SPECIAL EDITION

KANSAS DAMS

2014

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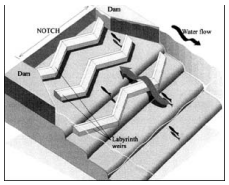
Kansas Department of Agriculture

RETHINKING STREAM OBSTRUCTIONS

Rahway Water Supply in New Jersey fish ladders



Little Falls Dam fish passage in Washington, D.C.

California's Budiselich Dam fishway

Stone fishway in Japan on Nihiyama River

A fish passage variation is the the fish elevator or fish lift. In this design, fish collect at the obstruction base, and then are carried to a release site that empties into the river above the barrier.

Because stream obstructions and dams block movement of migrating fish, communities nationwide have begun incorporating fish passages, also known as fish passes or fish steps, into their dam designs. Not only do these structures allow native fish to travel, they can be built to prevent upstream migration of non-native and invasive fish species. In this relatively new design aspect of dams, engineers draw from hydrology, hydraulics, ecology, and biology to create natural and engineered fishway design and may incorporate dam removal or rehabilitation, stream restoration, and watershed management into the renovation.

Each dam site with its own characteristics determines fish passage design. The U.S. Fish and Wildlife recommends three passage designs: engineered technical fishway, nature-like fishway, or rock ramp. Engineered fishways tend to use concrete or aluminum fish ladders in the Denil design that creates a cascading effect, slowing water velocity to the swimming speed of the desired species; similar to these are narrower steeppass fishway designed to produce different velocites simultaneously. Nature-like fishways provide a smaller bypass stream around a dam while rock ramps cover a channels' widths providing a ramp area in low head dam situations.

Pacific Northwest fish ladder

For example, the Bureau of Reclamation built the 900-foot-long Price-Stubb Fish passage on the Colorado River that consists of 190 concrete cylinders. At the Little Falls Dam fish passage on the Potomac River outside of Washington, D.C., the notched passage with an incline plane and labyrinth design had to allow fish migration as well as boater use. The design also had ensure sufficient water storage behind the dam. In California, the Budiselich Flashboard Dam Fish Passage Improvement Project designed to allow fall-run Chinook salmon and steelhead upstream migration consisted of seven arched, buried boulder weirs a rock ramp.

While most fish ladders have been built for salmon and trout on the coasts, Kansas recently has had a fish passage built to accommodate native species. This passage was part of the 2011-2013 dam rehabilitation done by the city of Wichita. The need to encourage native species is great, according to James Larson, aquatic ecologist, Kansas Department of Wildlife Parks and Tourism, who asserted in a Kansas Chapter American Fisheries Society newsletter, that 80 percent of species listed as threatened or endangered in the state of Kansas are aquatic. One reason for their declines, he said, is the fragmentation of streams by barriers such as impoundments and low-water crossings. In response, the KDWPT has been identifying and mapping in-stream barriers to aquatic organism passage and working to eliminate barriers. Currently, KDWPT is focusing on the removal of low-head dams in the Neosho River with assistance from the Fish and Wildlife Service and the Watershed Institute.

FISH PASSAGES DATE TO EARLY KANSAS LAWS

Kansas' first fish commisioner worked to ensure the incorporation of fish passages into river dams to provide for the "cheapest food that can be raised: fish"

The Kansas Department of Wildlife Parks and Tourism has begun a program to remove barriers to aquatic organism passage starting with Correll lowhead dam on the Neosho River, which no longer serves its intended use. This program's goal is one that dates back to early Kansas when enterprising settlers founded communities along rivers at sites where diverted water could drive machinery to grind grain, cut wood, produce textiles, and produce other goods.

Legislators of the time cognizant of the need for river dams also wanted to protect the fish in those rivers. So they enacted a law saying "Any person or company owning or operating a dam on any of the streams of the State of Kansas, shall, within one year after the passage of this act, construct a fish-way that will permit all kinds of fish to pass up the stream, except in cases where, in the opinion of the Commissioner, such dam will permit the passage of the fish."

State fish commissioner D. B. Long, a fishway promoter and appointed in 1877, viewed fish as an agricultural product, one that "was the cheapest food that can be raised" and "could feed the people of the State," as printed in the Dec. 5, 1878 Ellsworth Reporter.

He wrote in his 1878 report "The large territory comprising the State of Kansas, larger than all the New England States, with its long streams and numerous branches, gives to the fish culturist a vast field for labor.

"It requires time, patience, perseverance and money—with which there is no doubt of ultimate success in stocking our streams with a better variety of fish. Although an experiment to the people of Kansas, it is a reality to the people of the Old World. Fish farming has been in practice for over 2,000 years in China."

His efforts stocking Kansas rivers and streams with shad, salmon, and German carp (a soon-realized mistake) were thwarted by the many lowhead dams built for hydropower and their owners who didn't know how to build fish passages, disregarded legislation, or built "some of which might answer the purpose if the fish had wings," Long wrote in the state's biennial reports to the State Board of Agriculture.

"The law requires that the owners of dams must construct fish-ways over their dams, that will permit fish to pass up the stream. The great question is, how is it to be done? Many have complied with the law, or think they have and others are willing, but do not know how. In many cases they have written to me, and in many more cases, the citizens have petitioned me to compel owners of dams to construct fish-ways."

In 1881, Long wrote stream obstructions such as dams had resulted in fish depletion. The non-implementation of fishways vexed him but he thought it best to first use persuasion than prosecution because enforcement would take too much time.

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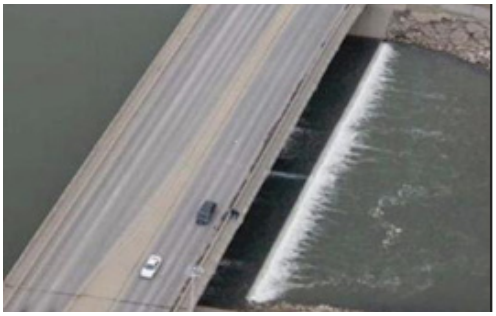
The solution, he thought was to copy exemplary models, which he hoped the Kansas Legislature would provide to counties—" and then I believe there will be no difficulty or annoyance in the future, and our finny tribes will follow their instinct and go the head-waters of the streams to deposit."

Long also thought plans that "embrace cheapness and durability, and should not interfere with the use of the water for power" should be given to owners of dams, acceding that some dams didn't require fish-ways when they were of the "rip-rap" style with little perpendicular fall. Another solution, he wrote, would be to have standard fish-way fund to pay for the right to use the river.

Lincoln Street Dam and Fish Passage

Built by Mo-Pacific Railroad in 1922 by 100 men and 40 horse team, the dam had a 40' intake tower. Later the reservoir was used for recreation and has its own Facebook site: I Swam in Barton Lake

The Division of Water Resources issued water structures permits for the $13.7 million innovative project to replace the Lincoln Street Bridge and dam in the main channel of the Arkansas River.



Connected to the aging bridge was a dam that would make in-place structural rehabilitation of both the bridge and the dam more difficult and expensive.

The DWR-approved design, by MKEC Engineering Consultants, Inc., relocated the dam a short distance downstream from the bridge.

DWR's permit process, under the Obstructions in Streams Act and Water Projects Environmental Coordination Act, examined criteria to prevent the project from reducing the stream channel's flow capacity or increasing flooding.

The permit review also gave other state agencies opportunity to analyze the project for environmental impacts. Another DWR permit required was for water appropriation stored behind the dam.

Photographs to the right show construction during the summer of 2012 after the city of Wichita decided to replace the deteriorating 1970 bridge, relocate the dam, and incorporate a boat passage and fishway into the project.

DWR Water Structures Program File Notes

Sedgwick County. . .*permit conditions include: minimizing turbidity during construction with the use of silt curtains, maintaining river flows, completing construction in one year to protect spawning dates of five threatened and endangered species, constructing a fishway based on specified designs and criteria in conjunction with USFWS and KDWP to offset the impacts of the project, removing all materials from the old structures to the existing river bed, and following the construction schedule specified in the construction plan sheets. Included in the Action Permit are the Performance Ctandards for the fishway that were previously provided to all parties.*



The city decided to replace the deteriorating 1970 bridge, relocate the dam, and incorporate a boat passage and fishway into the project.

Made of steel and concrete, the new dam was designed to employ four, bottom-hinged gates that allow water to pass over the top. The gates impounding more than 50 acre-feet of water in the flat river channel are supported on a concrete substructure.

They operate with automated hydraulic equipment and sensors to compare upstream river elevation data with current gate elevation to maintain the upstream water elevation at 1,284.5 feet. In addition, a manual mode allows for elevation adjustment, and a bypass mode lets operators lower the gates if the hydraulic system fails.

To enhance river use and eliminate portaging, a boat passage was designed for recreational watercraft to travel through relatively calm pools connected by short stretches of faster water. Reinforced concrete weirs furnish this smoother passage over each drop. Their design incorporates University of Illinois research at the Ven Te Chow Laboratory that evaluated hydraulic jump conditions to optimize boater safety over a wide range of Arkansas River flow rates.

Boaters, canoeists and kayakers approaching the dam will receive warning by 4-foot by 7-foot signs on each river bank. These signs will be 1,500 feet and 500 feet upstream from the dam with additional signage on the dam and also the service and maintenance bridge atop the dam's concrete piers.

Inaccessible to the public, the maintenance bridge is behind an 8-foot high fence and locked gate. Adjacent river banks stabilized with concrete retaining walls transition to earthen river bank protected by rip-rap.

Built into the boat passage is a modified Dutch pool and orifice fish pass that incorporates two sets of removable orifices designed to create custom flow conditions. Fisheries managers can change orifices and allow larger fish to pass upstream on one side, while providing protected passage for smaller, threatened and endangered species on the other side. Of primary concern are small chubs and darters that aren't particularly strong swimmers.

In 2012, the fish ladder and boat pass eroded and cracks formed in the concrete structure, which was repaired. Heavy rains and raising the Arkansas River for the Wichita River Festival were suspected damage causes.

Watching the Rivers

Restoring river reaches with fish passages encompasses tracking aquatic populations both above and below the dam.

When discussion began regarding the Lincoln Street Bridge and dam, the Kansas Department of Wildlife Parks and Tourism advocated for a fish passage in the dam replacement as part of its habitat-enhancing efforts.

"The bridge system was built when environmental effects were not fully considered," said Jessica Mounts, district fisheries biologist, Kansas Department of Wildlife, Parks, and Tourism. "I've been involved in the bridge project since the beginning because my job is making sure there are places for people to go fishing and there are fish for people to catch. It's a popular fishing place because a lot of big fish stack up under the dam."

About the downstream dam, Mounts said: "The passage is a system of large weirs going down that create a swell and a dip. On the sides is a fish ladder, which is a system of little blocks all lined up with little holes underneath at different levels to try to allow for the most wide range of fish species to use. The passage also has a clearance for human-propelled boats."

"Our river is home to several fish species that require the river to have long reaches of continuous flow. As we all know, the dams break up that continuity. Many fish species that are affected by this have seasonal migrations up and down the river system to reproduce and feed."

Some fish swim upstream to lay their eggs. Others move downstream in search of food. A few have eggs that float in the current along with their food source until they are big enough to swim on their own. Many of these native river fish eggs hatch within 24-48 hours. The newly-hatched young stay within the river current and follow its food. The movements up and down the river increase the chances of survival of the entire species in the river's ecosystem.

Jessica Mounts, Wichita, said, "There's going to be some opportunity for user conflict that we are going to have to work out like the catfisherman with humongous poles and strong fishing line fishing for large catch fish aren't going to be best friends with the guy going down the Arkansas River in his canoe. Ultimately, recreation on river is important to the city and me personally. Public support for project has been strong, and these projects will make the rivers more important part of our urban landscape and promote its healthy use."

"The bottom line," Mount said, "is the fish passage makes the river a healthier place. Without restoring these long reaches of river systems, many of these fish could be gone forever."

Since 2000, KDWPT staff have been tracking fish species above and below the dam using electric fishing and seining. In 2012, they identified 20,0000 individual fish and found improved biodiversity below dam.

While on the fish passage in May 2012, Mount said she saw several small species, "tiny little fish hiding out behind bars," and was optimistic about the passage."

She also noted that studies will be done to gauge the passage's efficacy. For instance, they will look at migrating predatory mortalities because "not only are the small prey fish moving, in the middle part of ladder, predatory fish — striped bass hybrids, catfish species, gar — move, too."

"We want to know how we are affecting biodiversity above and below and compare to historical data and making sure we are not creating a worse situation."

Some monitoring of the 35 to 40 expected fish species will be done with PIT — Passive Integrated Transponder — tags implanted via injection into Arkansas River fish.

"We can't track location or migratory patterns or how far it swims but we will get a blip if the fish swims by. We'll know: Did fish pass this spot or not?"

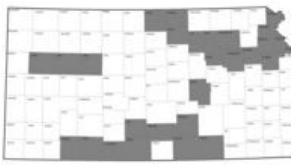
DWR Water Structures Program File Notes

KDWPT Performance Criteria for Lincoln Street Dam

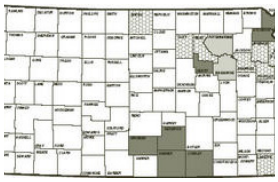
The entrance of the fishway will allow the target species to access the structure during different flow regimes, and velocities through the slots will allow the target species to navigate the fishway during each annual cycle regardless of flow conditions, particularly during the spawning season from April 1 - August 31. The substrate of the fishway will contain various sizes of gravel/cobble< 64 mm in diameter pressed into the concrete that are similar to the natural stream bed of the river. Fish community monitoring will take place for three consecutive years and should include documenting the fish communities above, below, and within the fishway. In addition, quarterly sampling should take place to monitor individual species use. Long-term maintenance will be required to keep the fishway functional. This includes keeping it free of material such as woody debris that would impede fish movement. Its entrance would maintain contact with the river bed and be allowed to scour around it, which would prevent fish access to the entry.

ARKANSAS RIVER POPULATIONS OF CONCERN

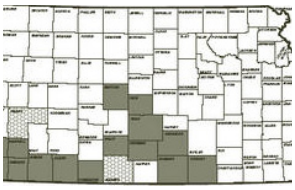
The Kansas Nongame and Endangered Species Conservation Act of 1975 requires KDWPT to identify and undertake appropriate conservation measures for listed species, including these five in the Arkansas River.



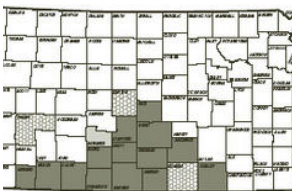
Plains Minnow (Hybognathus placitus): A species that feeds on microscopic plants at the bottom of rivers, it used to be common bait fish but numbers have declined the last 30 years. This minnow needs high flows during the summer to trigger spawning.



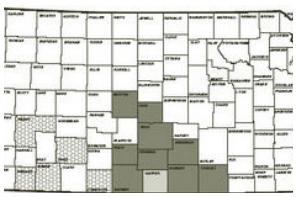
Silver Chub (Macrhybopsis storeriana): Of large, sandy rivers, this 3-inch fish can grow up to 6 inches in size. With a blunt, rounded snout and mustache like a catfish, it lives on or near bottom of a stream and once was common in the Kansas and Missouri rivers, but now is rarely seen.



Arkansas River Shiner (Notropis girardi): Less than 2 inches, this straw-colored fish with silvery sides requires flood flows to successfully spawn because eggs must float downstream. The shiner used to be found the entire length of the Arkansas River, but is n only a few places now because of reduced flows.



Arkansas Darter (Etheostoma cragini): A cousin to the perch, darters prefer shallow, clear, flowing water with sandy bottoms and are found near shore in vegetative cover The olive-brown small fish is localized in its southern Kansas range but common where it occurs.



Arkansas River Speckled Chub (Macrhybopsis tetranema): About 2 3/4 inches when grown, the “peppered” chub named for its dotted body is found in shallow, sandy channels and likes swift currents in the lower Arkansas River and tributaries. It depends on quickly rising water of spring rains for successful hatches.

Information and photographs on this page from Kansas Wildlife Parks and Tourism

GREATER GOOD: SAYING "NO" TO A FISH PASSAGE

Invasive species can red-light plans to install a fish passage at a dam location

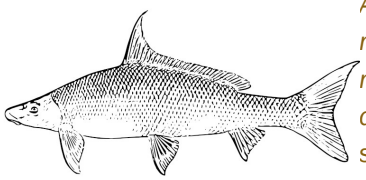
While money may be available, sometimes a fish passage isn't feasible. For example, in Lawrence, owners of Bowersock Dam wanted to install a way for fish to swim upstream. However, the dam blocks Asian carp, an invasive species that crowds out other fish, endangers boaters with its jumping, and takes over an area's vegetation. In this situation, the Kansas River barrier protects the downstream area. Therefore, while Bowersock Dam owners wanted to install a passage and had funding, the negative environmental impacts outweighed the passage's benefits.

Because state of Kansas statutes charge Water Structures in the Division of Water Resources to administer a permit program, installing a fish passage is a modification that DWR would need to approve as the state permitting entity monitoring water structures' design and impact. Other state agencies, too, would monitor impact.

Low Impact Hydropower Institute File Notes

May 5, 2009: Thank you for the opportunity to comment on the re-certification of Bowersock's operations as Low Impact Hydropower Project. Like all impoundments the many benefits of Bowersock dam must be weighed against potential negative environmental impacts. To date, potential environmental impacts of Bowersock have primarily centered on aquatic organism passage. In 2004, the Department recommended against installing a fish passage structure on Bowersock Dam due to concerns that the potential movement of invasive species (specifically species of Asiatic carp) upstream would be more detrimental than the potential benefits derived for native species. This recommendation was based on conversations with other state and federal agencies, as well as experts in the state and elsewhere.

Since 2004, discussions regarding fish passage on the Kansas River have continued among parties interested in the health of the Kansas River fish community. Based on these discussions, there appears to be increasing evidence that Bowersock does not function as a complete barrier to non-native organism passage as evidenced by the continued presence of Asiatic carp upstream of the dam. In addition, although the dam may not prevent all aquatic organism passage, it may obstruct movement of some native species sufficiently to prevent adequate distribution and reproduction within the river. For example, seasonally large numbers of migratory Blue Suckers (Cycleptus elongates) tend to occur immediately below Bowersock. At this time, the Department is not recommending construction of a fish passage structure in association with Bowersock Dam because sufficient information regarding benefits and detriments of such an action is not available. However, we hope that results of on-going and planned research will provide the information necessary to make an informed decision in the near future. If this new information indicates the dam does not present the spread of non-native species upstream and may hinder recovery of Threatened or Endangered species, the Department would recommend that a fish passage structure be considered for installation. J. Michael Hayden, Secretary, Kansas Department of Wildlife and Parks



ROAD CROSSINGS AND FISH PASSAGES

Why did the fish cross the road? To get to the other side.

When thinking of fish habitat, people don't think of the road crossings that block small, native freshwater fishes from traveling on small streams.

In recent years, for example, the U.S. Fish and Wildlife Service assessed Kansas road crossing structures in the West Branch Mill Creek Watershed and found nearly 50 percent of surveyed road crossings were likely impassable for small, native freshwater fishes.

These fish included the Topeka shiner (Notropis topeka), the small fish that lives in small to mid-size prairie streams and has been declining in numbers because of habitat destruction, sedimentation, changes in water quality, and impoundments.

Impacts of Road Crossings on Prairie Stream (Kansas Cooperative Fish and Wildlife Research Unit) Fishes: Inappropriate road-stream crossings may prohibit the movement of stream fishes by creating physical or behavioral barriers. Impeding the natural migrations of these fish can result in negative impacts including reductions in species abundance and diversity, loss of genetic diversity, habitat fragmentation, and species extirpation. A mark-recapture study was conducted to evaluate fish passage through three types of vehicle crossings located on streams that contain federally endangered Topeka shiners (topeka) in the Flint Hills of Northeast Kansas. We tested passage through five concrete box culverts, five low-water crossings (concrete slabs vented by one or multiple culverts), and two single corrugated culverts. In addition, each site had a control reach where fish were marked below a natural barrier in the same stream allowing movement patterns to be compared between control and road crossing reaches for each site.

A total of 6,539 fish including 192 Topeka shiners were marked in April and May 2007 and 723 (11.1%) were recaptured in June, July, and August 2007. Fish passage occurred at all crossing types. However, Topeka shiner passage was observed only through box culverts and corrugated culverts.

Of the recaptured fish, upstream movement was higher at controls than at crossing reaches (19.1%) for low-water crossings. There was no difference in the proportion of fish that moved upstream, compared to control reaches, at box culverts or corrugated culverts. These results suggest that crossing type affects the degree of fish passage, with low-water crossings having the greatest impact. Use of properly designed and installed crossing structures has great promise in conserving critical stream habitat, preserving native fish communities and aiding recovery of the Topeka shiner.

Topeka Shiners are protected by the Kansas Nongame and Endangered Species Conservation Act, the Federal Endangered Species Act, and state and federal regulations applicable to those acts

The Kansas Obstructions in Streams Act requires prior approval from the chief engineer to construct stream obstructions, including culverts, to ensure construction is done according to engineering criteria designed to protect lives and property from structural failure, erosion, and flooding.

The Division of Water Resources also requires culverts to have a permit for modifications. The Application for General Permit: Bridge or Culvert Replacement Project can be used and has a worksheet to determine eligibility determination. If the project qualifies, applicants can use the shorter general permit rather than the standard Form 2-100, Application for Permit: Dams, Stream Obstructions, and Channel Changes. Contact 785-296-2933 or WaterStructures@kda.ks.gov for more information.