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The Water Issue



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Built in 1850, the Cass River Dam was demolished as part of the Frankenmuth Fish Passage project. PHOTO BY MATTHEW MATTESON, CTI AND ASSOCIATES INC.

Where a Dam Ran Through It

In Saginaw County, Mich., a multi-year effort to remove a 165-year-old dam and build a new fish passage has returned the Cass River back to nature.

By Matthew S. Matteson, EIT, GIT, M.S.A.M.E.

The Cass River is one of the most important rivers in the State of Michigan. Located in the Saginaw Bay watershed, which spans 908-mi² and is home to more than 90 fish species and 1.4 million residents, the river historically played a critical role in settling new communities, transporting materials, and trading with the Chippewa who had also settled along the river.

In the 1840s, Lutherans under the guidance of a pastor named Wilhelm Loehe in Bavaria, settled in the area in an effort to support German pioneers already in the Midwest and to introduce Christianity to Native Americans. They found a swath of

680-acres of Indian Reservation land for sale along the Cass and began to build what would become the “Little Bavaria” of the United States. The town turned to the river as a source of primitive hydraulic power via a water wheel to power both milling and logging operations that continued up into the mid-20th century. This innovation, however, would come at a price.

By building a dam near the mouth of the Cass River, the settlers inadvertently blocked nearly 73-mi of spawning grounds to fish unable to jump the dam. Occasionally, floods would allow sturgeon, walleye and other migrating non-jumping fish to bypass the structure. But as the dam continued to grow to serve its community so too did the likelihood of fish not being able to progress upstream. In 1915, upstream fishing became so affected that residents petitioned its removal. It was not until 100 years later that they received their wish.

COST-SHARE FUNDING

With a 35 percent non-federal sponsorship provided by businesses, grants, and

private investors, the City of Frankenmuth partnered with the Detroit District of the U.S. Army Corps of Engineers (USACE) in what would be one of the largest fish passages ever built in the Midwest. The work included demolition of a 235-ft wide concrete and timber dam measuring 13-ft in height, and installation of a new, eco-friendly rock ramp designed to create an easily navigable slope for fish with a natural rapids imitation. The project was authorized under the Great Lakes Fishery and Ecosystem Restoration Program, with some of the federal funds coming from the Great Lake Restoration Initiative.

Under contract to USACE, CTI and Associates Inc.—headquartered in Novi, Mich.—received notice to proceed on the Frankenmuth Fish Passage project in September 2014. Initial work focused on preparing the project for the following year. An adjacent golf course driving range, owned by one of the project sponsors, was excavated to provide flood plain equalization for the materials that would be used in the river project. Levee repairs



Completed in October 2015, the Frankenmuth Fish Passage has opened up 73-mi of additional spawning grounds along the Cass River that were previously only available during flood conditions.

PHOTO BY CRAIG NEWHOUSE, HOVERCAMLS LLC

also were performed to enhance the city's flood protection program. Stone to be used in constructing the fish passage was delivered daily and sample loads of weir stones measuring 3-ft by 3-ft by 3-ft and 5-ft by 4-ft by 3-ft were delivered to the site for inspection and evaluation. These large weir stones would become the foundation and hydraulic barrier that later formed the 14-weir long fish passage. All stone used in the project was 100 percent Michigan limestone, blasted from a northern Michigan quarry using project-designed blasting measures to achieve consistent dimensioning of stones within the project tolerances.

CTT's quality control engineer worked to inspect all rocks to ensure the blasted stones did not exhibit characteristics that would be detrimental to the project's success.

SCHEDULING CONSTRUCTION

The project was scheduled strategically so that the balance of the fish passage work would be done in the summer of 2015 to coincide with the historical low-flow conditions of the river. Stone deliveries and staging continued in June 2015 with each weir stone individually inspected upon delivery to assure adherence to strict design specifications. Construction of the haul road began in July along the south river embankment, followed by commencement of the in-river work with placement of over 6,000-T of recycled concrete into a deep scour hole that formed over many years at the base of the dam. To assure that work in the river was safe for the fish, wildlife and the environment, even in the event of a broken hydraulic line, all heavy equipment

had fully purged hydraulic lines that were filled with EcoTerra vegetable-based hydraulic oil. Equipment was inspected daily before entering the river to ensure that fluids were at proper levels, alarms and safeguards were in proper working condition, and that no leaks were present.

Placement of the rock ramp base material followed, which comprised more than 10,000-T of 2-ft diameter stones blended with small riprap at a grade of 3 percent. Each weir placed over the ramp stone base consisted of a 3-ft diameter "footer" stone and a 5-ft diameter "header" stone with individual stone weights exceeding 10,000-lb. The weirs were built with very tight survey tolerances. Each stone was placed individually to form an arch configuration that spanned the full width of the river to



serve as the new hydraulic barrier, allowing for the same post-construction river profile upstream that was relied upon for years before demolition of the dam.

The impounded water upstream of the dam had served as a tourist attraction for the operation of the Bavarian Belle Riverboat and Frankenmuth Fun Ships, which was a significant factor in the decision to construct a rock ramp fish passage structure that would meet both economic and ecological goals. Each weir was designed with an open flow gap, which measured approximately 30-ft in width for canoe passage, and additional pool volumes were designed in between the weirs to minimize turbulent flow and to slow the energy of the rushing water. In total, 24,873-T of rock was placed in the river or bank armoring,

encompassing approximately 1.6-acres of the fish passage footprint.

Work was completed on Oct. 6, 2015. CTT's civil construction capability allowed self-performance of over 94 percent of the \$2.5 million contract—resulting in timely completion and effective spending to keep costs low. The Frankenmuth Fish Passage was a great success, and even before removal of the dam, various fish species, minks, and birds of prey were spotted utilizing the new waterway and the pre-existing hydraulic grade of the river was maintained.

A MODEL TO FOLLOW

Not every project can be a perfect partnership. But this one seemed close. Every step—from award through design and construction—serves as an excellent model

of what local, state and federal collaboration is capable of accomplishing.

The City of Frankenmuth and its sponsors worked hand-in-hand with USACE and were actively involved in weekly progress meetings and discussions. As a result, the beautiful tourist town nestled along the Cass River, and home to the largest Christmas store in the world, received a gift of its own: the opening up of 73-mi of additional spawning grounds for more than 90 species of fish, which will provide sustainable economic and ecological benefits to the community and the region.

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