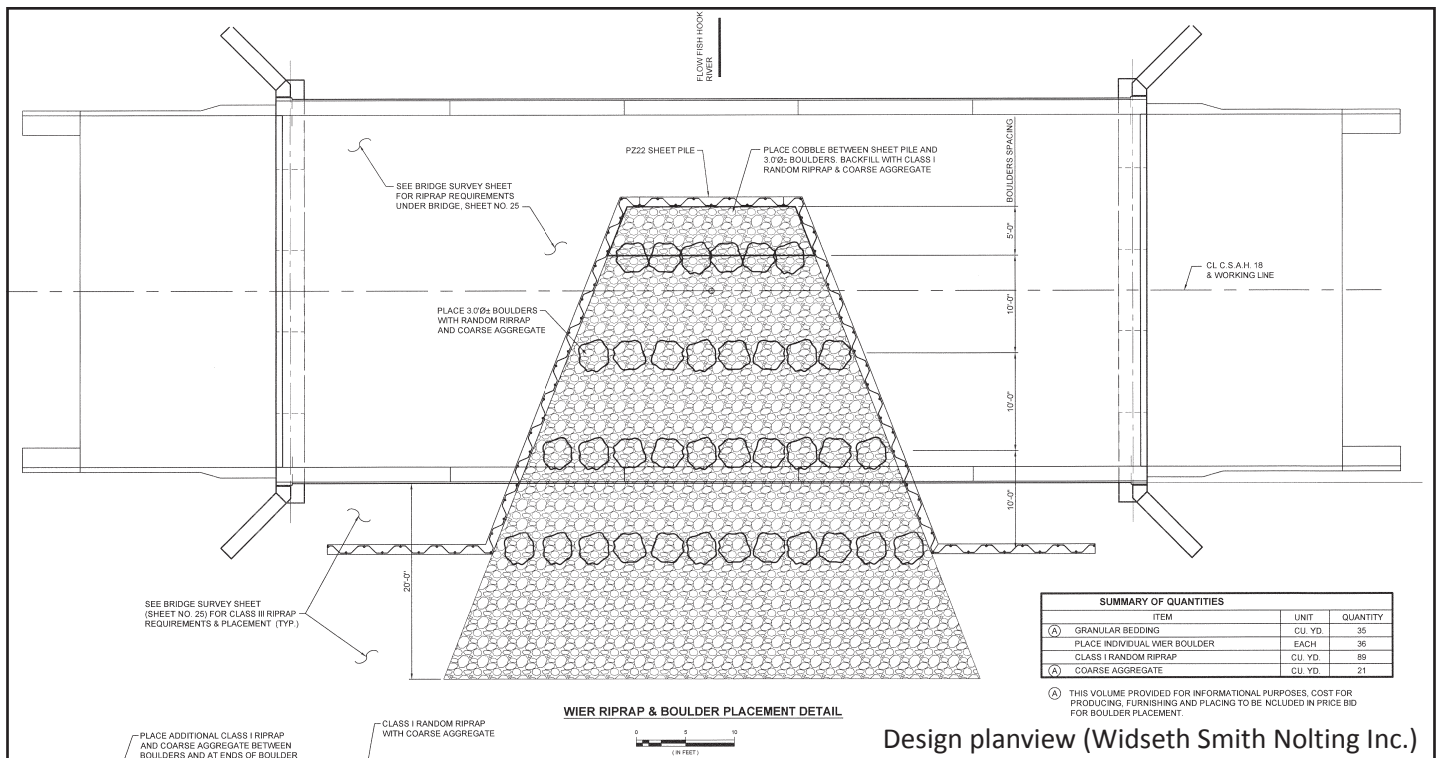


View of dam from upstream lake

After



Completed rapids



Design planview (Wideth Smith Nolting Inc.)

Straight River

Mississippi River Basin

Dam Facts

Mean flow: Approximately 149 cfs
Drainage area: 218 mi²
Dam height: 5.1 feet (at low flows during construction)
Crest width: 93 feet
Crest elevation: 1,124.9 MSL
Year built: 1930, original structure was built about 1859
Original dam function: grist mill
Drowning deaths: unknown

Location: Owatonna, MN

44° 5' 1.050° N

93° 13' 57.02° W

River network:

- Straight River 27.3 miles upstream of confluence with...
- ➔ Cannon River: 58.2 miles upstream of confluence with...
- ➔ Mississippi River: 795.5 miles upstream of confluence with the Ohio River,
- ≈ A total of 1,839.8 miles upstream of the Gulf of Mexico.

Restoration Design

Project type: Full river width bypass

Project goals:

- ☆ provide fish and turtle passage and habitat

Design concept: Rock Arch Rapids bypass channel. The project also has a wet path adjacent to the rapids for turtle passage.

Slope: 3%

Channel width: 60 feet

Project designers:

Tor Hanson (Project Engineer), Barr Engineering
 Luther Aadland, MN DNR

Builders/Contractor: Park Construction

Materials: 2,350 tons rock filter
 3,775 tons natural stone base
 980 tons riprap
 300 boulders

Year completed: 2006

Cost: \$1,150,000 (primarily for dam repairs)

Connectivity

Mainstem river miles reconnected:

30.5 to headwaters

Assessment:

The fishway has excessive head-loss per weir (1-foot). This was partially corrected by building boulder pockets downstream of weir gaps to distribute head-loss but the project would've benefitted from two additional weirs.

Before



Upstream view of dam from right bank



Construction of boulder weir

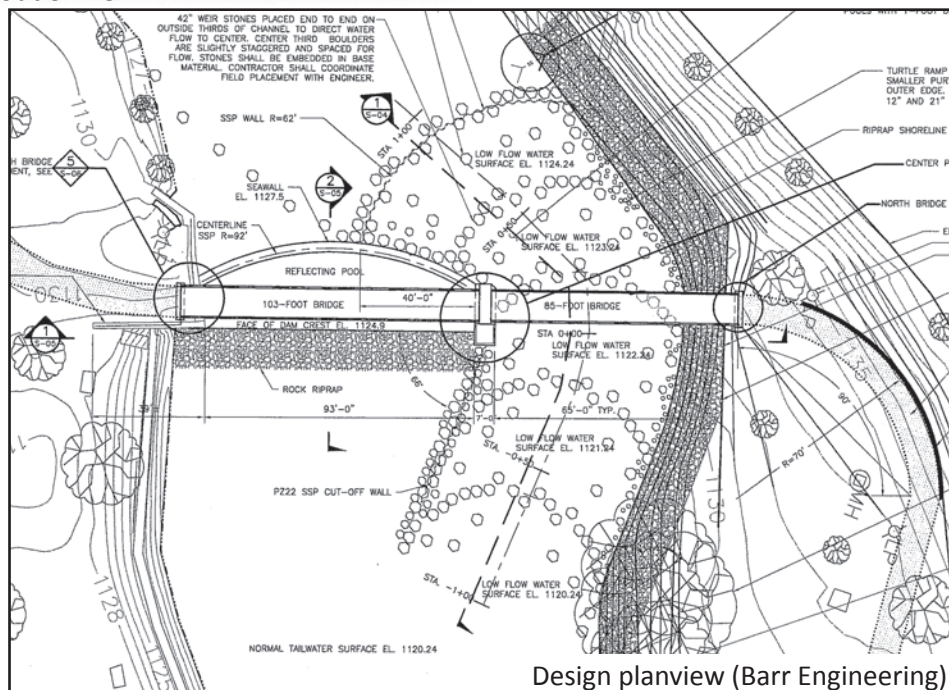
After



Upstream view of fishway and dam at low flow



Partial weir to reduce headloss



Design planview (Barr Engineering)

Dam Facts

Mean flow: Approximately 141 cfs

Drainage area: 446 mi²

Dam height: 7.5 feet (two constructed riffles downstream maintain minimum tailwater)

Crest width: 90 feet (old crest)
240 feet (new crest)

Crest elevation: 1,038.8 MSL, gaps between boulders at 1,037.8 MSL

Year built: 1857(original dam)

Original dam function: mill

Drowning deaths: unknown

Location: Hutchinson, MN

44° 53' 43.87° N

94° 22' 12.79° W

River network:

- South Fork Crow River 66.8 miles upstream of confluence with...
- ➔ Crow River mainstem: 25 miles upstream of confluence with...
- ➔ Mississippi River: 879 miles upstream of confluence with the Ohio River,
- ≈ A total of 1,929.6 miles upstream of the Gulf of Mexico.

Restoration Design

Project type: Dam replaced with rock ramp

Project goals:

- ☆ provide fish passage and habitat
- ☆ improve safety by eliminating hydraulic roller
- ☆ provide whitewater boating opportunity

Design concept: Rock Arch Rapids

Slope: 3%

Project description:

A gated dam was replaced with fixed-crest rapids with a sheet-pile core. The first boulder weir had a top elevation a foot above the sheet piling. The crest was widened to compensate for the lack of gates and to maintain 100-year flood elevations.

Project designers:

Jon Ausdemore, and Tom McDonald (Project Engineers), Barr Engineering,
Kent Exner (Project Engineer), City of Hutchinson
Rob Collett and Luther Aadland, MN DNR

Builders/Contractor: Park Construction

Materials: 8,230 tons base fieldstone

2,515 tons filter rock

1,400 tons granular filter

150 tons 1-6" cobble

150 tons 3/8-3/4" chinking gravel

330 4' boulders

6 flat fishing boulders and other materials

Year completed: 2008

Cost: \$1,043,198.65

Connectivity

Mainstem river miles reconnected:

124 miles to headwaters (the South Fork Crow is free-flowing to the Mississippi). A dam with about 2-feet of head in Watertown is a partial barrier at river mile 14 on the South Fork Crow River.

Assessment:

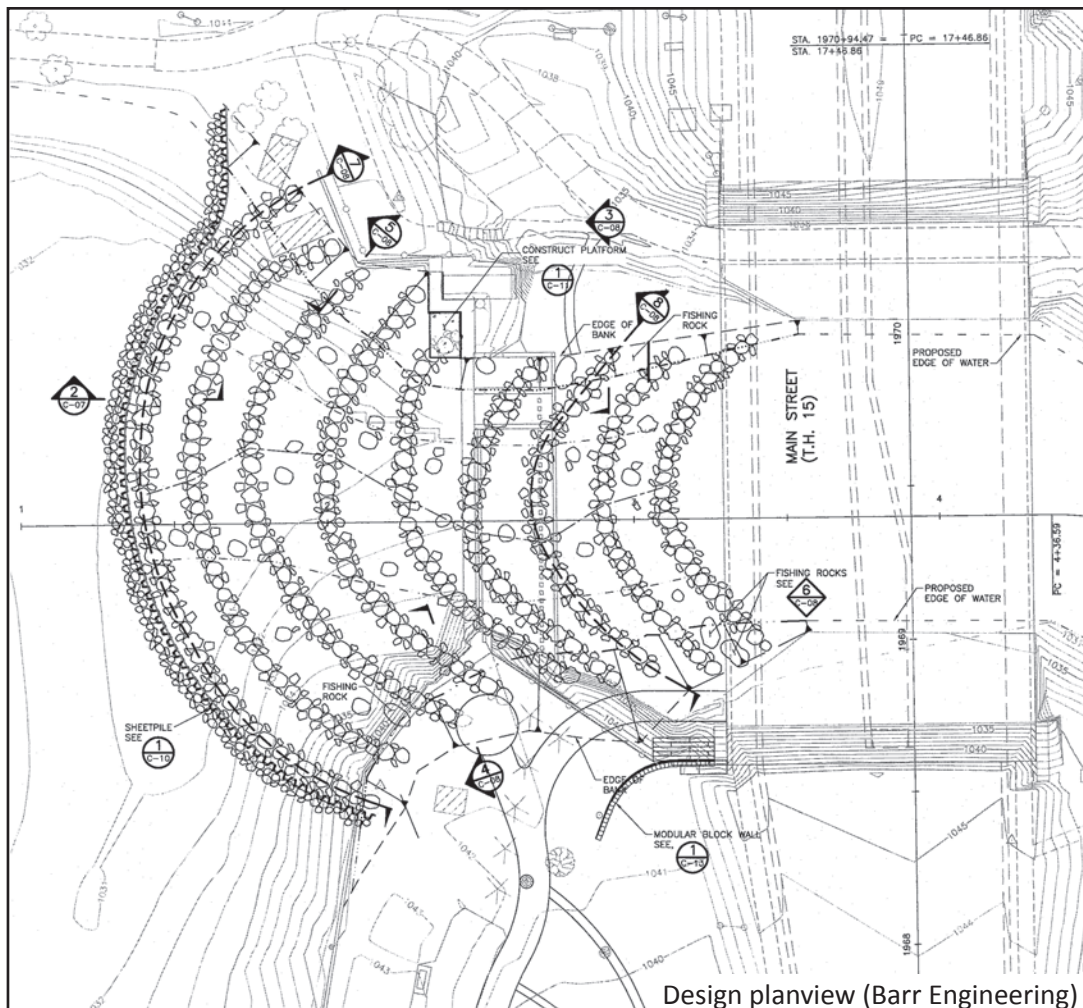
The very wide flat crest (about four times natural bankfull width) created fish passage problems, as depth of flow over the crest was shallow. My recommendations of an elliptical or graduated crest were overridden by lake level concerns. This problem was partially compensated with narrow gaps through the weirs that provided greater depth for passage. Walleye, bigmouth buffalo, channel catfish, black bullhead, and common carp were observed passing the rapids.

Before

Upstream view of dam from right bank

After

Upstream view of completed ramp



#43

ONAMIA DAM

South Fork Crow River

Mississippi River Basin

Dam Facts

Mean flow: Approximately 210 cfs
Drainage area: 444 mi²
Dam height: 6 feet
Crest width: 48 feet
Crest elevation: 1,245.35 MSL
Year built: 1938
Original dam function: lake level control
Drowning deaths: none known

Location:
 46° 4' 9.002° N
 93° 40' 48.2° W
River network:
 ■ Onamia River: 137.1 miles upstream of confluence with...
 ➔ Mississippi River: 871.4 miles upstream of confluence with the Ohio River,
 ≈ A total of 1,967.3 miles upstream of the Gulf of Mexico.

Restoration Design

Project type: Dam replaced with rock ramp
Project goals:
 ☆ provide fish passage and habitat
 ☆ improve safety by eliminating hydraulic roller

Project designers:
 Jon Hendrickson, MN DNR
Materials: 490 yards fieldstone
 166 2-4' boulders
Year completed: 2007
Cost: \$53,556.46

During

Removal of dam



Construction of rapids

After

Completed rapids viewed from right bank

