Aquatic Restoration Through Hydropower Licensing, Bond Falls Project, Michigan

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Hydropower dams and diversions have the potential to alter many watershed and aquatic processes. The effects of multiple dams in a watershed can have negative cumulative effects at a watershed scale. The Federal Energy Regulatory Commission (FERC) originally licensed many hydropower dams in the Midwest US in the 1940s and 1950s, prior to the passage of legislation such as the Federal Power Act, as amended (1986). Today the facilities and operations of many of these hydropower projects are being reexamined as the original licenses expire. License proceedings, administered by FERC, provide an opportunity to gain a better understanding of cumulative effects on watershed processes, and to design measures to protect and restore specific features of the watershed in the future, including instream flows, substrate, channel stability, large wood, and water quality. The relicensing of the Bond Falls Hydroelectric Project on the Ottawa National Forest provided the opportunity for natural resource agencies and others, in conjunction with the licensee, to review the ongoing effects of the project, and to clearly define the resource conditions that the project must maintain or restore in the future. The licensing process was long and contentious with many competing interests. The new license was recently issued based on a negotiated settlement among the interested parties. The settlement provides for an improved flow regime, a mitigation fund to address project-related resource impacts, and a framework for the implementation team to work through issues using an adaptive management approach.

Keywords: *aquatic restoration, hydropower, negotiation, settlement, consensus*

Background

The Bond Falls hydroelectric project is located in the Ontonagon River watershed in the western portion of Michigan's Upper Peninsula (Figure 1). The project affects approximately 250 kilometers of rivers and streams. Eighty-two percent of the rivers and streams affected are a part of the Ottawa National Forest (Figure 2). The Victoria Dam and powerhouse were constructed in 1931 on the West Branch of the Ontonagon River, the same year that the Ottawa National Forest was established. It is a 12.3-megawatt facility, or enough to provide power to about 13,000 residences at full capacity.

In 1937 the Bond Falls reservoir and diversion canal were constructed. The canal diverts water from the Middle Branch of the Ontonagon River to the West Branch via the South Branch, Sucker Creek, Bluff Creek and Roselawn Creek. Dams were constructed at the outlets of two

Figure 1. The Bond Falls Project lies in the Ontonagon River watershed of Michigan's Upper Peninsula.

M Furniss, C Clifton, and K Ronnenberg, eds., 2007. *Advancing the Fundamental Sciences: Proceedings of the Forest Service National Earth Sciences Conference, San Diego, CA, 18-22 October 2004*, PNW-GTR-689, Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

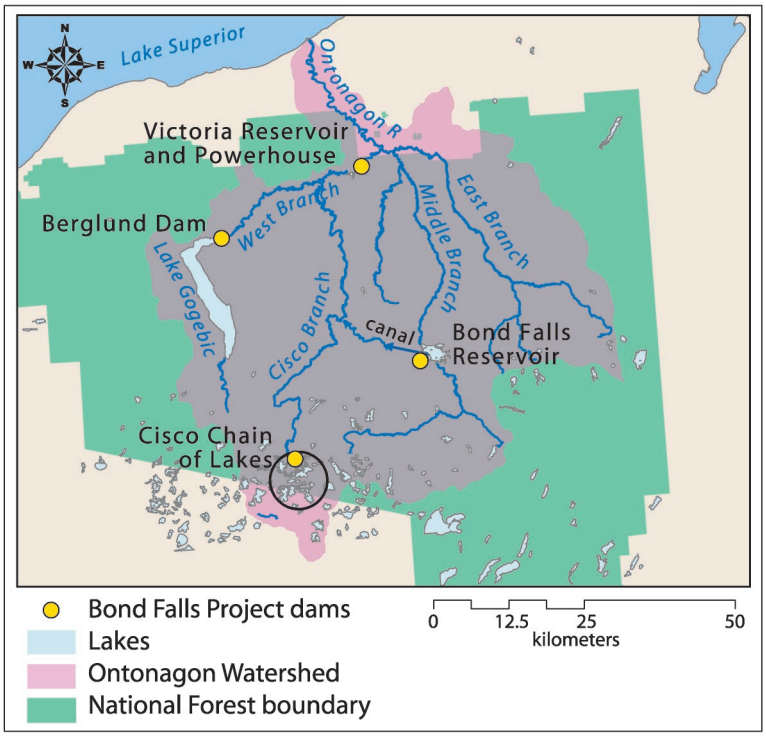


Figure 2. Reservoirs and rivers associated with the Bond Falls hydroelectric project, within the Ottawa National Forest.

other natural lakes, providing additional reservoir storage capacity for hydropower production. The total reservoir storage capacity available for use is 104.5 cubic kilometers. The mean annual daily discharge at the powerhouse is about 24.6 cubic meters per second (cms).

The original license for the project was issued in 1952 for the project for a 50-year term, retroactive to 1939. In 1985 the Federal Energy Regulatory Commission (FERC) initiated the re-licensing of the project by conducting agency and public meetings. Upper Peninsula Power Company (UPPCO) formally applied for a new license in 1987. The original license expired the following year; however, dam safety issues delayed the licensing process for another three years while the Victoria Dam was reconstructed to meet current safety standards, as required by the FERC. In 1992 several segments of rivers affected by the project were designated as recreational or scenic rivers under the Wild and Scenic Rivers Act (P.L. 90-542, as amended). Additional resource studies were conducted from 1992-1995, and the FERC declared that the project was "ready for environmental assessment" in 1996.

Resource agencies and non-governmental organizations (NGOs) recommended license conditions to the FERC that were much different from the way the power company proposed to operate the project. In 1997, the FERC encouraged the interested parties to enter into settlement negotiations in attempt to come to an agreement. The settlement agreement process had been previously used successfully in Michigan on another contentious hydropower project, and the decision was made by all parties to attempt to use a similar process for Bond Falls. The parties included agencies and NGOs that had widely divergent interests (Table 1). The Cisco Chain and Lake Gogebic Riparian associations and North Shore Riparian Owners chose not to participate in the settlement process.

In 1999, after approximately three years of difficult negotiations, the parties had reached a draft settlement. The final settlement was signed the following year, and the FERC developed draft and final environmental impact statements from 2001 to 2002. The license was issued in August of 2003, fifteen years after the original license expired.

Issues

The key issue that the parties needed to resolve was water management. Specific issues included the timing, magnitude and changes in flow rates, and water level elevations in the reservoirs. The power company contended that any changes in the existing water management operations would adversely affect the project economics. Understanding how the components of the project had been historically managed and how resources are affected is critical to understanding the outcome of the negotiated settlement.

Table 1. Parties to the negotiated settlement and their primary interests.

Party	Primary Interest(s)
Cisco Chain Association	Water levels at Cisco Lake
Keweena Bay Tribe	Natural resources, tribal rights
Lake Gogebic Riparian Association	Water levels at Lake Gogebic
Michigan Department of Natural Resources	Fisheries, wildlife, recreation
Michigan Department of Environmental Quality	Water quality
Michigan Hydro Relicensing Coalition	Represented the interests of six conservation non-governmental organizations
North Shore Riparian Owners	Water levels at Lake Gogebic
Upper Peninsula Power Company	Project economics
USDA Forest Service	National resources

Victoria Reservoir, Bypassed Reach of the West Branch, and the Ontonagon River

Victoria Dam is a 13.7-meter high concrete structure, constructed just upstream from a natural waterfall. During its initial licensing period, the powerhouse was operated as a "peaking" facility, with discharges ranging from zero to 22.7 cms on a daily basis. The power plant was operated during periods of peak energy demand, depending on inflows. A flume bypasses 2.6 kilometers of river between the dam and the powerhouse. Because there was no minimum flow requirement for the bypassed reach, it was often dewatered. A reproducing population of the State Threatened and Forest Service Sensitive lake sturgeon (*Acipenser fulvescens*) occurred historically in the river below the project (Schoolcraft 1821). The Michigan Department of Natural Resources has a goal of restoring this population. The waterfall is a migration barrier to fish; therefore, upstream fish passage was not an issue. The bypassed reach is relatively steep with cobble to bolder substrate, potentially suitable spawning habitat for lake sturgeon.

West Branch of the Ontonagon River and Lake Gogebic

Bergland Dam, at the outlet of Lake Gogebic, regulates the water level of the 57 square kilometer lake. The dam has raised the elevation of the natural lake by 1.2 meters. Many private residences surround the lake; a priority under the original license was to maintain a full pool during the summer recreation season. By placing a priority on lake water elevations, the river below the lake would frequently be reduced to leakage flows (about 0.1 cubic meters per second) during the summer resulting in adverse effects on the aquatic system downstream. During the winter UPPCO was allowed to draw down the reservoir 0.6 meters (to be used downstream for hydropower generation) and refill the lake in the spring.

The lake is about 19 km long and oriented approximately north-south. When the lake is at or near full pool and there is a strong wind from the south, waves pound against the north shore contributing to shoreline erosion. North shore residents have complained that they are losing their shoreline and have asked UPPCO to lower the water levels and mitigate the damage by installing erosion control structures. Meanwhile, residents on other portions of the lake said that they would be adversely affected by lower water levels, as lower levels would expose navigation hazards and their docks would be in water that was too shallow for boat access.

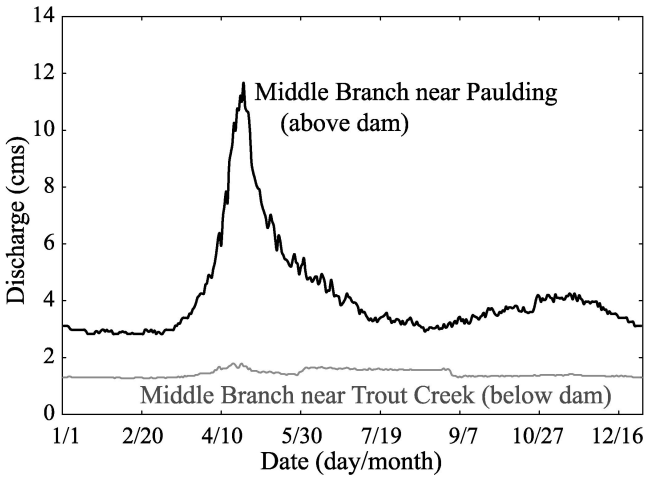
Cisco Chain of Lakes and the Cisco Branch of the Ontonagon River

The Cisco Chain of Lakes consists of about a dozen lakes that are interconnected. The 3.4-meter high dam at the Cisco Lake outlet controls the water level in all lakes. Water levels are very important to the residents on the lakes to provide for navigation between the lakes. Similar to Lake Gogebic, lake water levels took precedence over streamflows in the original license, frequently reducing flows in the Cisco Branch to leakage (about 0.01 cms). During the winter UPPCO would draw down the lakes 0.3 meters to gain 4.9 cubic kilometers of water for power production.

Bond Falls Reservoir, Middle Branch of the Ontonagon, and the Diversion Canal

The Bond Falls Reservoir is a 13.7 m earthfill dam on the Middle Branch of the Ontonagon River, just upstream from Bond Falls. The natural flow of the Middle Branch joins the Ontonagon River downstream from the Victoria powerhouse. Water is diverted through a constructed canal that discharges to tributaries to the South Branch. The

Figure 3. Median of daily mean discharge values upstream (Middle Branch near Paulding) and downstream (Middle Branch near Trout Creek) of Bond Falls Reservoir, 1942-2003.



South Branch joins the West Branch above the Victoria Reservoir. Discharges in the canal varied from zero to 10.8 cubic meters per second (cms). The effects of the diversion on the mean daily flows below the Bond Falls reservoir can be readily observed using data from the upstream and downstream gages (Figure 3). The additional flows in the small tributary streams created tremendous changes in stream channel morphology. Rapid fluctuations in flow eroded streambanks, resulting in an unstable stream system with adverse effects on benthos and fish populations (Taft 1995).

Annual water level fluctuations at the Bond Falls reservoir were as much as 7.3 meters. The reservoir provides habitat for the Federally Threatened bald eagle (*Haliaeetus leucocephalus*). Other species of interest that may be affected by reservoir elevation fluctuations include the State-Threatened and Forest Service Sensitive common loon (*Gavia immer*) and trumpeter swan (*Cygnus buccinator*). The entire assemblage of plant and animal species that depend on the near-shore environment can also be adversely affected by large fluctuations in water levels.

Other Issues

A number of other issues were considered in the negotiation process, including sub-standard recreation facilities, water quality, wildlife habitat, fish passage, fish entrainment, nuisance plants, and woody debris management. Recreation facilities were mostly old and did not meet current standards regarding accessibility or adequacy. Water quality concerns included meeting state standards for dissolved oxygen and temperature below project facilities. Wildlife habitat issues raised included how land and vegetation would be managed around the reservoirs to provide the needed wildlife habitat – particularly old-growth habitat. The Bond Falls Project area provides habitat or potential habitat for 46 threatened, endangered or sensitive species. Upstream fish passage was an issue only at the Bergland and Cisco dams, as the other dams are located directly above natural waterfalls. A fish entrainment study conducted as a part of the licensing process found that about 235,000 fish per year were entrained (drawn into the generating flow) and the turbines killed approximately 71,000 fish (RMC Environmental Services 1996). Resource agencies and NGOs also wanted UPPCO to take responsibility for the prevention, inventory and control of invasive plants (primarily purple loosestrife [*Lythrum salicaria*] and Eurasian watermilfoil [*Myriophyllum spicatum*]). Woody debris management concerns surrounded the fate of debris that accumulated in the reservoirs at the dams that otherwise would have continued to move downstream. Recreation issues, including fishable and boatable rivers, were closely related to the aquatic issues concerning the volume and timing of flows and water levels.

Negotiation and Settlement

The Forest Service formed a small interdisciplinary team to review reports, conduct independent analyses, conduct water quality monitoring, and participate in the negotiations leading to settlement. The Forest Service team included a wildlife biologist, a fisheries biologist, a hydrologist and a recreation specialist. Other agencies and NGOs were more narrowly focused in their interests and generally had only one representative. The power company had a lot at stake in the negotiations and was primarily represented by three to four individuals, including a contracted consultant at some meetings.

The strength of the Forest Service negotiation position stemmed from several laws that had been enacted since the original license was issued. Most notable was the Federal Power Act (FPA), as amended in 1986. Section 4(e) of the FPA allows the Forest Service to condition the license to assure the operations of an existing or proposed hydroelectric project are consistent with the goals established in the Forest Land and Resource Management Plan. The 1986 Ottawa National Forest Plan established many goals related to aquatic and recreation resources that were not being met under the original license (USDA Forest Service 2002).

The negotiations were long and contentious. The parties initially met about every six weeks during the negotiation process. But with little pressure from the FERC and an apparent lack of strong commitment to the process by

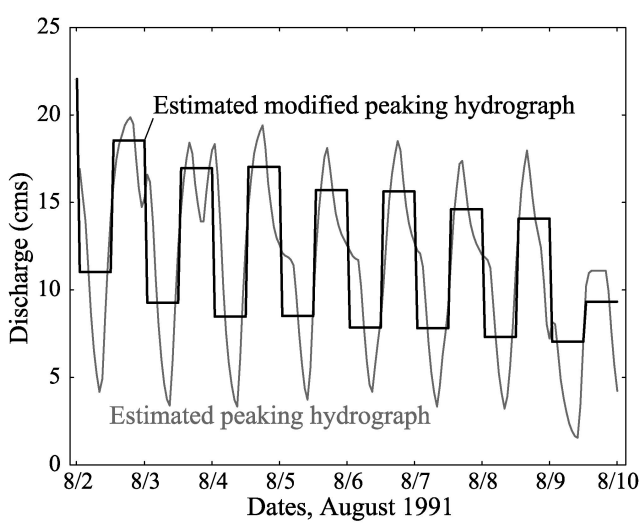
UPPCO, meetings were sometimes cancelled or dates slipped further. With the passage of so much time between meetings, the parties would often have to go back and review everything that was agreed to previously. The process was further delayed after Wisconsin Public Service (WPS) acquired UPPCO in 1998. With the introduction of new faces at the negotiation table, the process slowed as agreements had to be reviewed, explained and discussed again.

The parties tackled the minor issues first, to gain confidence and build trust in each other. They followed an outline that eventually led them to negotiate the most difficult issues – flows and water levels. Flows and water levels were modeled to try out various operating scenarios. Results from the operations model were combined with aquatic habitat modeling to estimate the effects of differing operations on habitat and recreation values. The power company used the modeling results to estimate economic impacts. The parties used the models as a basis for communicating interests and to help solve the complex problem of allocating resources. Using modeling results and independent analyses, negotiations continued for more than three years before a settlement was reached.

Results of the Negotiated Settlement

Some of the most significant results of the settlement included more natural flow levels in the rivers, reduced fluctuations in reservoir elevations, and the establishment of a mitigation fund and an implementation team to meet other resource needs.

Figure 4. Estimated discharge below the Victoria hydroelectric plant and simulated discharge under a "modified peaking" condition. Simulated discharge was based on the rules defining "modified peaking" according to the terms of the settlement.



Flows in the Middle Branch of the Ontonagon River

The flows in the Middle Branch are linked to the water levels and canal discharges from the Bond Falls Reservoir. The Middle Branch flows were the most contentious issue, as this river had perhaps the highest resource potential of the various project river segments, and had been severely affected by operations under the previous license. From the perspective of UPPCO/WPS, every drop of water that goes down the Middle Branch is a drop that does not go through the turbines at Victoria. Studies were conducted using the Instream Flow Incremental Methodology (IFIM) to determine flows that would support viable populations of aquatic species and recreational uses of the river. Flows in the Middle Branch are dependent on water levels in the reservoir and discharges in the canal. Water level fluctuations and canal discharges had to be moderated in order to achieve a more natural runoff pattern in the Middle Branch.

The parties agreed to a minimum flow that varied through the year to better emulate a more natural hydrograph and meet the needs of aquatic species and recreation. The winter drawdown of the reservoir was limited to 2.4 meters and the maximum discharges to the canal were limited to 5.0 cms. These changes served to allow for higher flows in the Middle Branch during the spring to provide channel-maintenance flows.

Victoria Dam and Power Plant Operations

The parties agreed to change the operations of the power facility from a peaking facility to a run-of-river operation during sturgeon spawning season, and a "modified peaking" facility during the remainder of the year. Modified peaking was defined as the minimum discharge on any day had to be at least half of the maximum discharge of the previous day (Figure 4). This provision assured that the stream channel below the facility would be constantly wetted and aquatic resource values protected.

During the sturgeon spawning periods, minimum flows of 4.2 cms would be released into the bypassed reach to provide sturgeon-spawning habitat. Flows would be maintained through June 15 to assure that young fish would reach rearing habitat in Lake Superior.

West Branch Minimum Flows

Operations at Bergland Dam at the outlet of Lake Gogebic would be modified under the terms of the settlement to provide a minimum flow of 0.9 to 1.4 cms, depending on water level elevations. Minimum flows would be reduced as water levels decline in the reservoir.

The minimum flows were designed to provide adequate, if not optimal, habitat to protect aquatic, aesthetic, and recreation resource values of the river.

Mitigation and Enhancement Fund, Implementation Team

A mitigation and enhancement fund was established to provide resources to address other issues through the term of the license. The settlement provided for the establishment of an implementation team, consisting of representatives of all parties to the settlement. The team operates by consensus to determine priorities for funding proposed projects. Potential projects include recreation improvements, fish entrainment prevention, water quality monitoring, fish passage facilities, wildlife and fisheries habitat improvements, erosion control, telemetry for gaging, wildlife and fisheries studies, and nuisance plant inventory and control. The licensee will contribute monies to the fund on an annual basis, amounting to $2.46 million (year 2000 dollars) over the 40-year term of the license.

Implementation

Issues regarding the implementation of the terms of the license arose immediately. In 2003, drier-than-normal conditions during late summer meant that flow conditions and water levels could not be met at the West Branch Ontonagon River and Lake Gogebic, respectively. Provisions within the settlement call for the power company to consult with the implementation team when conditions cannot be met. The team then makes a decision and notifies the FERC. When the same conditions could not be met the following year, the team met and decided on temporary changes in target elevations and "trigger" water levels for 2005 to help alleviate the problems. This adaptive management strategy will help the team to work through the complicated provisions of the settlement to best meet the needs of the affected parties and resources.

Since the license was issued, the team has reviewed and agreed to the content of many implementation plans prepared by UPPCO/WPS including: the management of water quality, recreation resources, wildlife habitat, Threatened and Endangered species, woody debris, erosion, and project operations and monitoring. The plans will help guide the team in the coming years as priorities are set and projects are implemented.

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