8-8-03

THE STURGEON RIVER PROJECT: A CASE STUDY

by

Lee Emery

Fishery Biologist
Office of Energy Projects
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

INTRODUCTION[1]

FERC regulates, under the authority of the Federal Power Act, the licensing of over 1,600 non-federal hydropower projects located across the United States. You are familiar with these projects because they are in your backyard, so to speak, and produce the power used in many of your homes, even more so, if you are a resident of the Pacific Northwest. These projects include the mom-and-pop operations as well as the larger municipal and public utility district operations. Between 2000 and the year 2010 the licenses for 218 hydropower projects will expire. So, in the next few years, the licensees of these projects will have to decide whether they want to relicense their projects.

DAM REMOVALS

A licensee may seek to surrender its project license during the term of the license or at relicensing, if itself or no other entity is interested in seeking a new license. When a license is surrendered, there are several options for disposition of project facilities. The licensee can: (1) quit generating power, lock the gate and ensure the project is safe and secure; (2) leave the dam in place and remove all generating equipment and block all power intakes; and (3) remove the dam and all project facilities. The dam removal option is seldom the option selected, but it has and does occur, particularly if the project is very old and is uneconomical to continue operating and maintaining. However, as noted, even with the surrender of a license, dam removal is not always part of decommissioning because dams provide other valuable public interest benefits such as flood control, water supply, recreation, irrigation, navigation, and valuable waterfront properties. In fact, to date, where dams have been removed under decommissioning represents less than 1 percent (0.8125 %) of all projects ever licensed.

I conducted a review of all the licenses issued by FERC to see how many dams had been purposefully removed or were proposed for removal. I want to stress that those projects where dams have been proposed for removal are truly just proposals and they may not ever be removed. I say this because the Commission would have to act on any formal proposal for dam removal once the action is presented to them.

---

[1] Any opinions or views I may offer here or elsewhere in this paper are my own and not those of the Office of Energy Projects, the Federal Energy Regulatory Commission, individual Commissioners, or other members of the Commission staff.

In general, my review found that dams that were removed and proposed for removal were for the most part small, uneconomical projects that had reached a stage where relicensing them was not practical. In some instances, acts of nature, like destruction of the facilities by floods or filling of reservoirs with silt, speeded up the licensee's decision to surrender the licenses. Other factors influencing the decision to decommission the projects range from agreements reached in settlements to operational and environmental costs and concerns, particularly those related to the need to provide fish passage facilities at the projects. A couple of projects among those proposed for removal were unable to get power purchase agreements and one project is part of an EPA Superfund cleanup site.

To understand considerations that go into decisions on dam removal, I will present a case study of one FERC-licensed dam proposed for and presently undergoing removal.

THE STURGEON PROJECT NO. 2471

The Sturgeon Project is an 800 kilowatt hydropower project located on the Sturgeon River, Dickinson County, in Michigan's Upper Peninsula. The Sturgeon Project was one of 157 FERC-licensed hydropower projects that had licenses expiring by December 31, 1993 (referred to as the Class of '93). The licensee failed to file a timely license application to renew its license with the Commission by the statutory due date. It was the only project from among the 157 projects that did not meet the deadline. The Commission filed notices soliciting license applications for the project from anyone other than the existing licensee. To make a long story short, no other party filed a license application for the project and in January 2001, the Commission approved the surrender request for the license, which included a proposal to remove most of the project works and facilities, including the dam.

The licensee was also seeking to relicense eight other hydropower projects in the same river basin and the surrender of the Sturgeon Project became a part of a settlement that was also approved by the Commission at the same time. The licensee had determined that the project was no longer economically feasible to operate and maintain and the Commission found it was in the best public interest to surrender the project and remove the project facilities (94 FERC ¶ 61,038 (2001). At the same time that the Commission approved a surrender for the project, they also approved a nonpower license for the project to serve as a temporary bridge that allowed the licensee to continue generating power until which time the dam removal terms approved by the Commission are fulfilled to the satisfaction of the Commission. [The licensee will likely cease operating the project in August when the top 1/3 of the dam

will be removed]. The licensee also based its decision to surrender its license for the project on the enhancement of river resources that were part of the settlement agreement. The removal of the dam and facilities would not significantly affect the licensee's ability to meet electrical demand for the area (the power generated at the projects represents less than two-hundreths of one percent of the total energy required to meet the licensee's customers needs).

The Sturgeon Project is the only hydropower project located on the Sturgeon River. The dam is located about 8 miles upstream from the confluence of the Menominee River. The Sturgeon River is a mid-sized stream and one of five major tributaries to the Menominee River. The Sturgeon River has a drainage area of about 305 square miles and the 248-acre project reservoir is known locally as the Bergen Backwaters. There is limited commercial development in the area, extensive forests, (87 percent of the project lands are forested), and existing conditions of the aquatic resources combine to yield high-quality habitat for fish, waterfowl, and upland wildlife that primarily attracts local residents for hunting and fishing. Tourism value of the Sturgeon Project is low. Water quality is generally good in the Sturgeon River and the state classifies the waters within the project boundary as a warm water sport fishery. The dominant fish species captured in the reservoir are yellow perch, rock bass, bluegill, and largemouth bass.

The Sturgeon Project facilities are very similar to other FERC-licensed projects that have undergone dam removal or that have been proposed for removal. The projects where dam removal has occurred had dams with average ages of about 77 years and average dam heights of around 24 feet. The Sturgeon Project dam is 84 years old and 53 feet high. The dam is a concrete arch dam founded on bedrock.

Extensive plans and development have gone into the process of filing with the Commission a surrender of license application with dam removal. The Commission staff, based on its previous experiences with dam removal, also used lessons learned from other projects to develop project-specific measures tailored to the project and its environmental setting, geology, and other concerns. The licensee was authorized to remove the dam under a staged removal plan whereby over a 5-year period water would be drawn down and dam removal would begin in the first year with 1/3 (about 15 feet) removed from the top of the dam, and then consecutively, another 1/3 of the dam in each of the third (15 feet) and fifth years (20 feet). The licensee is authorized to temporarily operate the project for several years while the reservoir is gradually drained, the reservoir bed is stabilized, and most of the project works are removed. Dam removal was initiated in August 2003 and the dam should be completely removed by around 2007.

Now I'm going to discuss some potential benefits to fishery resources that could occur with the removal of the Sturgeon Project dam.

POTENTIAL BENEFITS TO FISHERY RESOURCES

Fish Passage and Recolonization

Fish passage is not a crucial issue at the Sturgeon Project. There are no migratory species that need to get upstream of the Sturgeon Dam to complete their life cycle. However, removal of the dam would allow free movement of resident fish up and downstream of the current dam site. The removal of the Sturgeon Project dam would allow resident fish access to about 39 miles of free-flowing river from its mouth to upstream areas.

Fish recolonization rates and patterns after dam removals appear to be rapid if downstream source populations are available, fish have access to the site, and suitable habitat is available in the reach above the former dam. A small dam on the Baraboo River in southwest Wisconsin (not a FERC Project) showed the number of fish species had doubled in 18 months after removal of a small 9-foot-tall dam (American Rivers, 1999). Catalano's recent Masters Thesis (Catalano, 2002) evaluating fish habitat relations and fish distribution after the removal of four dams on the Baraboo River (not FERC Projects) found rapid recovery of fish to the area and these results would likely be observed at the Sturgeon Project once the dam is removed.

Restoration of the Natural Waterway

Changing River Structure from Lentic to Lotic

Removing dams restores rivers to their natural condition. The river course once inundated by a reservoir, changes from a lentic to a lotic structure. The conversion of the 248-acre reservoir above the Sturgeon Project dam from a lentic to lotic free-flowing stream condition is among the largest reservoirs to undergo that conversion. The Sturgeon reservoir is populated by warmwater species and would be replaced by stream dwelling coolwater fish such as northern pike, walleye, yellow perch, and smallmouth bass once the dam is removed. Basically the exchange would involve the conversion of an impoundment fishery to a riverine fishery. There

would be a loss of lake-based recreational activities such as boating, waterfowl hunting, and ice fishing in the trade-off for natural riverine conditions and fish assemblages and perhaps the development of a new whitewater recreational boating area. The removal of the reservoir would restore a quality, 1,800-foot-long stretch of whitewater rapids (the stream drops 66 feet in height over that distance) that had been inundated for 84 years. This type of habitat is valuable in the Menominee River Basin. The removal of the hydropower project would also benefit fishery resources by eliminating fish entrainment and impingement mortality although there was no evidence to indicate fish mortality was a problem at the project.

Changing Reservoir and Downstream Channel Geomorphology

Dams, even small dams, can have profound effects on riverine habitat and channel form. Dams reduce peak flows as a flood control measure by storing high volumes of inflow in their reservoirs and releasing the flow gradually. Without going into detail and discussing channel evolution models (Simon and Rinaldi, 2000), this rearrangement of flows by dams is a significant change from natural conditions and channel-forming discharges are reduced. The dynamic connections among the various cross-sectional landscapes of the river—its channel, islands, bars, beaches, and floodplains—no longer operate as an integrated system. Thus, dam removal restores the peak flows and returns the dynamic connections among the various parts of the river landscape downstream (The Heinz Center, 2002). It is not guaranteed that the stream will return to the predam channel form, alignment, or grade immediately (Lenhart, 2000), and may never do so. But, the return of the river channel to its natural state is likely to produce more ecological niches for fish than the less complex stream geomorphology with the dam in place.

The geology of the Sturgeon Project area, consisting of Precambrian bedrock of the Canadian Shield, would act to limit any great changes in river or channel form after dam removal. A rocky shoreline dominates the lower half of the reservoir and is not subject to erosion. There are three other areas in the impoundment where bedrock is exposed. However, there is one area immediately upstream of the dam where the river channel would change from a maximum depth of 9 feet to a maximum of between 2 or 3 feet deep and cut a new channel about 20 to 30 feet wide as about 3,000 cubic yards of sand deposited as sediments would be removed.

Changing Water Quality and Quantity (from limited flows to run-of-river)

Typically, dam removal can improve water quality in several ways, but I'm only going to discuss three: (1) going from a no-flow or minimum flow release to natural run-of-river conditions, (2) increases in dissolved oxygen, and (3) returning water temperatures to natural conditions. Large reservoirs can form thermoclines in the summer months leaving cooler less oxygenated waters in the hypolimnion (Wetzel, 1975). This can create a problem when water is released from these lower levels of a reservoir. However, most dam removal studies typically don't concentrate on measuring the effects of dam removal on water temperatures. Obviously, concerns about temperature and dissolved oxygen levels are more of a concern at larger projects, where higher dams and bigger reservoirs are involved. Many of the dams where removal has occurred, are small, low-head dams with small reservoirs, so temperature and dissolved oxygen are not big factors.

For the Sturgeon Project in Michigan, the temperatures and dissolved oxygen levels likely would improve significantly over those recorded in the reservoir prior to removal, especially since there will be recovery of a lengthy whitewater rapids area of the stream. Studies conducted by the licensee show that water temperatures above and below the reservoir were not much different than temperatures in the reservoir. However, dissolved oxygen levels fell below the state standards of 5 milligrams per liter in July and August at depths below 23 feet in the reservoir and similarly, in the tailwater releases from the project during the same months. Dam removal should improve water quality in the project-affected sections of the Sturgeon River and thereby improve conditions for fish and other aquatic resources.

The Sturgeon Project is operated in a run-of-river mode, so problems with no flows or reduced flows are not a concern. There is a short, 240-foot-long bypassed reach with leakage from the dam and input from overflows during high water periods, however fishery habitat is very limited in that reach even if there were additional minimal flows.

Controlling Sedimentation and Siltation During and After Dam Removal

Many dams are considered potential candidates for dam removal if their reservoirs contain large quantities of sediments, particularly those that have become so filled with sediments they no longer serve their intended purpose. The disposition of sediment out of a reservoir in a relatively short time can create a major concern for fish residing in the river or migrating upstream to the dam. Large quantities of sediments in a stream can be detrimental to fish by eroding and clogging gills, suffocating fish, smothering fish nests and eggs, and destroying spawning habitat.

In a recent paper in the Journal of the American Water Resources Association (Doyle, Stanley, and Harbor, 2002), the authors estimated that 33 percent of the sediment stored behind a dam on the Hudson River in New York, moved downstream within the first year of removal. Similarly, these authors estimated that transport of sediments out of 6 other reservoirs identified in their report, ranged from 13 to 80 percent during the first year with the potential for devastating, short-term impacts on fish populations at some projects.

The detailed sediment removal plan for the Sturgeon Project is typical of the right way to remove a dam and control sediments. The licensee calculated the amounts of sediments contained in the reservoir and tested them for contaminants to ensure they were safe for release downstream. Compared to other projects where dams have been removed, the amounts of sediments in the Sturgeon Project reservoir are low. The licensee plans an incremental or staged progressive removal of the dam over a 5-year period with staged, partial drawdowns of the reservoir to assist in consolidating mobile sediments for stabilization and removal. The first drawdown of the reservoir is proposed to be 8 feet, with several years intervening before the next drawdown. If the drawdown rates cause excessive release of sediments into the river, thereby violating state water quality standards, the monitoring of these releases would indicate to the licensee that dredging and disposal of the sediments on upland sites was needed.

The licensee has estimated that using the staged drawdown of the reservoir would not cause the backwater shallow areas of the reservoir to be reflooded, except by events greater than the 10-year storm. The time period between drawdowns would also allow natural vegetation to grow on the exposed reservoir shoreline. In fact, encroachment by existing shoreline forests and woody shrubs into the former backwater wetland areas is expected. There are about 112 acres of wetlands and 27 acres of shrub swamp in the reservoir area. Currently, soil bank erosion is practically nonexistent, with over half of the reservoir having a steep rocky shoreline.

Measures to control the sediments, which are a mixture of sand (46,000 cubic yards) and organic deposits (3,200 cu. yds), are strictly controlled to minimize releases downstream and to control erosion of exposed river banks along the newly formed shoreline within the former reservoir. If incision of the former reservoir channel banks occur during drawdown, then a combination of vegetative plantings and structural components (i.e., stone toe) may be necessary to stabilize banks, but this seems highly unlikely at the Sturgeon reservoir. At the Sturgeon Project, turbidity will be monitored downstream of the dam during the release of sediments

and the recovery of the stream is expected to occur within a short period of time after the dam is removed. The types and quantities of sediments that would be released from the reservoir are expected to have brief effects on water quality and fishery resources.

CONCLUSION

Dam removals can have positive benefits on fishery resources. Recovery of the natural stream system is relatively fast, depending on river flows and the amount and types of sediment that is stored behind the dams. Similarly, recovery of fish populations to the new area is rapid. The best success for recovery of the river and its fishery resources will occur with thorough planning and a step-by-step process of gathering data and assessing various outcome scenarios, including all aspects of whether or not a dam should be removed. Entities considering dam removal should also at a minimum: (1) test the reservoir sediments for the presence of toxic pollutants; (2) determine the volume of sediments upstream of the dam in the reservoir and the potential impacts of the release of the sediments on downstream users and fishery and aquatic resources; (3) investigate potential hazards and blockages that may occur unseen in the reservoir that would become exposed after dam removal; (4) make estimates of any future stream erosion of the former reservoir bed and shoreline; and (5) determine the entities in charge of authorizing any removals and obtain any and all necessary permits and approvals prior to beginning any work.