THE BOARDMAN-OTTAWAY:
A RIVER REBORN

The Boardman-Ottaway: A River Reborn is the largest comprehensive dam removal effort in Michigan's history and one of the most significant in the Great Lakes Basin. The overall project involved removing three dams (Brown Bridge, Boardman and Sabin) on the Boardman River, originally known as the Ottaway by the Ojibwa and Odawa Native Americans. The project reconnects 160 miles of river and tributaries that were fragmented by the dams for 126 years. An estimated seven miles of river and tributaries that were buried under impoundments are now daylighted, and their adjacent floodplains and upland corridors restored. Outdoor recreation abounds with paddlers, hikers and anglers enjoying the recovered river, and community safety is improved with removal of the aging infrastructure. Fish, wildlife and aquatic insects thrive in the coldwater, gravel habitat that was once forgotten under the sediment-laden warmwater impoundments.

The Boardman River is a Lake Michigan tributary located in Grand Traverse and Kalkaska counties. Its watershed covers 291 square miles, draining 182,800 acres of land and producing one-third the volume of water in Grand Traverse Bay. The river is a state-designated Natural River and Blue Ribbon Trout Stream.

During the logging era of the mid-1800s, the river and surrounding habitats were dramatically changed with the clear-cutting of old-growth white and red pine stands as well as beech, sugar maple, and hemlock forests. The course of the river was further impacted with the construction of Union Street Dam in 1867. Built as a large grist mill to process grain into flour, and rebuilt in 1885, the dam helped fuel a growing city but was devastating to the river's aquatic habitat.

Queen City Light and Power then built a series of hydropower dams on the river: Boardman (1894, rebuilt and relocated in 1931), Sabin (1906, enlarged in 1914, rebuilt in 1930), Keystone (1909, failed in 1961) and Brown Bridge (1922). These hydroelectric dams originally supplied a significant percentage of the city's electrical needs but declined over time as the community grew. Under the best conditions, the dams could generate up to 2.225 megawatts in total, supporting an estimated 1,450 homes or 4% of Grand Traverse County at current day usage. In 2005, Traverse City Light and Power determined the three hydropower dams were no longer economically feasible to generate electricity due to aging spillways, needed repairs, and upgrades required for relicensing. Thus, Traverse City Light and Power relinquished their lease of the dams.

Former Brown Bridge Dam

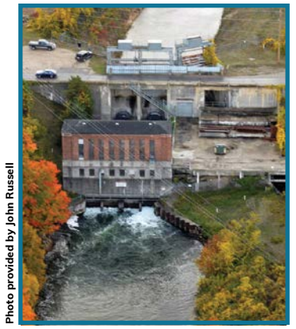
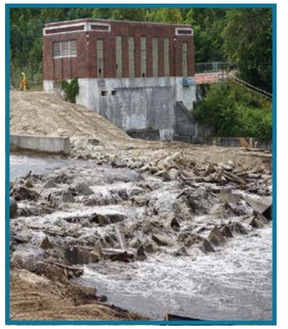


Photo provided by John Russell

Former Boardman Dam



Former Sabin Dam

To determine the fate of the former hydropower dams as well as the Union Street Dam, the owners, the City of Traverse City (Brown Bridge and Union Street) and Grand Traverse County (Boardman and Sabin) worked with a local-led Boardman River Dams Committee to involve the community in exploring the options of retaining, modifying and removing the dams. Ultimately, removal was the decision for the three hydropower dams with modification of Union Street Dam. Modification of Union Street Dam was recommended because the dam blocks invasive sea lamprey and maintains the Boardman Lake water level 6-8' above the natural lake level. An Implementation Team (IT) comprised of federal, tribal, state and local partners was formed under a settlement agreement to oversee the future of the dams, and the Conservation Resource Alliance (CRA) became the project manager to the IT.

Collectively the project spanned 15 years and blended grants from over 30 sources totaling $25 million to complete the design, permitting and construction phases for restoring the river and removing the Brown Bridge, Boardman and Sabin Dams along with the parallel $3.5 million effort of building a new Cass Road Bridge. *The Boardman-Ottaway: A River Reborn* has been an extraordinary illustration of human solidarity for environmental health. Visit the Grand Traverse region to experience the river reborn for yourself... time spent by a river is never wasted.

Implementation Team (IT)

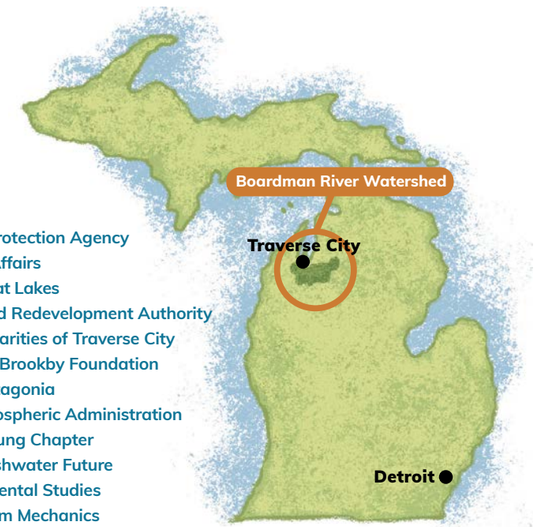
• City of Traverse City • Grand Traverse Band of Ottawa and Chippewa Indians • Grand Traverse County
• Michigan Department of Natural Resources • Michigan Department of Environment, Great Lakes and Energy
• Michigan Hydro Relicensing Coalition • Traverse City Light and Power • U.S. Fish & Wildlife Service

Ex Officio IT Members

• Conservation Resource Alliance
• Grand Traverse Conservation District
• Grand Traverse County Road Commission
• The Charter Township of Garfield
• The Watershed Center Grand Traverse Bay

Additional Partners & Funders

• U.S. Army Corps of Engineers • U.S. Environmental Protection Agency
• Great Lakes Restoration Initiative • Bureau of Indian Affairs
• National Fish & Wildlife Foundation - Sustain Our Great Lakes
• Great Lakes Fishery Trust • Grand Traverse Brownfield Redevelopment Authority
• Michigan Department of Transportation • Rotary Charities of Traverse City
• Rotary Camps and Services • Frey Foundation • The Brookby Foundation
• Oleson Foundation • The Conservation Alliance • Patagonia
• DTE Energy Foundation • National Oceanic and Atmospheric Administration
• Trout Unlimited incl. the Adams Chapter and Paul Young Chapter
• USDA Natural Resources Conservation Service • Freshwater Future
• USDA Forest Service • AuSable Institute of Environmental Studies
• Herpetological Resource & Management, LLC • Stream Mechanics



Brown Bridge Dam Removal

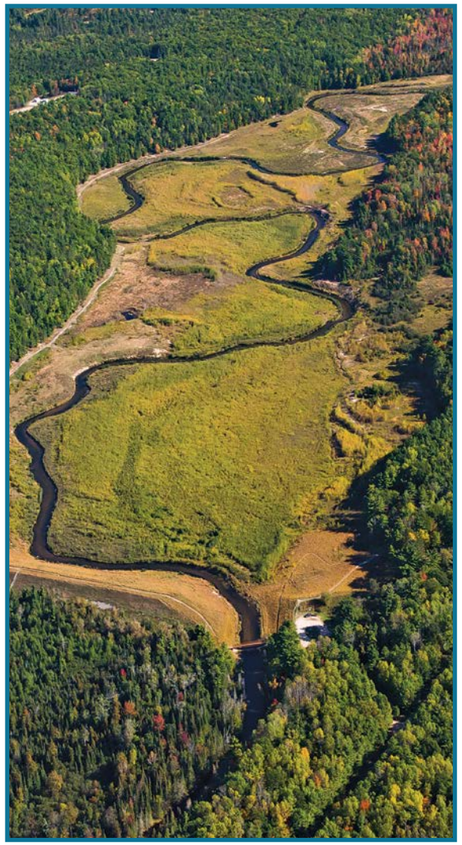
Brown Bridge Dam was the farthest upstream dam on the river and created the largest impoundment at 191 acres. Impounding a river warms the water which can create areas with less oxygen that are unable to support life. Temperature data showed a +6°F increase above and immediately below the dam during the summer, with maximum temperatures exceeding 70°F. This is a critical temperature difference especially for sensitive species like brook trout that need water temperatures less than 68°F.

Construction highlights include re-establishing the longest length of river channel at 2.9 miles, and the challenges of dewatering the pond and rebuilding the river channel at the sole powerhouse location. There was an unexpected incident with the Brown Bridge dewatering structure on October 6, 2012, during which a large portion of the pond drained out in a day. No one wanted this to happen, and it was a physically and emotionally exhausting experience for everyone involved including downstream landowners and community members. Many lessons were learned in response to that day; the engineering team was reassembled for the remainder of the overall effort, and alternative dewatering designs and methods were used at the next two dams.

The project site is fully within the 1,310-acre Brown Bridge Quiet Area owned by the City of Traverse City; now with two footbridges and a river access site, the recreational opportunities abound for hikers, anglers and paddlers along the recovered river.

HIGHLIGHTS:

- Location: N 44.643082, W 85.509961
- River Mile: 18.5
- Owner: City of Traverse City
- Cost: $4.4M for design and construction
- Dam built in 1921
- Dam removal in 2012
- Dam height of 46’ with a head of 33’
- Dam length of 1,650’ incl. earthen embankment comprised of fill and concrete, brick powerhouse with concrete spillway
- Impoundment 191 acres
- Drainage area of 151 square miles
- 1.4M cubic yards of sediment impounded during dam operation
- Decommissioned in 2006, pond lowered 3’ in 2008 and 6’ in 2011 due to limited spillway capacity
- 277,000 cubic yards of sediment managed during dam removal
- 2.9 miles of river restored, average river width of 45’ and floodplain width of 30’
- Stabilization of 3 connecting creeks involving combination of wetland, open water habitat and placement of culverts and fieldstone
- 6,500 linear feet of instream wood installed for habitat and streambank protection
- Added partners of AMEC and InterFluve (design) and Molon Excavating, Inc. and Bierlein Companies Inc. (construction)



The river meanders once again through the former impoundment. A foot bridge now connects trails where the powerhouse once stood. (October 2019)

Photo provided by John Russell

Due to an inadequate spillway, two drawdowns were required exposing the heavy sand filling Brown Bridge Pond prior to dam removal. (Summer 2010)

Photo provided by John Russell

As the pond was drawn down, tree stumps surfaced, dotting the sand and sediment that had built up over the years. (September 2012)

The Grand Traverse Band welcomed the Implementation Team and partners with a drum ceremony to celebrate the return of the river. (August 2013)

Boardman Dam Removal

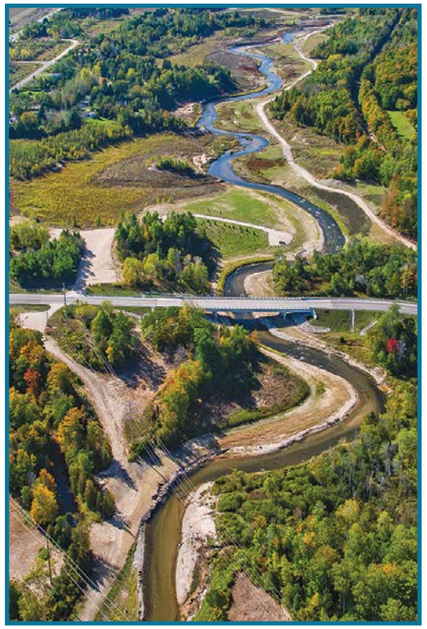
Of all three dams, the Boardman impoundment, known locally as “Keystone Pond,” had the largest amount of sediment to move around to recreate the river channel due in part to the 1961 failure of the Keystone Dam 2 miles upstream. A construction highlight was that 14 gravity-fed siphons were used to drain the pond 21’ down at Boardman Dam. The siphons were comprised of 30” diameter pipes made of high-density polyethylene, fused together to make 300’ lengths. They were individually operated and monitored 24 hours a day at varying capacity according to stream flow and rain events so that the impoundment was drawn down 6”-12” per day.

Another construction highlight included building the new Robbins Bridge at Cass Road to replace the one-lane crossing over the powerhouse. Fortunately, the Grand Traverse County Road Commission and Michigan DOT provided $3.31M in construction funds and sequenced it in 2016 so that the 252’ span bridge could be built in “the dry” a year before dam removal. The bridge was positioned over the historic river channel, where the river would soon be returned the following year.

The U.S. Army Corps of Engineers was a primary partner for the Boardman and Sabin Dam removals, providing $8M from EPA and $4.9M through the Great Lakes Fishery and Ecosystem Restoration Program for dam removal and restoration. The Grand Traverse Band of Ottawa and Chippewa Indians was the local sponsor, signing contracts with the Corps and providing over $3M through grants from the Bureau of Indian Affairs, Great Lakes Fishery Trust, and the Great Lakes Restoration Initiative.

HIGHLIGHTS:

- Location: N 44.697762, W 85.624545
- River Mile: 6.1
- Owner: Grand Traverse County
- Cost: $10.5M for design and construction
- Dam built in 1894 and relocated/rebuilt in 1930
- Dam removal in 2017
- Dam height of 43’ with a head of 41’
- Dam length of 650’ long earthen embankment comprised of fill, concrete, steel rod and sheet pile with a detached brick powerhouse and spillway 400’ to the west
- Impoundment 104 acres
- Drainage area of 267 square miles
- 788,000 cubic yards of sediment impounded during dam operation
- Decommissioned in 2006, pond lowered 16’ in 2007 due to limited spillway capacity
- 300,000 cubic yards of sediment managed during dam removal
- 1.8 miles of river restored, average river width of 60’ and floodplain width of 40’
- Stabilization of 5 connecting creeks involving combination of wetland enhancement and placement of fieldstone, instream wood, fords and culvert
- 138 log piles, 214 logs, and 171 logs with intact roots placed for instream habitat and streambank protection
- 280’ of coconut fiber logs and 520’ whole tree revetments installed along base of streambanks
- 50 habitat boulders placed to break up river current and provide habitat
- 2,274 linear feet of fabric encapsulated soil (FES) lifts installed up and downstream of Robbins Bridge for streambank protection near this important infrastructure
- Added partners of AECOM and InterFluve (design), and Michels, Cardno, and Kanouse Outdoor Restoration (construction)



The river was returned to its original channel flowing under the new Robbins Bridge on Cass Rd. (Oct. 2019)

Photo provided by Jim Anderson

The Boardman Dam impoundment. Note the powerhouse and dam, called the core wall, are separate structures. (October 2016)

Logs and intact roots are recessed into streambanks and secured to the stream bottom to provide habitat and strengthen outside bends. (June 2017)

Gravity-fed siphons lowered the impoundment 21’ and an auxiliary spillway (left) drained the remaining water so the siphons could be removed and the river channel built in their place. (July 2017)

Sabin Dam Removal

Sabin Dam supported the smallest impoundment at 35 acres, but it was the most sediment laden and as a result, very shallow. A construction highlight was that the concrete spillway was deemed strong enough to handle the flows of the draw down while being demolished in 1' increments. This allowed for the adjacent powerhouse to be removed and the stream channel built in its place.

When Sabin Dam was built in the early 1900s, the river was also dredged, straightened, and lowered 8' down for 4,200' downstream. To address this challenge, project engineers had to redesign the river channel at the former powerhouse site with different sized stone and substrates to bring the river bottom back up to a proper elevation. Logs, intact root stumps, and fabric encapsulated soil lifts comprised the new streambanks to create stability in this steep section.

Both Boardman and Sabin Dam project areas are within the 505-acre Grand Traverse Natural Education Reserve owned by Grand Traverse County. Complete with the Boardman River Nature Center, the area offers expanded hiking and biking trails, and boat access sites, providing year-round outdoor recreation and education opportunities for the community.

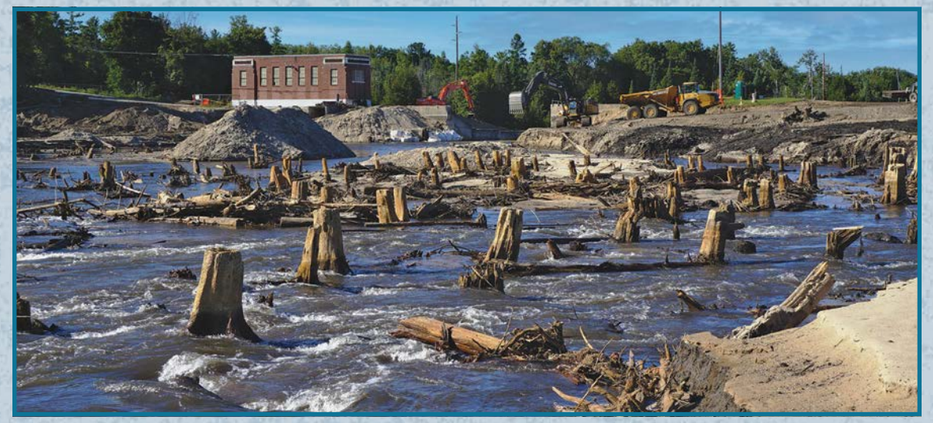
HIGHLIGHTS:

- Location: N 44.707836, W 86.054106
- River Mile 5.3
- Owner: Grand Traverse County
- Cost: $6M for design and construction
- Dam built in 1906 and repaired/rebuilt in 1914 and 1930
- Dam removal in 2018
- Dam height of 21' with a head of 20'
- Dam length of 340' long earthen embankment comprised of fill, with a brick powerhouse and concrete spillway
- Impoundment 35 acres
- Drainage area of 268 square miles
- 322,000 cubic yards of sediment impounded during dam operation
- Decommissioned in 2006, pond lowered 4' in 2011 due to limited spillway capacity
- 122,316 cubic yards sediment managed
- .8 mile of river daylighted and restored, average river width of 60' and floodpain width of 40'
- 1,800' of fabric encapsulated soil (FES) lifts placed for streambank protection
- 152 log piles, 211 logs, and 370 logs with roots intact placed for instream habitat and streambank protection
- 410' whole tree revetments installed along base of streambanks
- 100 habitat boulders placed to break up river current and provide habitat
- 3 snake hibernacula constructed in adjacent upland areas utilizing broken concrete from site
- Stabilization of 4 connecting creeks involving creation of wildlife open water habitat, and placement of fieldstone, instream wood and foot bridges
- AECOM and InterFluve (design), and JobSite Services and M.J. VanDamme (construction)

The river flows freely through the 505-acre Grand Traverse Natural Education Reserve. (October 2019)

Photo provided by John Russell

Underneath Sabin's impoundment were years of accumulated sand and sediment. All sediment was kept on-site and smoothed into adjacent upland areas outside of the river channel and its floodplain. (October 2012)



Preserved underwater for over 100 years, tree stumps remind us of the forest that once was before the dams were built. (August 2018)

Native trees and shrubs were planted along the river. (October 2020)

Native grasses and wildflowers stabilize soils and provide habitat for bees and butterflies. (August 2020)

Monitoring

"We forget that the water cycle and the life cycle are one."- Jacques Yves Cousteau

With the rebirth of the river also comes the interconnectedness of the life that inhabits it. Water temperatures downstream of the former dams have returned to normal, gravel beds abound, and streambanks are getting rooted with new trees, shrubs, and plants. Wildlife, aquatic insects, and fish species are rebounding in the newly restored stream reaches and adjacent uplands.

Exploration of all these dynamics included studying the aquatic insects, fish, herpetological species, and stream channel. Control of invasive plant-tree-shrub species, native tree and shrub planting, and incorporation of instream wood have rounded out the post-care of the river. As the river heals, the *Boardman River Watershed Prosperity Plan (https://www.gtbay.org)* becomes the roadmap for community partners to manage the watershed in its entirety.

HIGHLIGHTS:

- **The Au Sable Institute of Environmental Studies** conducted aquatic insect surveys for all 3 dam sites from 2011 to 2020 at 16 locations. Overall, a remarkable variety of mayflies, stoneflies and caddisflies were found indicating a strong stream recovery. The overall density of insects continues to increase with time as a forested river corridor gradually returns and provides fallen leaves and branches for food and habitat. Unfortunately, the invasive New Zealand Mud Snail has taken hold in the Boardman River but the data collected for it can be utilized in potential future studies of how this snail impacts river health.

- **The Michigan Department of Natural Resources Fisheries Division** surveyed 1,000 feet of river downstream of Brown Bridge Road in 1985-1987, 1994, 2005, 2010, 2012-19 and 2021. Only trout species were collected to calculate population estimates. Based on the 2010 population estimate, 6 Brook Trout were estimated to inhabit the 1,000-foot reach of stream, while the 2019 survey estimated 184 Brook Trout. This reflects a nearly 3,000% increase in Brook Trout abundance from 2010 to 2019. Conversely, 344 Brown Trout were estimated to inhabit the same stretch in 2010 and then 250 in 2019, a 27.35% decrease. The dramatic shift in numbers of Brook Trout is most likely attributed to the return to colder water temperatures following the removal of Brown Bridge Dam and its warm impoundment.

- **Herpetological Resource & Management, LLC** conducted reptile (snakes and turtles) and amphibian (frogs and salamander) assessments of the Boardman River collectively from Lone Pine Trailhead to South Airport Road in 2016, 2017 and 2020. In total, 8 species of reptiles and 7 species of amphibians were found. This included a juvenile State protected Fowler's Toad, meaning there is natural reproduction in the area. Historical data combined with the newly restored habitat create conditions that could support 10 more species of amphibians and reptiles. Riverine complexes throughout the Great Lakes region provide critical habitat to a range of herpetofauna and other wildlife species. Dams create physical barriers to amphibian and reptile movements and fragment populations, which can lead to decreased genetic diversity and overall lower population fitness.

- **Grand Traverse Band of Ottawa and Chippewa Indians** contracted with Stream Mechanics to monitor stream channel development at the former Boardman and Sabin dam sites with MDNR grant funding from 2018 through 2021. The stream channel, gravel beds, pools, floodplains, riparian vegetation, and instream wood were measured and documented in certain locations. General observations include that the channel is functioning and still adjusting while the streambanks become more rooted with plant and tree life.

Scientists measure the river depth and width to assess how it is evolving since the dam removals. (August 2021)

Eastern Garter Snake (Thamnophis sirtalis)

Northern Leopard Frog (Rana pipiens)

Brown Trout (Salmo trutta)

Giant Stonefly (Pteronarcys species)

THE BOARDMAN
A RIVER REBORN

This endeavor was a success thanks to the help of more than 40 partners and $25M in funding and local match.
Thank you for restoring the Boardman-Ottaway River!

Conservation Resource Alliance

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www.rivercare.org | www.theboardman.org