The Growing Crisis of Aging Dams: Policy Considerations and Recommendations for Michigan Policy Makers

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On behalf of the

MRP
Michigan River Partnership

Contents

The Michigan River Partnership

The *Michigan River Partnership*[1] (MRP) is a broad-based coalition of government and nongovernment partners formed in 2004 to:

- Assess opportunities to **facilitate dam removal** on Michigan rivers
- Highlight the need to **repair dams** that are not candidates for removal
- Provide dam owners, opinion leaders, and other stakeholders with the information necessary to **optimize decision-making processes at the local level**
- Underscore the need for **dedicated funding** to address emerging challenges posed by aging dams

While the MRP's initial focus was on the need for Michigan to improve funding opportunities to remove dams that provide little or no benefit, a need emerged to balance dam removal with an examination of the issues related to repairing dams that still serve important functions. This project included stakeholder participation, research, and strategy development that resulted in this report, designed as a reference for anyone interested in exploring options for either removing or repairing and retaining a dam. The primary audiences for this project are policy and decision makers, affected parties, and other practitioners involved in dam maintenance and removal. It is also designed to help raise awareness among decision makers about the challenges faced by current dam owners confronted with the need to repair or remove a dam due to safety, cost, and environmental factors.

Funding for this project was made possible by grants from the C.S. Mott Foundation and the National Fish and Wildlife Foundation.

[1] A list of participating organizations is provided in Appendix A.

Executive Summary

Once perceived as almost entirely beneficial, dams are seen more realistically today as having both positive and negative effects.[2] Over the last decade, growing concern about dam safety, fisheries, environmental quality, and the aesthetic characteristics of rivers has become more widespread in the state. Moreover, reconnection of tributary rivers and their watersheds continues to emerge as a significant component of larger, regional initiatives that focus on Great Lakes restoration.

The purposes dams serve often evolve from their original intent, though most dams were constructed originally as local infrastructure projects to drive economic development activities. Despite their potential negative effects on natural river function, some dams still provide benefits to society. Some dams form reservoirs that provide vital water supply to municipalities and industries. Similarly, impoundments created by some dams provide valuable uses where water-based recreational opportunities are otherwise lacking, such as boating and fishing. These amenities may increase property values, thus adding to the tax base for local governments. Impoundments in some areas also provide valuable wildlife habitat and refuge.

Nevertheless, many dam owners do not have the financial capability to maintain either the original function of the dam or its current purpose, or remove the dam. Dam owners are often required to repair antiquated structures without sufficient knowledge about potential removal options or finding the financial resources necessary to accomplish it. Likewise, public entities that own dams face similar financial constraints when considering dam removal or repair.

In Michigan, a majority (93 percent) of the approximately 2,500 dams in the state were constructed more than 25 years ago. Since the average life expectancy of dams is 50 years, this suggests that over the next 25 years many of these dams will need to be removed or repaired due to their age. Some of these dams have already been abandoned by their owners, and others and may be abandoned if the costs for repair or removal are prohibitive.

Without dedicated state funds to assist municipalities and other dam owners whose dams are approaching the end of their lifespan, little progress will be made to avert this growing problem. Some states (including Maine, Massachusetts, New Jersey, Ohio, Utah, and Wisconsin) provide dedicated funding in the form of a grant or loan to repair or remove unsafe dams or dams otherwise in need of rehabilitation. A number of states (California, Connecticut, Maine, New Hampshire, North Carolina, Ohio, Pennsylvania, and Wisconsin) have applied dedicated state funds or coordinate the use of federal funds to dam removal projects as part of watershed plans, habitat improvement, river restoration, and fishery enhancement. These funds often originate through special legislation for a dedicated funding source for natural resource protection and restoration and to address the public health, safety and welfare issues outlined in this report.

[2] Aspen Institute, *Dam Removal: A new option for a new century*, Program on Energy, the Environment, and the Economy (Queenstown, Md.: Aspen Institute, 2002).

The lack of dedicated funds for dam removal and repair portends an increasing problem as dams across Michigan age and the need to make reinvestment decisions becomes more acute. As we improve our understanding of the adverse impacts that dams have on rivers, fish and wildlife, and water quality, selective removal of dams can be a simple, cost-effective way to alleviate both the financial burden and the environmental and safety problems old dams present. It would be unfortunate and shortsighted to miss this opportunity to proactively determine the future of Michigan's old dams. However, it appears that without state and federal support, it will be difficult for willing owners to take action and, as a result, dam failure will become more common, placing at greater risk public safety, health, welfare, and the environment. In Michigan, there are nearly 120 identified dams in need of an estimated $50 million to address repair and/or removal issues.[3] Resource managers estimate that the numbers are likely much higher, but that they lack the detailed information necessary to develop a total cost estimate.

With so many dams nearing the end of their useful lives, Michigan needs a new way of assessing the aging dams, the public value of our dammed and free-flowing rivers, and the significant monetary investment that must be made in this aging infrastructure. Dam owners, from the private or public sector, will need assistance to plan, finance, and execute projects that rehabilitate or remove these structures. At the same time, until dedicated funds for these activities are developed, there are limited opportunities to access existing pools of funding by using creative thinking and a willingness to combine a variety of funding sources (see Appendix D: Funding Sources). These existing funding pools are not nearly sufficient to address all current and future needs, but they may improve the current situation by helping to finance high-priority projects.

RECOMMENDATIONS

- Create a dedicated state funding program for dam rehabilitation and dam removal in Michigan. This fund should include consideration of direct grants in addition to the capitalization of a low-interest loan program.
- Examine and streamline the current regulatory review process in the Michigan Department of Environmental Quality (MDEQ) and Michigan Department of Natural Resources (MDNR) for dam removal by reconciling the current overlap between conflicting state and federal regulations (e.g., wetlands protection, sedimentation control).
- Enhance Michigan's geographic information system and dam database to be used as a prioritization tool for dam removal and river restoration, including fisheries management.
- Require that any dams repaired using public funds include measures to mitigate resource damages that occur as a result of the dam's continued operation. This includes, but is not limited to, examining opportunities for enhancing fish passage and providing safe portage paths.

[3] Association of State Dam Safety Officials Task Committee, *The Cost of Rehabilitating Our Nation's Dams: A Methodology, Estimate & Proposed Funding Mechanisms* (Lexington, Ky.: Association of State Dam Safety Officials, December 2002, revised October 2003). [Online, accessed 11/9/2007.] Available: *http://www.damsafety.org/media/Documents/PDF/Cost%20of%20Rehabing%20Dams%20Report.pdf*.

- Develop and disseminate an information brochure as part of routine dam safety and permit correspondence by the MDEQ. The brochure should focus on the potential cost savings and community benefits that can result from dam removal.
- Develop a river restoration team comprised of representatives from the MDEQ and MDNR that can facilitate outreach and information exchange for dam owners wishing to remove or modify a dam.
- Encourage the MDEQ to emphasize the need for local communities to assess their dam(s) as part of comprehensive watershed management planning.
- Explore new and expanded public/private partnerships with nonprofit organizations (e.g., Michigan River Network) to help maximize distribution of information and leverage resources for river restoration and dam removal.

Dams in Michigan

INTRODUCTION

Beginning in the 1800s, dams were constructed in Michigan—first for the transport of timber, then for waterpower for gristmills, sawmills for logging, and later for electric generation and water supply purposes. By 1940, dams had been constructed in the lower portion of nearly every major tributary to the Great Lakes; hundreds of dam structures remain in some watersheds. Many dams have outlived their original purposes, and through neglect or abandonment, are in a state of disrepair, and serve a limited or marginal purpose. In many cases, the owners of dams do not have the financial resources to make needed repairs or remove their dams. And in some instances, dam owners simply stop paying taxes and let the structure revert to the appropriate tax reverting authority.

A variety of options currently exist for dam owners regarding the future of an existing dam structure, ranging from repair and retention to outright removal. Choices become increasingly complex as a dam ages, local conditions evolve, and the costs and benefits of these activities change over time.

For decades, dam removal was considered a radical approach to river restoration. Dams were considered valuable infrastructure similar to bridges and roads. Dams were viewed as permanent fixtures on the landscape; indeed most residents have never seen their communities without the dam in place. The concept of dam removal can elicit strong emotions because of this historical perspective. Yet often aging dams cause drownings and create nuisance conditions, leading to divisive and heated debate on all sides of the issues. Although it is important that the concerns provoking these emotions be expressed and considered, a decision by both the dam owner and public agencies involved should be based on a balanced and rational analysis of the pros and cons of both dam removal and dam retention.[4]

Removing dams to enhance fish passage and address unsafe and unwanted dams is emerging as a river and watershed management tool that is gaining support and popularity. Dam removals have been documented since the early 1900s—including a large number removed in just the last decade—and many more are undocumented. In part, this reflects America's aging dam infrastructure; in part, it reflects significant changes in land uses and the structure of our economy, which have reduced our need for dams for power generation, as well as a growing concern about river ecology. At least 465 dams have been removed from United States waterways—and at least 100 more are either slated for removal or under active consideration for removal.[5] Regardless of the controversy, dam removal will become an increasingly important issue in many communities. In Michigan, approximately 24 dams have been removed over the last ten years.

[4] Aspen Institute.

[5] American Rivers, Friends of the Earth, and Trout Unlimited, *Dam Removal Success Stories: Restoring Rivers Through Selective Removal of Dams That Don't Make Sense* (N.p.: American Rivers, Friends of the Earth, and Trout Unlimited, December 1999).

REGULATORY OVERSIGHT

The most extensive effort to catalog dams in the United States is the National Inventory of Dams (NID), maintained by the U.S. Army (USACE) of Engineers and the Federal Emergency Management Agency (FEMA). This database includes dams that are considered a high risk to downstream areas; dams that are higher than six feet with more than 50 acre-feet of storage; or dams that are higher than 25 feet with more than 15 acre-feet of storage. The NID identifies 880 dams in Michigan.[6] A more comprehensive database compiled by the State of Michigan has identified 2,552 Michigan dams. Many dams were built in the mid-1900s to enhance land development. Others were constructed on existing lakes to stabilize lake level fluctuations that affect both natural resources and property values. Still others were built on tributaries to create impoundments for recreational purposes. Today, many of these initial purposes have changed to secondary purposes provided by the dam. For example, a saw mill may have been converted to hydroelectric, then retired, yet still provides recreation, lake level control, or wetland benefits. About half of these dams (those that are six feet or more in height and impound at least five surface acres at the design flood elevation) fall under state regulatory authority provided under Part 315 of Natural Resources and Environmental Protection Act (NREPA) to ensure their safety.

The Dam Safety Unit of the Michigan Department of Environmental Quality (MDEQ) administers Part 315 and has the regulatory authority to order owners to address structural, operational, and maintenance deficiencies in the safety of a dam if these deficiencies threaten natural resources or public health, safety, and welfare. The MDEQ Dam Safety Program also administers the provisions of Part 307 of NREPA (The Inland Lake Level Act). Of the approximately 2,500 dams in the state, 326 are regulated by Part 307 (Inland Lake Levels) and 816 are regulated by Part 315 (Dam Safety). Part 307 regulates dams that establish legal lake levels while Part 315 regulates all other dams that are over six feet in height and with more than five acres impounded during the design flood. In addition, 96 dams are regulated by the Federal Energy Regulatory Commission (FERC) under the Federal Power Act. As a result, these dams are exempt from Part 315 and Michigan regulatory oversight.

An MDEQ permit must be acquired prior to any construction or repair of regulated dams. Additionally, these dams must be inspected every three to five years based on their hazard potential rating. Staff at the MDEQ are responsible for reviewing all Dam Safety Reports (DSRs). Once a DSR identifies deficiencies that endanger a dam, whether they are structural or related to the dam's hydraulic capacity (its ability to safely handle a specified flood flow), the MDEQ is required to notify the dam owner of the owner's responsibility to maintain dam safety. The agency may also issue emergency orders to a dam owner to immediately draw down, breach, or cease operation of a dam when its condition poses an imminent danger of failure and is causing or threatening to cause harm to public health, safety, welfare, property, or natural resources.

[6] FEMA, *National Inventory of Dams.* [Online, accessed 11/14/07.] Available: *http://crunch.tec.army.mil /nidpublic/webpages/nid.cfm.*

A recent amendment to Part 301 (Inland Lakes and Streams) of NREPA was passed by the legislature and signed by the governor on July 7, 2006 (P.A. 275 of 2006). This addition allows the MDEQ, after notice and an opportunity for a public hearing, to "issue a general permit on a statewide basis or within a local unit of government for projects that are similar in nature for the removal of qualifying small dams that will cause only minimal adverse environmental effects when performed separately and that will only have minimal cumulative adverse effect on the environment." The general permit only impacts dams where

- the height of the dam is less than two feet;
- the impoundment from the dam covers less than two acres;
- the dam does not serve as the first dam upstream from the Great Lakes or their connecting waterways;
- the dam does not serve as a sea lamprey barrier;
- no threatened or endangered species have been identified in the area that will be impacted by the project;
- there are no known areas of contaminated sediments in the area that will be impacted by the project; and
- the department has received written permission for the removal of the dam from all riparian property owners adjacent to the dam's impoundment.

This amendment provides one example of a method to help streamline the process of removing small dams that are not regulated by the MDEQ Dam Safety Unit under Part 315. While these small dams may not present a danger to public safety, removing them is an integral step to restoring a river to its free flowing state for the benefit of the public and the environment.

HAZARD POTENTIAL

A dam is classified by the potential hazard its failure poses, rather than its actual condition or likelihood of failure. In Michigan, the following hazard classifications are used:

High Hazard

Failure may cause serious damage to inhabited homes, agricultural buildings, campgrounds, recreational facilities, industrial or commercial buildings, public utilities, or main highways or railroads, where environmental degradation would be significant, or where danger to individuals exists with the potential for loss of life.

Significant Hazard

Failure may cause damage limited to isolated inhabited homes, agricultural buildings, structures, secondary highways, short-line railroads, or public utilities, where environmental degradation may be significant, or where danger to individuals exists.

Low Hazard

Failure may cause damage limited to agriculture, uninhabited buildings, structures, or township or county roads, where environmental degradation would be minimal, and danger to individuals is slight or nonexistent.

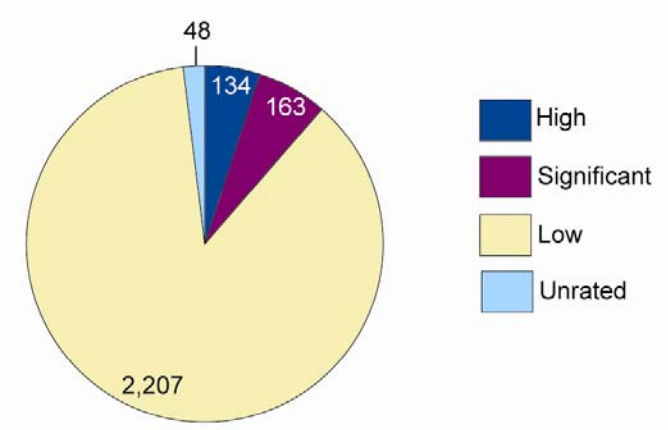
BY THE NUMBERS

While Michigan has a good dam inventory, it is difficult to know with certainty the precise structural or hydraulic condition of these dams, given that not all dams are subject to reporting requirements. A variety of water level–control structures have been built in the state over the last two centuries, ranging from small rock and timber crib structures to large dams of earth and concrete. No formal records exist for some of these structures.

Analysis of the available data from Michigan's dam database produces the following snapshots of our dams. Approximately 5 percent (134) of Michigan's dams are categorized as high-hazard dams, 6 percent (163) are significant-hazard dams, and 87 percent (2,207) are low-hazard dams (see Exhibit 1). Among these dams, the Federal Energy Regulatory Commission regulates 96 power-producing dams. There are 251 dams upstream of towns with populations of at least 5,000, and 107 of these are within one mile of the population center.

At the time of this report, thirty dams have either structural or hydraulic deficiencies (eight dams have both); 140 dams will impound at least one square mile at flood conditions; and 225 dams serve drainage areas (watersheds) over 50 square miles, a little larger than the land area of the City of Grand Rapids.

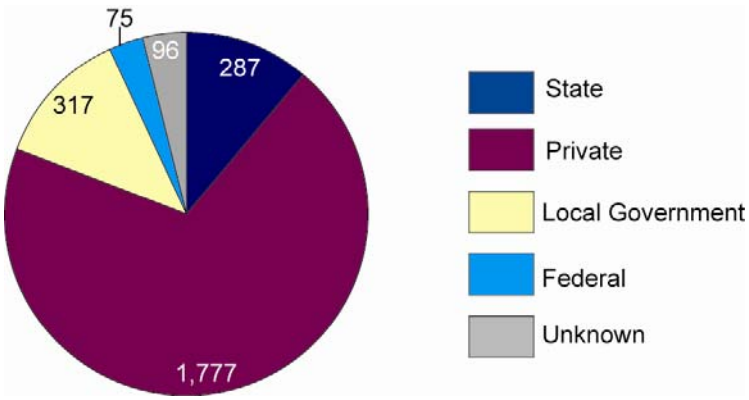
EXHIBIT 1
Dams, by Hazard Rating



SOURCE: Prein&Newhof, October 2006.

Eleven percent of Michigan's dams (287) are owned by the State of Michigan; 70 percent (1,777) are privately-owned; 12 percent (317) are owned by local governments; while fewer than 3 percent (75) are federally owned (see Exhibit 2).

EXHIBIT 2
Dams, by Ownership

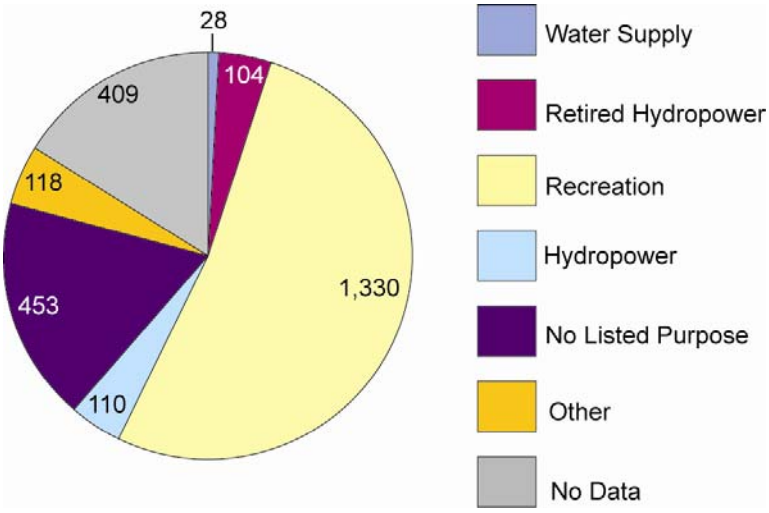


SOURCE: Prein&Newhof, October 2006.

More than half (52 percent, 1,330) of the dams in Michigan serve a recreational purpose; about 4 percent (110) produce hydropower and another 4 percent (104) are retired hydropower dams; and 18 percent (453) serve no listed purpose (see Exhibit 3, which identifies the dam's intended primary purpose).

Many dams provide valuable environmental services. For example, state and federal dams currently provide water control for waterfowl and fisheries management purposes, including an effort to control sea lamprey using weirs (low-head dams) that prohibit them from spawning.

EXHIBIT 3
Dams, by Purpose



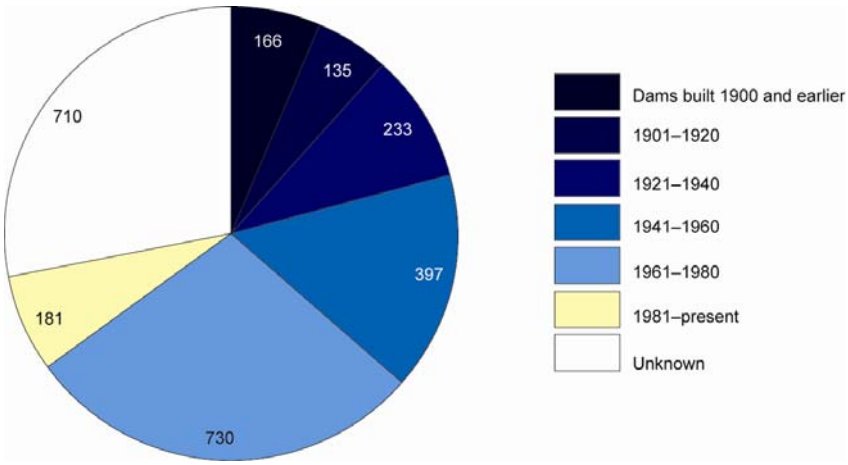
SOURCE: Prein&Newhof, October 2006.

THE LOOMING CRISIS

Many dams across the country have aged beyond their planned life expectancy, causing safety risks for communities downstream. Dam owners, whether from the private or public sector, are being challenged to plan and accept responsibility for the costs of rehabilitation or decommissioning and removal. The average life expectancy of a dam is 50 years, and a full one-quarter of all U.S. dams are now more than 50 years old. The American Society of Civil Engineers estimates that by the year 2020 that figure will reach 85 percent.[7] Most dams in Michigan (93 percent) are more than 25 years old. Over a third of Michigan's dams are more than 50 years old (see Exhibit 4). This suggests that over the next 25 years, due to their age or to a change in ownership, many of these dams will need to be repaired or removed to address deficiencies in either structural condition or regulatory requirements. Some of these dams have already been abandoned, and others may be abandoned if the repair or removal costs are prohibitive.

While age can be an indicator of the need for attention, age in itself does not necessarily result in a hazardous condition. The design life of a dam will vary depending on its type and the material used to construct it, but it is not unusual for a dam to function effectively for 100 years or more if properly maintained.[8] Regardless, aging dams will require considerable maintenance and significant reinvestment in the coming years, particularly those dams that have seen little or no maintenance over the last two decades.

EXHIBIT 4
Current Dams, by Year of Construction



SOURCE: Prein&Newhof, February 2007.

[7] FEMA.

[8] Mary Ellen Cromwell, Chief, Michigan Department of Environmental Quality (MDEQ), Land and Water Management Division (LWMD), personal letter to Mark Coscarelli, Public Sector Consultants (Lansing, Michigan, June 8, 2005).

Today, dam removal costs in many cases are significantly less than estimated expenditures for long-term safety and environmental compliance, repair, and maintenance. Removal costs of 70 small dams in Wisconsin, for example, were found to be an average of two to five times lower than estimated repair costs. On the Baraboo River in Wisconsin, the cost of removing the three-meter-high Oak Street Dam was $30,000, compared to dam repair estimates of $300,000. In Maine, removal costs for the eight-meter-high Edwards Dam were roughly one-third the $9 million price tag of upgrading fish ladders to meet mandatory relicensing conditions. On average, removal costs were only 37 percent of the estimated dam repair costs for ten dams profiled in the report, *Dam Removal Success Stories: Restoring Rivers Through Selective Removal of Dams that Don't Make Sense*.[9] Some examples of repair and removal costs in Michigan are provided in the case studies in Appendix F.

TRADE-OFFS OF DAM REMOVAL VERSUS DAM REPAIR

Despite their negative effects on natural river function, some dams do provide some public and environmental benefits. They may ensure vital water supply to municipalities and industries or provide electric power generation; they may be barriers to sea lamprey migration or provide sediment control or flood storage. Impoundments created by some dams provide valuable recreational uses where water-based recreational opportunities are otherwise lacking. Impoundments in some areas also provide valuable wildlife habitat and refuge. These benefits must be considered when debating dam removal.

The decision to retain or remove a dam requires careful planning and review. The decision process used to determine the ultimate disposition of a dam is critical to the outcome; private interests and private funding may not represent the best interests of the public in natural resource values, public safety, and recreational potential. The decision making process should include all relevant information including economic, ecological, cultural and sociologic issues. An owner's decision to retain a dam might not be examined for its public and environmental implications. However, because of state and federal regulations, the decision to remove a dam generally becomes a public process.[10]

Dam removal may result in fundamental changes to the local environment. Generally, when a dam is removed the reservoir behind it is also eliminated, and with it the flat-water habitat that had been created. Wetlands surrounding the reservoir, if they occur, will also be drained, although new wetlands are often reestablished both in the newly restored river reach above the former dam site and in the river below. Newly created wetlands may be of a different type or value than the wetlands lost due to removal.

Sediment that collects behind a dam, sometimes over decades, may contain toxics such as PCBs, dioxin, and heavy metals. To avoid release of these toxic-laden sediments in the process of dam removal, significant cost may be incurred to remove the sediments and properly dispose of them. Short-term impacts of dam removal can include increased water turbidity and sediment deposition downstream from the release of large amounts of sediment from the reservoir, and water quality impacts from sudden releases of water and

[9] American Rivers.

[10] Heinz Center.

changes in temperature. These impacts, however, can be prevented through proper water level drawdown, sediment management and dam removal techniques. These types of trade-offs present complex issues for regulatory agencies and dam owners.

Issues to Consider for Retention/ Removal of a Dam

Dam removal issues can be organized in the following categories:

- Economic and social dimensions
- Environmental and ecological impacts
- Legal and regulatory perspectives
- Design and construction approaches
- Other technical aspects

For key questions to consider when faced with a decision regarding a dam project, please refer to Appendix B.

Economic and Social Dimensions

There are many local, regional, state, and federal stakeholders to consider when faced with a decision regarding a dam, and each entity may find different economic and social value in keeping, altering, or removing the dam. The costs and benefits of retaining or removing a dam are not borne equally among the parties, often making it difficult to determine who should be the responsible party to take the lead. Generally, decisions and leadership fall on the owner, but often watershed groups, fisheries professionals or recreational interests come forward to advocate for action; however, if the dam fails, is abandoned, or becomes tax-reverted property, the costs of removal or repair fall to the government and are borne by the taxpayers of the municipality and/or state. State and federal agencies have different and sometimes conflicting interests in dam retention or removal—public safety, wetland protection, wildlife habitat, fish passage, water quality, sediment management, and recreation are all concerns. These varied interests can create friction or confusion as to which regulations supersede others.

From an economic standpoint, dam removal is not unambiguously good.[11] Economic analysis can be helpful for setting priorities and facilitating communication among stakeholders and agencies. Benefit-cost analysis provides a process for identifying and measuring the outcomes of dam removal, whether they are perceived as positive or negative, and for clarifying trade-offs. It is important to consider that one stakeholder group's view of benefits and costs may differ from another's, and any assessment may change over time to reflect local conditions and values.

People feel passionately about rivers, but also about dams and their reservoirs. Efforts to restore rivers, fisheries, and livelihoods lost to dams can be met with resistance and skepticism at the local level, especially if dam removal advocates neglect to engage important stakeholders; address technical, legal, and economic cost issues; or examine feasible alternatives and possible negative impacts. Moreover, consideration of dam removal can incite significant opposition in cases where a dam is viewed as a site of

[11] Heinz Center.

historical significance with limited regard to contemporary environmental objectives. In addition, the water impoundments created by dams may be viewed as an economic stimulus for recreation and/or downtown development. Ironically, many communities that have removed a dam similarly find the revitalized river to be an economic stimulus for recreation and development as well. The perceived ongoing benefits provided by a dam must be objectively evaluated against opportunities for dam removal and its potential benefits, including enhanced fish passage, flow restoration, and new recreational opportunities.

Environmental and Ecological Impacts

Dams are known to affect river systems by altering several key parameters including flow regimes and physical habitats; channel shape; sediment transport; water temperature and chemistry; and populations of algae, benthic macroinvertebrates, riparian vegetation, and resident and migratory fish.[12]

Short-term ecological impacts of dam removal (or failure) include an increased sediment load that may cause suffocation and abrasion to various aquatic organisms and habitats. However, several recorded dam removals have suggested that the increased sediment load caused by removal should be a short-term effect. Pre-removal studies for contaminated sediment may be effective at controlling toxic release problems and would be strictly regulated by the state's pollution control laws.[13]

While there are some possible dangers associated with dam removal, existing dams can also have negative environmental impacts. A dam failure has the potential to do great environmental harm if the sediments trapped behind it are released in an uncontrolled manner, especially if the sediment is contaminated. In addition, water impounded behind a dam is slowed and creates a greater exposed surface area. This leads to increased temperatures in the impounded water which, in turn, reduces the amount of dissolved oxygen in the water. They also fragment a river's ecosystem, blocking fish passage and the movement of organisms upon which fish and other wildlife depend for survival. In Michigan, 141 trout streams are dammed, and only 32 of these dams provide for fish passage. Passage is often poor and typically designed to pass only the "jumping" fishes such as trout and salmon, not walleye, bass, lake sturgeon, and other important species.

Legal Perspectives

The legal aspects of each dam removal project on Michigan's inland waterways are inherently unique and complex. Elements of property law, tax law, land-use planning, and zoning must be evaluated. Extensive and proactive planning and appraisal of the possible outcomes are essential for a successful dam removal project.

Since the ownership of the dam structure and adjacent land are unique in every case, every dam removal will have different legal issues that must be considered. Property rights laws applied to resolve past issues are based in Michigan case law and are

[12] L. N. Poff and D. D. Hart, How dams vary and why it matters for the emerging science of dam removal, *Bioscience* 52 (2002): 659–668.

[13] Part 31 of NREPA.

therefore situation- and fact-dependent. The body of law used to resolve property disputes is constantly evolving and expanding. With these caveats in mind, there are nevertheless general issues to identify and consider in any dam removal.

It should be emphasized that the following information is intended solely to illustrate the legal complexity inherent in any dam removal project. Under no circumstances should this information be interpreted as legal advice or a statement of Michigan law. Anyone involved in a dam removal project is advised to seek legal counsel to determine if and how any of the issues identified in this study apply to the specific case in question.

The MDEQ and MDNR provide a useful framework for evaluating potential legal issues surrounding dam removal in the publication entitled *Dam Removal Guidance for Owners.*[14] In this guide, the state highlights the need to identify the current ownership of the dam structure and surrounding lands and ascertain any riparian ownership or flowage rights.

1. Who owns the dam structure and surrounding lands?

Legal property issues may arise when dam removal is considered. Landowners abutting the impoundment area behind the dam will likely have varying property rights depending on the fee title of the lands owned by the dam owner, and those property rights obtained by the dam owner to the lands upstream of the dam that are impounded. Those property rights are acquired either by fee title, flowage easement (right to flood lands to a particular elevation), or acquired by the right of prescription over time (15 years in Michigan). Examination of property deeds is necessary to identify the details specific to each affected property parcel that abuts the impoundment for a dam removal situation. Deed examination can be further complicated when easements or conveyances are not recorded with the deeds, leading to claims of prescriptive rights for the dam owners.

Understanding current ownership of the dam structure helps determine the party responsible for removal or repair. Many dams are privately owned. Those privately owned dams may include all the land within the "normal" impoundment level and lands potentially flooded (during a storm event) under the same ownership (i.e., that of the dam owner). In other cases, a dam owner may only own the dam structure and there may be several other riparian owners (i.e., property owners of land abutting the impoundment). Such dam owners may be either a private entity or a public entity such as the state or local unit of government.

In Michigan, ownership of the bottomlands of inland lakes and streams is granted to riparian landowners.[15] Ownership of inland waters bottomland should be distinguished from ownership of Great Lakes bottomland in Michigan, which is vested in the State of Michigan to be held in trust for the benefit of the public of the state.[16] In contrast, inland bottomlands vest in the various riparian owners adjacent to the water body, unless those property rights to those lands have been sold in fee title, defined by recorded survey,

[14] Excerpts from the full document are included in Appendix C, containing issues other than legal.

[15] *West Michigan Dock and Market Corporation v. Lakeland Investments*, 210 Mich. App. 505 (1995).

[16] *Schweikart v. Stivala*, 329 Mich. 180 (1950).

conveyed by flowage easement to the dam owner, or lost to the property owner by prescription over 15 years of impounding, as stated previously. Riparian ownership does not include exclusive right to the water flowing in the river. For a dam removal, property rights of upstream riparians may only be obtained by the purchase from the dam owner, or relinquishment of flowage easements by the dam owner.

Therefore, various proprietary interests in the water and land surrounding a dam removal site may lead to a range of processes between the upstream riparians and the dam owner. It may be important for upstream riparians to be notified via the Part 315 permit process to secure future riparian rights from the dam owner. It is necessary to have the support of the community, to the fullest extent possible, to accomplish a successful and efficient dam removal or repair. Recognizing parties that may not have a legal claim, but feel they have a very real interest in the outcome is essential. It is important to address these many interests as early as possible in the process to avoid any possible conflicts that could lead to additional strife, expense, and time investment.

If a dam is to be repaired, dam owners have responsibilities as well. For instance, an owner is liable for any downstream damages caused by a breach of the dam. At the same time, the dam owner retains the right to re-impound the land as established in Michigan case law.

2. Are there any riparian rights or flowage rights in the water body?

Riparian rights and flowage rights are two types of proprietary interests that are likely to exist at a dam site. These are real interests in property that have value. Riparian rights generally refer to the rights of landowners adjacent to a river, stream or inland lake[17] to access the shore and for reasonable use of the waterway. Flowage rights are established when land, not owned by the dam owner, is submerged by an impoundment. Accurate determination and appropriate safeguard of these property rights must be ensured to prevent any unauthorized interference with private property rights and to prevent any associated conflict, expense, and concern that may arise on the part of riparian landowners. Any landowner that feels his rights may be threatened or diminished by a dam removal may pose a significant impediment to the process. Proactive identification of the rights existent at a dam removal site may prevent unease about the security of property rights through the dam removal process.

When determining riparian boundaries on flowing waters, the “thread of the stream” rule is followed. Each landowner along a watercourse owns the bottomland to the midpoint of the stream. Additionally, when the inland water body is “navigable” there exists a public easement to navigate the water. Riparian property rights do not include exclusive ownership of the flowing water; the public’s right to access for recreation, navigation, and fishing is preserved.[18] Riparian owners may not interfere with the public’s right to

[17] The technical term for water property rights in an inland lake is “littoral.” However, in modern usage “riparian” has commonly referred to property rights stemming from land ownership adjacent to inland lakes as well as rivers and streams.

[18] *Paterson v. Dust*, 190 Mich 679 (1916).

traverse navigable waters. However, the public cannot legally cross private land to access navigable waters.

Flowage rights are other proprietary interests that commonly exist at a dam site and are conveyed by easement on each of the properties impacted. Flowage easements may be obtained through express grant, (usually, but not always, recorded with the deed to the land) or through prescription (resulting in no formal record).

In some cases, the dam owner also owns the land under the impoundment outright (i.e., fee title). In other circumstances, the dam owner acquires an easement in the submerged land known as flowage rights. Flowage rights refer to the right of a dam owner to retain water behind a dam wall and submerge the land behind the dam. In some cases flowage rights are obtained by the dam owner through express easement over the land of another owner. In these cases, flowage rights may have been recorded in deeds to property. Property deeds are examined to determine whether any flowage easements have been expressly reserved and recorded in the deed to run with the land.[19]

Flowage rights may also be obtained by prescription. Prescriptive rights are similar to "squatter's rights," accruing from the historical use of property for a specific purpose for a period of time determined by law (15 years in Michigan[20]). Prescriptive rights do not give title to the user; rather, they are the right to use the land only for the historical use.

Determination of property rights will have echoing effects in the community. Potentially, dam removal can impact the land's assessed value for purposes of taxation. Landowners that have previously enjoyed waterfront status may be separated from the water. Downstream owners may see their riparian floodplain returned to a flowing stream. The newly exposed land has the potential to create land use planning and zoning challenges and opportunities. In some cases, the exposed land becomes a common area and kept in a natural condition for the public to access. In others, the land is quit-claimed to the adjacent riparian owner(s). These decisions and options must be considered during the planning phase of a dam removal.

Problems arise when deeds have been lost or wrongly recorded over time or when flowage easements were never recorded properly or were established by prescription. When landowners have incorrect or misinformed expectations about their property interests, there may be unnecessary conflict over a dam removal project. Alternatively, when there is incomplete information available in the form of property deeds, uncertainty can complicate the dam removal process. Proactive identification of riparian and flowage rights at a dam site in advance of the dam removal would reduce the uncertainty and streamline planning for the newly uncovered land after the reservoir is drained.

Regulatory Perspectives

Dam removal is a process that requires complex, multilevel permitting and review from local, state, and federal regulatory agencies. Federal regulations include the Clean Water

[19] See *Glidden v. Beaverton Power Co.*, 223 Mich 383 (1923), which holds that express easement of flowage may not be destroyed by non-use.

[20] *Suffrow v Brewer*, 204 Mich 370 (1918).

Act[21] and the National Historic Preservation Act,[22] among several others.[23] Specifically, Section 106 of The National Historic Preservation Act requires that the Michigan State Historic Preservation Officer review all federal actions for their effect on cultural resources. This could have specific relevance to the dam retention/removal discussions because these structures often have local historic significance, which if formally designated could impact federal funding availability for removal or significant repairs.

If the dam to be removed is a hydroelectric facility, the Federal Energy Regulatory Commission (FERC) has authority over the dam and its "project area" and the operating license associated with the facility.

State regulations that would impact dam removal from the Natural Resource and Environmental Protection Act[24] include MDEQ Dam Safety approvals in addition to water quality approvals and wetland management objectives. In Michigan the MDEQ and the USACE, under Section 10 of the River and Harbors Act and Section 404 of the Clean Water Act, have a joint permitting process to streamline application for projects that concern the interface of land and water, such as dam removal. Localities must be consulted for demolition permits if required. Other regulatory considerations are tribal water rights, where they exist, and any contractual obligations for municipal provision of water supply and/or fire protection that may be affected by the dam removal.

Because dam removal is relatively new, the permitting process for a removal can be difficult. For the most part, the relevant regulatory requirements were conceived to address construction activities with potential adverse environmental effects. Dam removal is inherently a river restoration effort, thus dam removal does not fit easily into the current standards for review.[25] The regulatory atmosphere surrounding dam removal in Michigan is a complex one. Moreover, as in the case of property issues, the process is unique to each individual dam removal project. Some regulations, such as avoiding fill material in waterbodies, are intended to protect the environment but may actually serve to complicate the river restoration process that may include fill material to restore previously excavated power canals, or to counteract bank failure and erosion that may occur below dams. The Michigan Departments of Environmental Quality and Natural Resources are currently examining options for standardizing the permitting review process for dam removal projects.[26]

[21] 33 U.S.C. § 1344.

[22] 16 U.S.C. § 470f, 36 C.F.R. §800.1 et seq.

[23] Rivers and Harbors Act §10 (33 U.S.C. §403); National Environmental Policy Act (42 U.S.C. §4321 et seq.); Endangered Species Act (16 U.S.C. §1531 et seq.); Manguson-Stevenson Act (16 U.S.C. §1855[b][2].)

[24] P.A. 451 of 1994. parts 301, 307, and 315.

[25] William L. Graf, Ed., *Dam Removal Research: Status and Prospects* (Washington, D.C.: The Heinz Center, 2002), 138.

[26] Sharon Hanshue, Michigan Department of Natural Resources Fisheries Division, personal communication (Lansing, Mich.: November 2005).

Dam Removal Design and Construction Considerations

While the physical removal of the dam structure itself can be a relatively straightforward process, several associated issues should be addressed in order to protect and restore aquatic and riparian habitat and the stream channel. Careful planning can limit the effects of released sediment on aquatic life, prevent extensive erosion in the restored stream channel, and limit the potential intrusion of exotic plant species in the former impoundment.[27] Each restoration project is unique; in some cases these issues may be minor, while in other cases they can be complex and need to be appropriately managed.

Managing sediment release is critically important to dam removal projects. Dams trap sediment behind the dam wall that would otherwise be flushed down the watercourse by its natural flow. In some instances, industrial activity over the last 150 years has deposited toxic or hazardous chemicals into the watercourses. Some of these chemicals precipitate out of the water or attach to sediment particles when it slows behind a dam wall. As a result, toxic concentrations of chemicals can accumulate in the silt and sediment trapped behind a dam wall. Because of the hazards posed by such contaminants it is critical to contain or at least monitor the downstream dispersal of the contaminated sediments. [28] Dam removal without proper evaluation and planning for possible contaminated sediment has the potential to create a public health concern, and could damage the downstream environment.

Public concern about contaminated sediment does not have to be an impediment to the dam removal process. The MDEQ is charged with maintaining the state's surface water quality and is a party to the joint permitting process with the USACE that regulates any dam deconstruction project. A plan for contamination sampling and subsequent management can be included as a requirement of the permit for dam removal. Dredging and landfill disposal of contaminated sediment before dam removal is a common solution that serves to protect the public health and the environment.

Efforts to reseed exposed bottomlands after dam drawdown are also necessary steps to prevent degradation of the watershed when a dam is removed. Often, exotic invasive species are well equipped to migrate into a newly exposed riverbank and flourish. In order to preserve and more fully restore the integrity of the river system, steps to control the invasion of exotic weeds must be part of the planning process.

While certain techniques may be necessary for a particular project, the greatest expenses incurred by small dam removal projects have included dredging, off-site disposal of materials, developing access to the structure, and water control during construction.[29] Often the time and labor required to physically remove the dam is the least expensive component of the project.

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[27] Brian E. Graber et al., *Technical issues in small dam removal engineering*, The Future of Dams and Their Reservoirs, 21st Annual USSD Lecture Series (Denver, Colo.:2001).

[28] Graf, 109.

[29] Ibid.

Other Technical Aspects

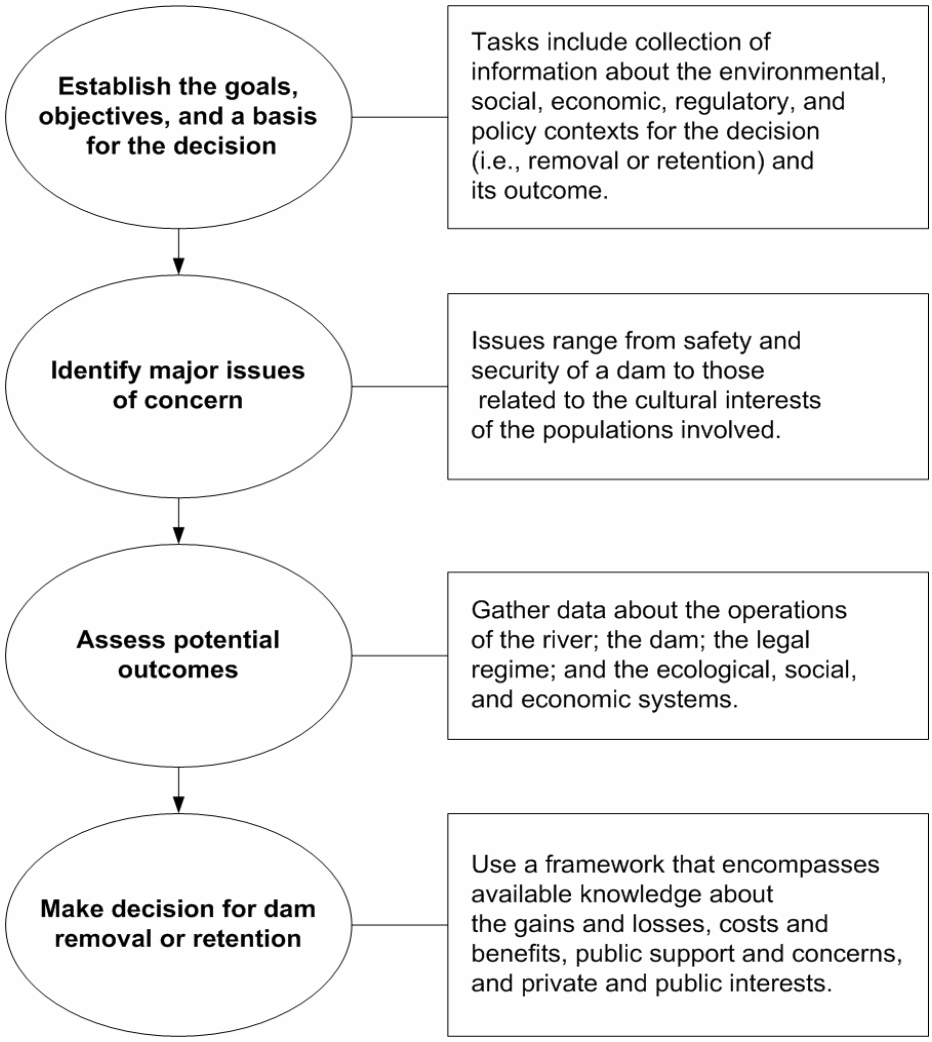
Removing a dam requires a multidisciplinary approach, and there are often unforeseen challenges that must be managed or mitigated.[30] Most dam removal projects have unique issues, different project goals, and regional differences based on geography and natural processes. Myriad issues apply in varying degrees to particular projects. For example, some dams trap very little sediment, so managing sediment may not be a significant issue. Some run-of-river dams that have small impoundments require very little channel reconstruction or revegetation following dam removal. Thus, there are no universal solutions or methodologies to address many of the technical issues that arise during dam removal projects. It is advisable to enlist the aid of local experts, engineers, and biologists who are familiar with local resources and possess the necessary technical expertise. Unfortunately, Michigan lacks a dedicated group of experts to facilitate dam removal so assistant is provided on a limited, ad hoc basis and often from out-of-state experts.

NEXT STEPS

From the series of questions in Appendix B, a suite of potentially contentious issues can be identified. This will help the dam owner and the public assess whether the dam should be considered for removal, what alternatives exist, and whether the process should move to further study. Exhibit 5 highlights the steps necessary when considering dam removal versus retention.

[30] Graf, 109.

EXHIBIT 5
Decision Matrix for Dam Removal versus Dam Retention



SOURCE: Adapted from *Dam Removal: Science & Decision Making*, Heinz Center, 2002.

DAM FUNDING IN MICHIGAN

Finding funding for dam repair or maintenance, dam removal or enhancing fish passage is a significant impediment to carrying out successful projects. Private owners and many small community dam owners require technical and financial assistance to manage a deteriorated dam. There are no funding programs dedicated specifically to dam repair or removal. However, many federal, state, and local government programs intended to improve water quality, protect or enhance wildlife habitat, restore natural resources, or alleviate dam safety concerns can be used to finance dam removal or modification, for example to add fish passage around a dam. In addition, there are potential sources of private funding, such as corporate environmental damage mitigation funds (these funds may be government-administered). For example, dams in Maine, Pennsylvania,

Wisconsin, and other states have been successfully removed using creative approaches that combine multiple types of public and private financing.[31] Approaches such as these take time and resources to fashion and require sophisticated management to accomplish.

Appendix D provides general information about possible funding options for dam removal and/or fish passage research. This information may be useful both in crafting a funding package for an individual project and in identifying potential new sources of funding. Appendix E offers summaries of other state programs regarding dam safety regulation and programs offering technical assistance and funding for removal.

Appendix F provides case studies related to Michigan's dams that show the range of issues related to dam failures, repairs, and removals.

CONCLUSIONS

The information provided in this study is cause for both concern and optimism. The lack of dedicated funds for dam removal portends an increasing problem as dams across Michigan age and the need for investment in repair or removal becomes more critical. It also exposes the potential for a significant opportunity. As we better understand the negative impacts that dams have on rivers, fish and wildlife, and water quality, removal of dams that don't make sense can be a simple, cost-effective way to alleviate many of these problems and improve the recreational value of our river resources. It would be unfortunate and shortsighted to miss these restoration opportunities simply because of the lack of funds for important projects. It is clear that without state and federal support, dams eventually will fail and put public safety at risk.

At the same time, until dedicated funds for dam removal or dam repairs can be developed, projects have been, and can be, partially financed through existing pools of funding by using creative thinking and a willingness to combine a variety of funding sources. These existing funding pools will not address all current and future needs, but they will help river restoration efforts by financing high priority projects. The authors of this report conclude

- Costs of dam removal or repair exceed most dam owners' ability to pay, risking impairment to the public health, safety, welfare, and the environment in Michigan.
- There is currently no state dedicated funding for dam maintenance, dam removal, or fish passage projects in Michigan, or for providing technical assistance to dam owners interested in dam removal.
- Dam owners generally lack adequate information and resources to fully consider dam removal as a potential option during dam-related decisions (e.g., dam safety, permitting).
- State financial assurance fund programs and other financial responsibility requirements (e.g., performance bonds) required in environmental programs may be an effective means to enhance regulatory compliance and ensure sufficient financial resources to mitigate damages.

[31] American Rivers, 1999.

- Benefit-cost analysis provides a process for identifying and measuring the outcomes and setting priorities, whether they are perceived as positive or negative, and for clarifying trade-offs between dam retention and dam removal.
- The legal aspects of each dam removal are inherently unique and complex. Elements of property law, tax law, land-use planning, and zoning must be evaluated.
- Current state and federal regulations that relate to dam removal (e.g., wetland protection, soil erosion and sedimentation control) involve complex, multilevel permitting and review and can impede potential river restoration projects. Collaboration and coordinate among state agencies is essential to creating an efficient and effective decision making process.
- Decisions about dams must be based on a balanced and rational analysis of the benefits and costs associated with removal or retention, and must include all stakeholders.
- Small communities often do not possess the expertise and manpower to oversee a dam removal or rehabilitation.
- Michigan's Dam Database and its Geographic Information System (GIS) platform may be an effective tool for resource managers and others considering dam removal.
- Removing dams is emerging as an increasingly popular and effective river and watershed management tool to enhance fish passage and address unsafe and unwanted local conditions.
- Nonprofit organizations in other states (e.g., Wisconsin River Alliance) have been effective at information dissemination and facilitation of dam removal. Nonprofits may serve as a clearinghouse and fiduciary to procure funding for dam removal.
- Federal funds cannot be relied upon to relieve the burden that Michigan's aging dam infrastructure has created. A distinct opportunity exists for Michigan to be among the frontrunners in development of dam policy for the next era of river restoration.

RECOMMENDATIONS

- Create a dedicated state funding program for dam rehabilitation and dam removal in Michigan. This fund should include consideration of direct grants in addition to the capitalization of a low-interest loan program.
- Examine and streamline the current regulatory review process in the MDEQ and MDNR for dam removal by reconciling the current overlap between conflicting state and federal regulations (e.g., wetlands protection, sediment control).
- Enhance Michigan's geographic information system and dam database to be used as a prioritization tool for dam removal and river restoration, including fisheries management.
- Require that any dams repaired using public funds include measures to mitigate resource damages that occur as a result of the dam's continued operation. This includes, but is not limited to, examining opportunities for enhancing fish passage and providing safe portage paths.
- Develop and disseminate an information brochure as part of routine dam safety and permit correspondence by the MDEQ. The brochure should focus on the potential cost savings and community benefits that can result from dam removal.

- Develop a river restoration team comprised of representatives from the MDEQ and MDNR that can facilitate outreach and information exchange for dam owners wishing to remove a dam.
- Encourage the MDEQ to emphasize the need for local communities to assess their dam(s) as part of comprehensive watershed management planning.
- Explore new and expanded partnerships with nonprofit organizations (e.g., Michigan River Network) to help maximize distribution of information and leverage resources for river restoration and dam removal.

Appendix A: Participating Organizations

- American Fisheries Society, Michigan Chapter
- Association of State Dam Safety Officials
- Izaak Walton League, Michigan Chapter
- Michigan Association of County Drain Commissioners
- Michigan Environmental Council
- Michigan Lakes and Streams Association
- Michigan Municipal League Foundation
- Michigan Sea Grant College Program
- Michigan State University—Extension/Dept. Fisheries & Wildlife
- Michigan Townships Association
- Michigan United Conservation Clubs
- Sierra Club
- The University of Michigan—School of Natural Resources and Environment
- Tip of the Mitt Watershed Council
- Trout Unlimited, Michigan Council

TECHNICAL ADVISORS

- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources
- Michigan Department of Transportation
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture - Natural Resources Conservation Service
- U.S. Fish and Wildlife Service

Appendix B: Key Questions about Dams

There are many factors to consider when electing to retain, repair, or remove a dam. The section below outlines many of the key questions that must be addressed to determine an appropriate course of action. Appendix C presents guidelines once a decision to remove a dam has been reached.

The following key questions should be considered when making a decision to remove, alter, or repair a dam structure.[32]

ECONOMIC AND SOCIAL DIMENSIONS

Economic

- What are the long-term and short-term costs of maintaining the dam versus the cost of removing the dam?
  - Have all costs and benefits been identified?
  - Are there accurate cost and time estimates for the project?
  - Have risks and uncertainties been thoroughly explored and identified?
- Will other existing infrastructure be impacted by a dam removal (e.g., bridge foundations)?
- Who is financially responsible for the dam and for any damage that might occur if the dam were breached (intentionally breached or breached during a flood event)? What are the potential costs (estimates) of repair and annual maintenance of the existing facility?
- When applicable, what is the status of the repayment on the debt for the dam? Has it met the financial criteria defined in its authorization language if it was a public project?
- Are there financial criteria that must be met or maintained if the project is funded with private or public funds?
- Is the dam providing a service that will need to be replaced by some alternative, and if so, what is its cost?
- What are the costs of alternative measures to mitigate project impacts?
- What are the costs to provide adequate protection measures if a dam is to be retained?
- How will property values be affected?
- How do the owners of the dam perceive the alternatives and their potential liability?
- How do the owners of the dam perceive any conflicts over removal?

Social

- Will there be changes in the types of, and access to, recreational opportunities?

[32] Questions are adapted from Ohio Department of Natural Resources, Division of Water Safety, *Lowhead Dam Removal Framework for Decision Making.* [Online, accessed 12/12/06.] Available: *http://www.ohiodnr.com/water/dsafety/lowhead_dams/framework.htm.*

- How many recreational boaters, anglers, or other recreational users will be affected?
- Will the impact be positive or negative?

- Will there be effects on local and regional populations in terms of economics (e.g., property tax revenue) or economic stability (or lack thereof), displacement, water supply, and/or loss of access to traditional use areas?
- Will there be direct and indirect effects on the cultural relationships of people to the landscape?
- Will there be direct and indirect impacts related to any necessary service that was provided by the dam, and how this service will be replaced?
- How will dam removal affect aesthetic values in the area for individual property owners or the area in general?
- Does the dam honor someone in particular?
- Are there historical values associated with the dam or the pool it creates?
- What plans have been made to involve stakeholders in the discussion?
  - Who are the major stakeholders?
  - What are the stakeholders' opinions about dam removal?
- What plans have been made to involve the public?
  - Has the public been notified?
  - What is the general public opinion?
- What political issues have been identified?
- Who are the primary local, regional, state, and federal political stakeholders?
- How would information on the project be communicated to all interested parties?
- Who will make the final decision?
- What are the main factors in the decision-making process?

ENVIRONMENTAL AND ECOLOGICAL IMPACTS

- Will removal of the structure help to enhance the recovery of threatened or endangered species?
  - What species?
  - How will dam removal enhance the recovery of the species?
- What species might need to be reintroduced to the exposed mudflats/bank areas after dam removal?
  - What costs will be associated with this effort?
- Will removal of the structure lead to changes in unwanted native (i.e., mosquitoes) or invasive species?
  - If so, what native or invasive species and what are the potential impacts?

- Are there likely to be problems associated with contaminated sediments currently contained behind the dam if the dam is removed?
  - What contaminated sediments are of concern?
  - What data has been collected on contaminated sediments? By whom?
  - What analysis has been completed on contaminated sediments?
  - What are the cost estimates associated with removing, sampling, testing, and disposal of the sediments?
- Will removing the dam cause sediment to move downstream to help build beaches?
- Are there potential beneficial uses for removed sediments?
- What is the natural ability of the stream/river to carry sediments and how does this relate to the sediments currently deposited behind the dam?
- Will dam removal lead to a net gain or loss in wetland area?
- Have so many other changes occurred in addition to the dam that removal of the dam will not achieve the desired ecosystem restoration goals?
- How will new lands created by the dam removal be used?
- What is the relationship of the dam and its removal to other parts of the watershed?
- How will drinking water supplies be affected?
- How will groundwater tables be affected? Will this change impact septic tanks?
- What time of year would be ideal for the dam removal? Consider safety, weather, and environmental issues such as fish spawning, flooding, etc.

LEGAL AND REGULATORY PERSPECTIVES

- Are there current existing or potential conflicts with laws and regulations designed to protect natural systems (e.g., Clean Water Act, Endangered Species Act, National Flood Insurance Program, FERC, Navigation – Section 10 Rivers and Harbors Act, COE 404)?
- Are there current existing or potential conflicts with laws and regulations designed to protect social, historical, or cultural values (e.g., National Historic Preservation Act, tribal water rights)?
- Are there existing contracts for water supply and delivery that would be affected by dam removal?
- Are there 6f or 4f conversion issues (pertaining to P.L. 88-578, the Land and Water Conservation Fund Act of 1965) that might be a factor if certain federal dollars were used?

DESIGN AND CONSTRUCTION APPROACHES

- How does the existing structure fit into the overall watershed management plan for the river system? Is it a critical element to meeting any legal agreements and providing a service to the local economy such as flood control, water supply, power production, irrigation, fire protection, or recreation?
- Do the operations of the current structure fit into a broader context of river basin control?

- When planning a dam removal, will flood control alternatives need to be formulated?
- Will modification need to be made to structures upstream or downstream of the dam such as bridges, road culverts, or other dams?
- What sources of funding have been identified for removal or restoration efforts?

TECHNICAL ASPECTS

- What are the future potential uses of the stream/river if the dam is removed?
- Does the dam fall under the Michigan Dam Safety Program?
  - Does the dam currently meet dam safety standards?
- Is there a significant potential for loss of life, injury, and/or property damage if the dam should fail or be removed?
- Is the dam vulnerable to failure because of either aging or inadequate maintenance?
  - What is its current condition?
  - What are the major deficiencies?
- Is the dam vulnerable to acts of terrorism?
- Are people safe around the dam?
  - Boating safety (hydraulics)
  - Playing on dam (broken concrete, slipping off, etc.)
  - Safe portages
  - Possible injuries or death caused by the presence or condition of the dam
- Would safety be improved if the dam were removed?

Appendix C: Michigan Dam Removal Guidance

DAM REMOVAL GUIDELINES FOR OWNERS

(Drafted by the MDNR Habitat Management Unit of the Fisheries Division and the MDEQ Dam Safety Unit, April 2004.)

The driving forces for consideration of dam removal are (1) the cost of maintenance and repair when the benefits of maintaining a dam are diminished; (2) public safety and liability concerns, and (3) potential fisheries, water quality and recreational use improvements that can be realized with dam removal. The purpose of this guidance document is to suggest issues that may need to be considered when deciding the future of a dam, and to assist in implementing a dam removal project. The steps outlined here are by no means complete; however, they can help dam owners and their communities develop a long-term plan for the dam which includes consideration of financial, public safety and environmental issues. If you have questions about the laws regulating dams, please contact the Department of Environmental Quality, Dam Safety Program staff in the Geology and Land Management Division, 517-335-3195 or visit the web site at: http://www.michigan.gov/deqglmd and click on "dam safety".

First Step: Consider What Purposes the Dam Serves

- Consider whether the dam itself provides any benefits, such as:
  a. Power production.
  b. Prevents movement of sea lamprey or other aquatic nuisance species.
  c. Fish exclusion for fisheries management purposes.
  d. Historic significance.
  e. Provides bridge, rail, or road crossing.
- Consider whether the impoundment created by the dam may serve one or more of the following services:
  a. Water supply for irrigation, fire suppression.
  b. Flood control.
  c. Navigation and transportation.
  d. Recreational boating, fishing, swimming, or park use.

Second Step: Consider Problems with the Dam Structure

- Safety and security of the dam
  a. Do boats, canoes or swimmers frequent the site – are they at risk?
  b. Does the site attract anglers?

c. Is the dam itself in poor condition and/or subject to an order from DEQ to repair or remove the dam?

d. What potential property damage would occur if the dam was to fail?

- What are the costs and liabilities of keeping the dam
  a. Repair cost estimate
  b. Maintenance cost estimate
  c. Operational concerns
- What environmental impacts should be considered? (Consult your local DNR and DEQ offices for assistance.)
  a. Water quality and aquatic habitat benefits of stream restoration
  b. Improvement of fisheries and wildlife habitat
  c. Recreational uses of the impoundment compared to a restored stream
  d. Other ecological or economic considerations

Third Step: Considerations for Dam Removal

- Would removal eliminate or reduce safety and security problems?
- Would removal improve recreational use of the site?
- Cost estimates
  a. Preliminary estimate of dam removal cost
  b. Sediment removal or management
  c. Stream bank restoration
  d. Replacement of dam-dependent services (water supply, road or bridge crossing, etc.)
- Potential funding sources
  a. Private or community foundation funding
  b. Environmental grants
  c. State or federal assistance programs

Fourth Step: Working with DEQ Dam Safety Program and/or DNR Fisheries Division

- Contact the DEQ dam safety program for information about the condition of the dam, and for permit application requirements and procedures.
- Contact the DNR, Fisheries Division, for information about the fisheries and wildlife values with and without the dam.
  a. General guidance on the removal of a dam (if a viable option)
  b. Information about potential funding sources for dam removal (if a viable option)
  c. Other requirements for planning, design and modification of the dam

Fifth Step: Explore Resident and Community Concerns Including Local Watershed Council, Conservation Clubs, Economic Development Groups, others

- Historic and aesthetic values of the dam and or impoundment
  a. Does the dam help define the community or suggest specific important aspects of its history? What alternatives may be considered to retain a portion of the dam as a monument to its history in the community?
  b. Would creation of an off-channel pond retain recreational uses or aesthetic values, while allowing return of a free-flowing river?
  c. What fisheries and wildlife values would likely occur in the area with and without the dam?
- Property owners' interests
  a. Residents of the impoundment may or may not have riparian rights to the water (access).
  b. Property values may change with and without the dam.
  c. Lake association or other resident or adjacent park owners may be interested in taking over ownership and maintenance of the dam.
- Other social issues
  a. Public safety issues with or without the dam
  b. Park or other public and use of the area: projected changes
     - Alternatives to preserve or replace valued recreational uses
  c. Flooding concerns (Hydraulic analysis may be needed to project how floodplains would be altered if the dam were breached.)
  d. Other local economic considerations (waterfront business development with and without the dam)

Sixth Step: Collect and Assess Information (Professional Engineering and/or Legal Services Necessary)

- Legal issues
  a. Who owns the dam structure and surrounding lands?
  b. Any riparian ownership or flowage rights?
  c. Any potential sources of sediment contamination?
  d. Regulatory concerns or limitations?
- Engineering issues
  a. Condition of the dam and deadlines to take action (if appropriate)
  b. Accessibility to the dam for repair or removal
  c. Potentially affected structures (e.g., bridges, utility crossings)
  d. Sediment quantification and removal

e. Flood storage capacity and changes in floodway

f. Upper limit of the impounded stream

g. Hydrology (gage data or hydrologic model)

h. Alternatives to modify or remove the dam

- Economic issues
  a. Final cost estimate of dam repair/rehabilitation of the impoundment

  b. Potential liability in the event of dam failure

  c. Potential operation, maintenance, and repair cost savings

Seventh Step: Taking Action

- Secure local, state, and federal permits.
- Complete site land survey, final design engineering plans.
- Secure funding (construction, site restoration, and monitoring).
- Determine sediment management plan (may include dredge and disposal or in-place stabilization as recommended by DEQ and DNR)
- Secure authorization for site access.

Resources

For further information about dam removals in Michigan:
http://www.michigan.gov/dnrdams

For dam removal information from the conservation organization, American Rivers:
http://www.americanrivers.org/damremoval/default.htm

From the River Alliance of Wisconsin, information on the small dam removal program:
http://www.wisconsinrivers.org/SmallDams/prog_dams.html

From the Heinz Center for Science, Economics and the Environment, two reports on Dam Removal Research:
http://www.heinzcenter.org

Appendix D: Funding Sources

Funding is *the* most significant limitation when we discuss opportunities for dam retention and removal. At the present time, there is no dedicated funding source at the federal level for removal of dams for ecological or recreation purposes, nor is there a dedicated source for repair or removal of unsafe dams. Nevertheless, there are some federal programs and dollars that might be tapped for at least part of the costs for dam removal or repair.

Although some dam removals have been funded directly through a single federal source, many successful dam removals have creatively combined monies from a variety of sources. Many of the federal funding programs provide grants to individuals and nonprofit organizations as well as state and local governments. Matching requirements are included with many federal funding sources—that is, most federal funding programs require a certain percentage of project costs to be borne by nonfederal funding sources. These match requirements can sometimes be difficult for local communities to meet. In some programs, more flexible matching fund rules are beginning to take hold.

The following table highlights both federal and nonfederal funding sources that could be applied to dam removals and/or for enhancing fish passage around existing barriers. **Programs in bold font are sources proven in Michigan.**

Funding Sources

Agency/ Organization	Program	Description
American Rivers		American Rivers is a national nonprofit conservation organization dedicated to protecting and restoring healthy natural rivers and the variety of life they sustain for people, fish, and wildlife. The American Rivers organization is a valuable source of information to anyone who is interested in dam removal and river restoration. To learn more about dam removal and potential funding sources visit the American Rivers website, *http://www.amrivers.org*.
Fish America Foundation	Marine and Anadromous Fish Habitat Restoration	Community-based nonprofit organizations, such as local sporting clubs and conservation associations, as well as state and local agencies, are encouraged to submit proposals. Projects must result in on-the-ground habitat restoration; clearly demonstrate significant benefits to marine, estuarine, or anadromous fisheries resources, particularly sport fish; and must involve community participation through an educational or volunteer component tied to the restoration activities. Website: *www.fishamerica.org*

Agency/ Organization	Program	Description
Great Lakes Fishery Trust	**1996 court settlement for fish losses at the Ludington Pumped Storage Project hydroelectric facility** No match required $3.5 million	The GLFT provides grant funds to nonprofit organizations and government entities for research projects that benefit Great Lakes fishery resources; rehabilitation of lake trout, lake sturgeon, and other Great Lakes fish species; protection and enhancement of Great Lakes fisheries habitat; public education about the Great Lakes fishery; and property acquisition for the above purposes or to provide access to the Great Lakes.
Michigan Department of Natural Resources	Natural Resources Trust Fund 25% match	The Fund provides financial assistance to local governments and the Department of Natural Resources to purchase lands for outdoor recreation and/or the protection of natural resources and open space.
National Fish and Wildlife Foundation (NFWF)	**Matching Grant Program**	NFWF funds projects to conserve and restore fish, wildlife, and native plants through matching grant programs. The foundation awards matching grants to projects that address priority actions promoting fish and wildlife conservation and the habitats on which they depend; work proactively to involve other conservation and community interests; leverage foundation-provided funding; and evaluate project outcomes. Website: *http://www.nfwf.org/programs/grant_apply.htm*
National Oceanic and Atmospheric Administration (NOAA)	1. Damage Assessment and Restoration Program (DARP) 2. Community-based Restoration Program (CRP) 3. Restoration Research Program (RRP)	The NOAA Restoration Center plans, implements, and funds coastal restoration projects throughout the United States. Three primary programs allow the Restoration Center to restore fisheries habitat. Key to this commitment is the Restoration Center's mission to expand local habitat restoration techniques into broad-scale, ecosystem restoration approaches in all coastal, estuarine, and anadromous fish habitats within the United States and its territories. Website: *http://www.nmfs.noaa.gov/habitat/restoration*
National Oceanic and Atmospheric Administration/ Great Lakes States (except Illinois)	Coastal Zone Management Program Coastal Zone Management Act 50% match	Federal/state partnership dedicated to comprehensive management of the nation's coastal resources, ensuring their protection for future generations while balancing competing national economic, cultural, and environmental interests. National program supports states through financial assistance, mediation, technical services and information, and participation in priority state, regional, and local forums.

Agency/ Organization	Program	Description
Private Foundations Andrew W. Mellon Foundation C. S. Mott Foundation Joyce Foundation Doris Duke Foundation Frey Foundation George Gund Foundation Pew Charitable Trusts Rockefeller Family Fund Surdna Foundation Weeden Foundation Wege Foundation	Varies by program	Great Lakes habitat and ecological restoration. Priorities vary by program.
Saginaw Bay Watershed Initiative Network (WIN)	Water Resources—Addresses environmental issues of concern to watershed residents, particularly water quality issues	The Saginaw Bay Watershed Initiative Network (WIN) is a consortium of communities, conservationists, foundations, and businesses working together to balance the region's economic, environmental, and social goals. Website: *http://www.saginawbaywin.org*
U.S. Army Corps of Engineers	**Great Lakes Fishery and Ecosystem Restoration (GLFER)** 506 WRDA 2000 Cost Share 65/35	WRDA 2000 authorized $100 million for the USACE to plan, design, and construct projects to restore the fishery, ecosystem, and beneficial uses of the Great Lakes with 35 percent matching funds from nonfederal project sponsors.
U.S. Army Corps of Engineers	Great Lakes Remedial Action Plans (RAPs)/ Section 401 WRDA 1990 Cost Share 50/50	The USACE supports RAP activities, including physical and environmental monitoring; remedial planning and design; construction management; development of geographic information systems (GIS); computer modeling and analysis; cost estimating; real estate; and public outreach support.
U.S. Army Corps of Engineers	**Habitat Restoration-Project Modifications for Improvement of the Environment/ Section 1135 of WRDA 1986** Cost Share 75/25	The USACE is authorized to plan, design, and construct fish and wildlife habitat restoration measures. To be eligible, restoration projects must involve modification of structures or operations of a project constructed by the USACE, or modification of an off-project site when it is found that the USACE project has contributed to degradation.
U.S. Fish and Wildlife Service	**Fish Passage Program**	The goal of this program is to restore native fish and other aquatic species to self-sustaining levels by reconnecting habitats that have been fragmented by artificial barriers, where such reconnection results in a positive ecological effect. Since 1999, the Regional Fish Passage Program and 33 partner organizations have completed 18 projects that have improved fish passage.

Agency/ Organization	Program	Description
U.S. Fish and Wildlife Service/ Great Lakes Fishery Commission (GLFC)	Great Lakes Fish and Wildlife Restoration Act Public Law 105-265, 25% nonfederal match $500,000 annually	Project priorities identified by the GLFC Lake Committees to be consistent with Great Lakes interjurisdictional fisheries and aquatic ecosystem programs. Emphasis placed on cooperative conservation, restoration, and management of the fishery resources of the Great Lakes Basin.
Dam Owners		Current dam owners must consider the contribution of private funding to enhance fish passage or to remove a dam.
	Natural Resources and Environmental Protection Act, PA 451 of 1994, Lake Level Control Special Assessment District, Section 30704	If a county board finds it expedient to have established the normal level of an inland lake, the county board shall direct the prosecuting attorney or other legal counsel of the county to initiate a proceeding by proper petition for determination of the normal level for that inland lake and for establishing a special assessment district.
	Hydroelectric Owners	

Appendix E:
Funding Programs in other States

Many states currently have dam safety programs that provide a permitting and safety review function. Often the programs are complemented by others that focus on opportunities for assisting dam owners considering opportunities for removal. It is difficult to accurately track which states are involved in funding dam removals, and exactly how they are funding these projects. As a result, the following information is intended to provide an overview of programs in other states, while recognizing that this is not an exhaustive list of state programs.

MAINE[33]

Dam Safety Funding

Maine recently passed legislation to create a $400,000 dam repair fund to be administered by the Maine Department of Environmental Protection (DEP). The Maine DEP is currently developing rules for the program, and it is unclear at this time whether the funds will be available for dam removal.

Other State Assistance and Initiatives

Although the State of Maine does not provide funding for dam removal, it has provided nonfinancial assistance for removal of dams. To help facilitate removal of the Edwards Dam on the Kennebec River, the state took title to the dam and removed it using nonstate funds to cover removal costs. The state is continuing this role, agreeing to take title to other dams that will be removed with nonstate funds, including the Smelt Hill Dam on the Presumscot River.

The purpose behind the State Planning Office (SPO) dam removal policy development initiative in fall 2002 was to solicit input from primary stakeholders on dam removal issues, to respond to a growing interest in this issue, to educate itself and others about pertinent Maine issues, and to create the conditions for a collaborative dialogue leading to appropriate adjustments in Maine policy and law, if necessary. So far a couple of controversial proposals for removal of hydropower generating dams in Maine have been the drivers for much of the debate. A few attempts at dam removal legislation have been offered but were not adopted.

The purpose of the SPO's involvement in the debate arrives out of an impulse to facilitate the development of a constructive and visionary approach to dam removals in Maine. The SPO should in no way be interpreted to be promoting dam removal. The SPO upholds the existing hydropower law and its intent, which recognizes the unique attributes and

[33] Sources: *http://www.maineenergyinfo.com/dam.htm;* Dam Repair Fund: *http://janus.state.me.us/legis/ros/lom/LOM119th/6Pub751-791/6Pub751-791-31.htm;* Edwards Dam Removal: *http://207.57.24.111/archives/arcpolicy/8hisagr6.html*; *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 99.

contribution to the indigenous energy supply that hydropower provides for the people of Maine.

MINNESOTA[34]

Dam Safety Funding

Minnesota does not have dedicated funding for dam repair or removal.

General Environmental Funding

The Minnesota state legislature has funded numerous dam repair and removal projects through direct appropriations.[35] The Minnesota Department of Natural Resources (DNR) provides a list of priority projects to the legislature every two years. One to two dam removals are normally included in the list, resulting in about one dam removal per year. This pace is expected to continue for at least ten years, according to the DNR.

NEW HAMPSHIRE[36]

Dam Safety Funding

New Hampshire does not have dedicated funding for dam repair or removal.

General Environmental Funding

New Hampshire's Fisheries Habitat Program is a relatively new program that provides funding for fish habitat protection, enhancement, and restoration. The program, administered by the New Hampshire Fish and Game Department, provides funding for removing barriers to fish movements within watersheds, including removal of dams. Funding for the program comes from a $1 surcharge on all fishing licenses sold in the state. The program is generating approximately $175,000 to $250,000 per year for habitat improvement projects. Combined with federal matching funds, the Fish and Game Department anticipates that approximately $500,000 per year will be available through the program. Three privately owned dams on the Ashuelot River are scheduled to be removed using funds from this program. The state's dam safety agency is collaborating closely with the Fish and Game Department on the Ashuelot River projects and will conduct the actual dam removal work.

According to the state's dam database there are more than 4,800 dams in New Hampshire. More than 1,600 of them are considered "inactive" because they no longer impound enough water to be regulated by the state. Most of these inactive dams have fallen into disrepair, been abandoned, and/or are now ruins. Although they aren't considered subject to current state dam regulations, some of these structures still pose

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[34] Source: *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*; *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 102.

[35] To see the Cannon and Kettle River case studies in the *Dam Removal Success Stories* report, go to *http://www.damremovaltoolkit.americanrivers.org*, click on "Case Studies of Completed Dam Removals" and then click on "Dam Removal Success Stories Report."

[36] Source: *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 103.

threats to the safety of people who swim, fish, paddle, or otherwise enjoy New Hampshire's rivers.

There are more than 3,200 "active" dams in New Hampshire that are regulated by the New Hampshire Department of Environmental Services Dam Bureau. As is the case in Michigan, a large number of these dams are more than 100 years old and they have far exceeded their design life expectancy. Many of these active dams are no longer serving their intended purpose and have fallen into disrepair. The deteriorating condition of many dams in New Hampshire poses public safety concerns, as well as long-term financial and legal burdens to their owners, which are often communities and taxpayers.

As an increasing number of dam owners and others seek to remove dams in New Hampshire, the DES Wetlands and Dam bureaus have collaborated to develop a permit application process for dam removal projects that addresses the needs of both bureaus and streamlines the process for the applicant.

In 2001, the DES created the Dam Removal and River Restoration Program. The program provides assistance to dam owners, and helps coordinate the involvement of multiple interests throughout the dam removal decision-making, planning, regulatory, and implementation processes. The goal of the program is to develop and implement an efficient and effective means of restoring rivers and eliminating public safety hazards through selective dam removal.

NEW JERSEY[37]

Dam Safety Funding

In 1992, New Jersey voters approved by referendum the Green Acres, Clean Water, Farmland and Historic Preservation Bond Act, which authorized the issuance of $15 million in state bonds to finance a revolving loan program to rehabilitate dams. The New Jersey Department of Environmental Protection (DEP) launched the Dam Restoration and Clean Water Trust Fund in 1994. The loan program is open to private dam owners, such as homeowner associations, but they are required to have a municipal co-borrower. Under the provisions of the law, the municipality can assess the properties that benefit from the project in order to pay off the loan. Under the program, low-interest loans (2 percent interest) with a 20-year maturity were made to 19 projects ranging in funding amount from $175,000 to $2.2 million. All of the loan funds from the original program have been allocated, but will be available again on a revolving basis as loans are repaid. None of the funded projects have been dam removals, but there is nothing in the law or program rules that precludes the funding from being used for that purpose.

In January 2000, the state legislature appropriated $95 million to the program and an additional $15 million for state-owned dams. Revolving loans and grants up to 100 percent of a project's cost are available to local governments. These funds also can be used for dam removal.

[37] Sources: *http://www.state.nj.us/dep/grantandloanprograms/nhr_driw.htm*; *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 104.

NEW YORK[38]

Dam Safety Funding

New York does not have dedicated funding for dam repair or removal.

General Environmental Funding

In 1996, New York voters approved a $1.75 billion Clean Water/Clean Air Bond Act that included $790 million in funding for municipal wastewater treatment improvement, pollution prevention, agricultural and nonagricultural nonpoint source abatement and control, and aquatic habitat restoration; and $265 million in funding for safe drinking water revolving loans. The bond act also authorized $15 million in assistance to municipalities for dam safety projects. By February 2000, $5 million of a total $7 million appropriated had been committed to fund 18 projects. In 2000, the governor's budget recommended an additional $2 million appropriation. Although none of the funded projects have involved dam removal at this time, the funds can be used for that purpose. The program provides grants for 75 percent of eligible costs with a minimum local match of 25 percent. There is a cap of $300,000 of Bond Act funding per project.

OHIO[39]

Dam Safety Funding

The Ohio Department of Natural Resources (DNR) and the Ohio Water Development Authority (OWDA) collaborated in 1999 to create two revolving loan programs to help public and private dam owners fund safety-related repairs and improvements. The DNR regulates the safety of nearly 1,800 Ohio dams, and OWDA provides financing to local governments for projects related to water supplies and water pollution control, such as wastewater treatment and storm water control facilities, as well as dam repairs. Eligible costs for ODWA financing include engineering and design fees, construction costs, and legal and inspection fees. Grants are made on a first-come, first-served basis. Neither program has yet been used to finance a dam removal, but removals are allowed under the program. The two dam safety loan programs are summarized below.

Ohio Water Development Dam Safety Loan Program (DSLP). This program offers loans to local governments (city, county, state agency, and water/sewer/conservation district) to finance improvements and repairs to dams as mandated by the Ohio DNR. Loans are approved each month at an interest rate that is set at 50 basis points above the average for an index of 20-year general obligation bonds. Loan terms can be from 5 to 25 years.

Ohio Water Development Dam Safety Linked Deposit Program (DSLDP). This program is similar to the DSLP except that loans can be made to individuals, private organizations, and businesses for improvements and repairs to dams. The program is unique in that it provides low-interest loans through private banks that participate in the Linked Deposit Program. Interest rates to borrowers are set at a predetermined rate below current rates for U.S. Treasury notes and bonds.

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[38] Sources: *http://nysl.nysed.gov/uhtbin/cgisirsi/pMAv740vnm/209070104/523/50575*; *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 105.

[39] Source: *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 107.

General Environmental Funding

The Ohio DNR removed the Jacoby Road Dam from the Little Miami River in 1997 using funds from the state's Scenic Rivers License Plate Program. Under the program, $15 of a $25 special license plate fee generates approximately $250,000 per year that the DNR uses for projects to protect and preserve Ohio's scenic rivers. The DNR uses the fees to fund its river restoration projects, such as removing the Jacoby Road Dam. Currently, there is no mechanism in place to provide grants with money generated by this program.

PENNSYLVANIA[40]

Dam Safety Funding

Pennsylvania does not have dedicated funding for dam repair or removal.

GENERAL ENVIRONMENTAL FUNDING

The Pennsylvania Fish and Boat Commission (PFBC) has a highly successful consultation and grant program for fish passage and habitat restoration, established approximately ten years ago. The program has raised more than $6 million to date and helped to remove more than 100 dams statewide, and has partnered with a large number of federal, state, nonprofit, municipal, and private-industry partners.

The PFBC is an independent state agency that regulates and manages fisheries and boating in the state. It has been actively involved in removing small dams and other obstructions to migratory fish passage on the Susquehanna River. Using fish passage funds from the U.S. Environmental Protection Agency (USEPA) Chesapeake Bay Program (which requires a 50 percent nonfederal match), the PFBC has worked with local communities to remove at least 31 dams, with plans to remove 30 more. A study of dam removal impacts in the Susquehanna River basin was also funded with $80,000 in USEPA Chesapeake Bay Program funds. The PFBC provides assistance to local communities in the form of free engineering design. It has worked with the Pennsylvania Department of Environmental Protection, which has created a streamlined permitting process to make dam removal less costly and more efficient.

Pennsylvania currently leads the nation in the removal of unwanted dams, with more than 120 dams removed over the past decade. With an estimated 5,000 dams still in the state, many will continue to be scrutinized and ultimately removed.

WISCONSIN[41]

Dam Safety Funding

Wisconsin has developed several dedicated funding sources for dam removal:

Dam Maintenance Repair, Modification, Abandonment, and Removal Program. Grants on a 50 percent matching basis are available for dams owned by municipalities or lake districts up to a maximum $200,000 state share for dam repair, reconstruction, or

[40] Source: *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 108.

[41] Source: *http://www.dnr.state.mi.us/PUBLICATIONS/PDFS/fishing/dams/Paying-Dam-Removal.pdf*, 110.

removal. About 12 percent of the $11.5 million in funds available over the program's 10-year life have been used for dam removal. Nearly all of the $11.5 million originally authorized in special bond funds has been allocated. No additional bonding authority for the program has been authorized.

Abandoned Dam Fund. This program is the only program in the country dedicated to funding removal of abandoned dams that pose safety threats and whose removal offers environmental benefits. The Wisconsin Department of Natural Resources (WDNR) formally declares a dam abandoned and undertakes removal. In the early- to mid-1990s, the WDNR removed two to three dams per year in this way. In the past, the WDNR had line-item budget funds averaging $50,000 per year for this purpose. It is now using approximately $100,000 of designated bonding for this purpose. The WDNR also could allocate additional funds through the municipal grants program to remove abandoned dams.

Small Dam Removal Grant Program.

Counties, cities, villages, towns, tribes, public inland lake protection and rehabilitation districts, and private dam owners can apply for grant funds to remove small or abandoned dams. Small dams are those with a hydraulic height of less than 15 feet and an impoundment of 100 surface acres or less at normal pool. Abandoned dams are those declared abandoned using the process under s. 30121(4), Wis. Stats. The WDNR will fund 50 percent of eligible project costs, with a maximum grant award of $50,000. Eligible project costs include labor, materials, and equipment directly related to planning the actual removal, the dam removal itself, and the restoration of the impoundment.

The three major reasons for dam removals in Wisconsin are as follows:

- Removal of an unsafe structure: Under Chapter 31.19 of Wisconsin statutes, the WDNR is required to inspect "large" dams at least once every 10 years to ensure their safety.
- Chapter 31.187 charges the WDNR with removing "abandoned" dams when either no owner is found or the owner or owners are not able to fund repairs.
- In a few cases, the WDNR have removed or proposed to remove dams that have a significant environmental impact. Many of those are on WDNR properties.

General Environmental Funding

River Ecosystem and Habitat Restoration Program. Legislation creating this program was passed in fall 1999. The program provides planning and project grants related to river protection and habitat restoration activities. The planning grants are capped at $10,000 and project grants at $50,000, with a 35 percent match required from the applicant. Dam removal and land acquisition related to dam removal could qualify for funding under this program.

The Small Dam Removal GIS project involved assembling a GIS database for the dams in Wisconsin's Lake Michigan, Lake Superior, Upper and Lower Chippewa Basins, and then using spatial analysis tools to rank the dams based on the potential benefit of their removal. These rankings reflect the River Alliance of Wisconsin's priorities for dam

removal in the state, and are included at both basin and watershed scales. A variety of ecological and logistical factors were considered in ranking the dams for removal, including:

- Dam density in the watershed
- Fisheries habitat affected
- Endangered species affected
- Potential connectivity restored
- Potential headwaters impacts
- Specially designated rivers
- Water quality mitigation

All together, these factors provide a good snapshot of the relative ecological impact of a given dam in a watershed. When this kind information is combined with considerations such as purpose of the dam, date of last inspection, whether the dam has an owner and is actively maintained, and whether the dam is located in an area that is a management priority, specific watersheds or rivers can be identified that would benefit greatly from selective dam removal. Even if they are not candidates for removal, dams that have a high ecological impact should be priorities for inspection to ensure that they are operating efficiently and in a way that minimizes adverse impact to rivers and water quality.

Approximately 130 dams have been removed from Wisconsin streams since 1967, ranging in size from small dams on trout streams, such as the Cartwright Dam on Shell Creek, to medium-size dams such as the Ontario Dam on the Kickapoo River, to fairly large dams on warm water streams such as the North Avenue Dam on the Milwaukee River.

In recent decades, Wisconsin has seen a large number of its historic dams aging and falling into disrepair. The WDNR has historically offered the owners of these dams the option of repairing the dam to meet current standards or abandoning the permits for the dam and removing it from the waterway. As dam removals have been accomplished over the last 20 years, significant improvements have been noted in water quality, habitat, and biodiversity at many of these sites. The department's activities in these situations have included participating in public information meetings to explain the benefits of dam removal to the surrounding ecosystem and assisting with funding to buy out the owner's interest in the dam. In the future these types of efforts will probably continue on a selective basis, driven by watershed plans that identify dams that are most detrimental to the ecosystem. These efforts cannot be accomplished without a willing owner or a responsible party willing and able to take over ownership of the dam and properly repair, operate, and maintain the structure.

The River Alliance of Wisconsin

The River Alliance of Wisconsin is a nonprofit, nonpartisan group of citizens, organizations, and businesses dedicated to advocating for the protection, enhancement and restoration of Wisconsin's rivers and watersheds, with an emphasis on dam removal. From its inception, the River Alliance has advocated for informed discussion about dams

that considers selectively removing dams that are old, unsafe, and obsolete—dams that are not serving the greater good and causing significant harm.

The Alliance focuses on:

- Building a statewide network of organizations to improve local rivers and watersheds
- Advocating for legislation and policies that restore flowing waters while opposing policies that degrade them
- Educating citizens on the benefits of healthy rivers for their use and enjoyment
- Collaborating with local officials and citizens to restore rivers through selective dam removal

The Alliance serves as a key organization that helps facilitate the dissemination of information that ultimately leads to selective dam removal and river restoration. Its organizational model has proved to be very effective at advocating on behalf of dam owners and other stakeholders with key environmental objectives in mind. The Alliance could serve as an excellent model for other states to consider.

Appendix F: Michigan Case Studies

Like each river system, each dam removal or repair process is unique. This collection of case studies seeks to represent a cross-section and illustrate the broad range of issues that have been or are being addressed on variety of dams in Michigan. Activities on many dam structures are stalled due to insufficient funds to support a definitive course of action.

This appendix includes case studies that focus on:

- Dams that are not being repaired/removed due to lack of funding
- Dam repair successes
- Dam removal successes

DAMS THAT ARE NOT BEING REPAIRED/REMOVED DUE TO LACK OF FUNDING

Chesaning Dam, Shiawassee River, Saginaw County

The Chesaning Dam was built in 1863 as a gristmill. The mill is no longer in existence. The Village of Chesaning is now the owner and maintains the pond in part to float the Chesaning Showboat, part of its annual summer festival.

The Michigan Department of Transportation (MDOT) reported to the MDEQ in 2002 its concern about the safety of the dam, noting a vortex upstream of the center of the dam. Subsequently a portion of the center of the dam collapsed in March of 2006. Since then, the dam has been in partial and continuous failure. The MDEQ has not ordered repair or removal at this point.

The village is developing a design, with the assistance of a consultant who volunteered services, for a series of rock weirs to replace the dam and provide sufficient pond elevation to accommodate the showboat. MDOT has installed a stream-bottom grade-control structure between the dam and its M-57 bridge structure to protect the foundation of the bridge until it can be replaced. The grade-control structure can be incorporated into the city's proposed rock weir design. If no action is taken, the dam will progressively fail, leading to stream degradation.

Costs for the proposed rock weirs are unknown. MDOT has expended approximately $650,000 for the streambed grade-control structure. The village is conducting local fundraisers to gain potential matching funds from the state and federal resource agencies.

Owner: Village of Chesaning
MDEQ Dam Safety ID: No. 360, low hazard rating
Dammed Water Body: Shiawassee River
Dam Height: 9 ft.
Spillway Length: 211 ft.
100-Year Flood Flow over Dam: 11,200 cfs.
Former Use of Dam: Grist mill
Current Use: Water level control for summer showboat festival
Estimated Cost of Removal: Unknown
Estimated Cost of Repair: $625,000 (2005 News article)

Chesaning Dam (partially failed), Chesaning, Michigan

Lyons Dam, Grand River, Ionia County

The Lyons Dam was constructed on the Grand River in 1857. The dam has been modified several times over its lifespan and its present structure is a rock and timber crib core with concrete covering its upstream and downstream faces. A fish ladder was added onto the dam in 1981.

In 1988 the MDNR denied a permit for refurbishing the dam for hydroelectric power by the Grand Lyon Hydro Power Company of Union Lake Michigan. In 1988 the MDEQ found structural and safety deficiencies and "ordered" per Act 184, PA of 1963, as amended, repair or removal of the dam. Since 1988, structural and safety deficiencies have been identified in at least two MDEQ Dam Safety Reports (DSRs). The 1988 report from the MDEQ Dam Safety Unit ordered repair or dam removal because of structural failure and undermining. A 1993 repair plan was prepared, but the work was never started because the village could not obtain an MDEQ permit.

Flood flows induced further damage in 2001 and the MDNR Fisheries Division provided $40,000 for emergency repairs when flooding threatened dam failure around the fish ladder. A flood in May 2004 endangered the dam's stability at each of its banks. At that time the site was watched closely by MDEQ Dam Safety Division officials, emergency management crews and federal resource agencies for its potential to rapidly fail.

In 2003 another DSR was required by the MDEQ, but repairs have still not been made. While the DSU did not issue an action date for repairs or removal, it wrote a strongly-worded letter to the village in 2004, calling for action and asking the village to make its intent to remove the dam official by a resolution of the village council. The council voted to pursue dam removal rather than incur the cost of repair and the responsibility of

perpetual maintenance. An engineering study estimates the cost of removal at $750,000. The village submitted a grant application to FEMA for assistance under its Hazard Mitigation Grant Program in response to the 2004 flood event, but they were denied.

The dam in its current condition is a safety hazard and attractive nuisance. A sudden breach could cause serious erosion on either river bank, threatening homes on the dam's west side; erosion around the bridge piers about 200 feet downstream of the dam; and uncontrolled mobilization of sediments and flash-flooding downstream.

The village is concerned about its liability if the dam were to break, but is does not have the financial resources to remove or repair it. Dam removal was proposed to the residents of Lyons (population 726), and there is some public opposition to it. Nevertheless, Lyons is obligated to invest a substantial sum to either repair ore remove the dam.

Owner: Village of Lyons
MDEQ Dam Safety ID: No. 509, low hazard
Dammed Water Body: Grand River
Dam Height: Approximately 8 ft.
Spillway Length: Approximately 300 ft.
100-Year Flood Flow over Dam: 27,000 cfs.
Former Use of Dam: Hydropower
Current Use: Recreation
Estimated Cost of Removal: $750,000

Lyons Dam, Lyons, Michigan

Mill Creek Dam, Mill Creek, Washtenaw County

The original Mill Pond Dam at this site was built in 1824, and at one time it was owned by Henry Ford. The existing dam is constructed of steel sheet pilings faced with a

masonry spillway. It was built around 1932 when MDOT built the current Dexter Main Street Bridge. The bridge is jointly owned by the City of Dexter and the Washtenaw County Road Commission.

The dam impounds about 20 acres of water. It is in reasonably good condition but the bridge needs to be replaced, providing an opportunity to consider dam removal or repair with modifications for fish passage. The bridge replacement is expected to occur in 2008. The bridge is load limited to 10 tons and it is in desperate need of replacement. The village has passed a resolution in support of dam removal as part of a county bridge replacement and has been actively investigating the project since at least 1999.

Feasibility studies and community outreach and education have been performed and most residents support dam removal. Estimated costs range from $300,000 to $1,500,000, depending upon sediment management strategy and toxicity testing results. A 1996 report by OHM stated removal of spillway with no pond reclamation estimated at $908,000. Reclamation of the pond estimated total project cost would be $1,597,000. The county Road Commission has pledged $400,000 from the bridge replacement projects budget to contribute toward costs associated with the actual dam removal, and will not fund any sediment management per se. If active sediment management or removal of potentially contaminated sediment is needed, Dexter needs to secure almost $1,000,000 in additional funding.

Although the dam is in good condition, its location near a park makes it an attractive nuisance causing public safety concern (e.g., a possible drowning). If the dam were left in place, a sudden breach could cause serious erosion on either river bank, perhaps endangering the stability of the bridge immediately downstream, and it would also release large quantities of sediment downstream in an uncontrolled fashion. Conversely, dam removal would result in restored fish passage between the Huron River and Mill Creek, water quality improvements, public recreational access and passage along the river, improved fisheries habitat and recreational fishing value

Owner: Village of Dexter and Washtenaw County Road Commission
MDEQ Dam Safety ID: No. 324, significant hazard rating
Dammed Water Body: Mill Creek, tributary of Huron River, 0.67 miles upstream of confluence
Dam Height: Approximately 15 ft.
Spillway Length: 71 ft. sheet pile crest, plus earthen embankment
200-Year Flood Flow over Dam: 2,000 cfs.
Former Use of Dam: Mill dam
Current Use: Recreation
Estimated Cost of Removal: $300,000 – $1,500,000

Mill Creek Dam, Dexter, Michigan

Pucker Street Dam, Dowagiac Creek, Berrien County

The Pucker Street dam in Niles was originally built of timber and rock cribs in the 1850's to power a grist mill. The City of Niles bought the dam in 1891 to provide hydroelectric power to its street lights. In 1928 Niles built a new hydroelectric dam just downstream of the original dam to provide power for peak usage periods to the city-owned electric utility. Deteriorating concrete at the dam was repaired in 1939, and the dam's impoundment was dredged in 1944. Sheet piles were added in 1949 to stop an undermining problem at the flume. The left retaining wall failed in 1951 and was replaced with a new concrete wall protected by steel sheet piles. The dam produced power for Niles until 1995, when settlement of the power house caused bearings in the generator to fail prematurely. Until that time, the dam provided only about 2 percent of Niles' power needs. In 1996 an MDEQ permit was obtained for repairs to the dam.

The dam's last dam safety inspection was submitted to the MDEQ in 2000, and the report revealed no significant safety-related action items at that time. Because of this dam, the Dowagiac River has been isolated from the St. Joseph River and Lake Michigan fish have been unable to migrate further upstream. The stretch of the Dowagiac River from the dam to the St. Joseph River has become an excellent salmon fishing spot because of the cold waters of the Dowagiac River and high-gradient waters at the dam site. The Dowagiac River here is perhaps one of the most aesthetically pleasing tributaries of the St. Joseph River, and receives excellent runs of steelhead all year. Highly favored by fly fishers for its gravely pockets, pools, and riffles, it is reminiscent of northern Michigan's hallowed Pere Marquette.

While the dam owner, the City of Niles, does not object to its removal, the city has asked the MDNR to find 100 percent funding for removal and plans to take no action until such funding is found. The city council passed a resolution in February 2003 to "remove the Dowagiac Creek/Pucker Street dam providing that 100 percent financing for the removal of the dam is incurred through public or private funds obtained by the MDNR and that the removal is at no cost to the City."

The MDEQ ordered the dam's impoundment drawn down in 1999 to the level of the concrete spillway, lowering the impoundment about five feet. An unknown quantity of sediment was released downstream during the drawdown. The river's width shrunk from about 100 feet wide to 15 to 20 feet wide after the drawdown as far as the park located about 0.5 miles upstream. The new impoundment totals about 20 acres compared to the former impoundment's 61 acres.

Also at that time, two of the dam's gates were left open to allow run-of-the-river flow past the dam at all times. Upstream riparians were upset and objected to the forced drawdown, and many still feel the drawdown negatively affected their property values. After the drawdown, a sediment trap was constructed just upstream of the dam, and it was cleaned out monthly for a couple of years. Post-drawdown sediment testing by the MDEQ revealed arsenic at just above detectible levels in the sediment taken from the sediment trap. The dam is partially drawn down and has its hazard potential reduced to "Low" in 2005.

According to city sources, the dam's impoundment extends at least one mile upstream, and the cost of removing sediments was once estimated at $1–2 million. Neither the city nor the MDNR has initiated any study to determine the cost or feasibility of removing the dam at this time.

Funding and the potential for disposal of contaminated sediment are the largest issues facing a potential dam removal project. While dam removal has been discussed, it has not yet been presented to the residents of Niles. When it is, some public opposition is expected due to prior experience with sediment management and fish kills.

The dam is an attractive nuisance, and anglers can access the area below its spillway. The risk of a human drowning is evident. There is no urgency to take action since the 1996 DSR cited no immediate safety issues. Eventual failure could cause erosion around the bridge piers about 200 feet upstream of the dam, and uncontrolled mobilization of sediments, fish kill, and flash-flooding downstream.

Owner: City of Niles
MDEQ Dam Safety ID: No. 537, low hazard rating
Dammed Water Body: Dowagiac River (a.k.a. Dowagiac Creek)
Dam Height: Approximately 16 ft. @ current level; 21 ft. at full head
Spillway Length: Approximately 100 ft.; five tainter gates and auxiliary spillway
100-Year Flood Flow over Dam: 1,800 cfs.
200-Year Flood Flow over Dam: 2,000 cfs.
Former Use of Dam: Hydroelectric
Current Use: None
Estimated Cost of Removal: $1,000,000 – $2,000,000 for sediment removal; no estimate for dam removal

Pucker Street Dam, Niles, Michigan

Redridge Dam, Salmon Trout River, Houghton County

The original timber and rock crib dam at this site was constructed starting in 1892 and completed in 1894. The current steel dam at the site, one of only two such dams in the United States, was built just downstream and 20 feet higher than the crest of the crib dam in 1901, inundating the crib dam. The steel dam is a Civil Engineering Historic Landmark as designated by the Michigan Section of the American Society of Civil Engineers in 1985. Both the steel and log dams were listed on the National Register of Historic Places in 1992. Stanton Township took ownership of the Redridge Dam in 1992.

The subject of dam removal was first broached in 1976. Then-owner Copper Range Company had large holes cut in the steel Redridge Dam in 1979 so that it would not retain water, and the earlier timber dam was exposed. In 2001, the MDEQ found that conditions existed that endangered the timber dam and ordered the owner to remove or repair the original wooden and rock filled crib structure. The MDEQ issued a permit in 2004 to remove the top 10 to 12 feet of the wooden crib behind the steel dam. This upper portion of the dam represented the most seriously deteriorated part of the structure. Furthermore, the removal has concentrated the flow into a controlled area where water can discharge freely over the dam. This partial dismantling resulted in a corresponding reduction in impoundment level and minimized the public safety threat.

The recent modifications have reduced the immediate concern with the timber crib dam. However, the township is still considering what the future of the Redridge Dam should be. Eventually, significant repairs or modifications will again become an issue for the dam as it continues to deteriorate.

Due to historic copper extraction at the site, stamp mill operations may have deposited contaminated stamp sand in the impoundment at the dam, which is located within an EPA-designated Area of Concern (AOC) for Torch Lake. Further investigation is necessary to ensure protection of the environment in the event of future dam removal. Local residents would like to preserve the steel dam for recreational use and for its history. Both of these concerns reflect issues that must be addressed in long term planning for the Redridge dams.

Stanton Township's long-term plan is to remove the original timber dam, but there are no funds currently available either locally or at the state level to repair, replace, or remove the dam. Repair costs were estimated between $300,000 and $1,000,000 before 2004.

Owner: Stanton Township
MDEQ Dam Safety ID: No. 91, significant hazard rating
Dammed Water Body: Salmon Trout River
Dam Height: 50 ft.
Spillway Length: 228 ft.
200-Year Flood Flow over Dam: 1,600 cfs.
Former Use of Dam: Stamp mill operations
Current Use: Recreation and historic values
Estimated Cost of Removal: $300,000 – $1,000,000

Redridge Dam viewed from downstream, after the removal of the top 10–12 feet of the dam

Hamilton Dam, Flint River, Genesee County

The original structure was built around 1920 with storage of approximately 100 acre/feet (seven acres of surface area). A ladder design is available for fish passage but is ineffective for most warm water fish species. The 2005 dam safety inspection revealed both hydraulic and structural deficiencies, and the dam was deemed to be in "very poor overall condition." It most recently was used as one of Flint's water supply impoundments. The MDNR's Fisheries Division would like to see this dam taken out to improve the Flint River's fishery habitat. There is a river walk immediately downstream of the dam. A sudden breach could inundate the walkway and sweep pedestrians into the floodwaters. Also, because the dam is an attractive nuisance located near a public park, there is always the danger of a drowning there. A breach may also cause serious erosion on either river bank and at the downstream bridge, and it will also release large quantities of sediment downstream.

In August 2004, the MDEQ's Dam Safety Unit issued an administrative order to Flint to correct conditions at the Hamilton Dam that pose a serious threat to the dam. The City of Flint subsequently proposed a plan to build a replacement dam in 2007–2008 independent of the existing dam, and demolish the existing dam once the replacement is functional. Proposed funding for the estimated $7.5 million project would come from the City's sewer and water fund. The City learned that it would not be able to borrow money from the State Revolving Fund, (SRF), a popular mechanism for sewer and water system improvement projects, if they decided to build a new dam at essentially the same site as the existing dam. To date, a lack of funding has prevented either a rehabilitation or removal. Without a committed and stable source of funding, this dam may well remain in its current condition for many more years.

Owner: City of Flint
MDEQ Dam Safety ID: No. 60, high hazard rating
Dam Height: Approximately 24 ft.; head at normal flow approximately 11 ft.
Spillway Length: 300 ft crest; 198 ft spillway
200-Year Flood Flow over Dam: 34,400 cfs.
Former Use of Dam: Timber mill
Current Use: Backup water supply impoundment and recreation
Estimated Cost of Repairs: $7.5 million

Hamilton Dam, Flint, Michigan

DAM REPAIR SUCESSES

Brown's Pond Dam, Sand Creek, Muskegon County

The original dam on this site was built in 1844 and provided power for a mill. The current dam was built in 1914. The dam creates the 13-acre Brown's Pond, fronted by almost 21 private residences. The pond was home for a time to a tourist hotel, the Rochdale Inn, in the 1920s and 1930s. The Rochdale Inn closed in 1941. At one time, Fruitvale Road passed over the spillway and on top of the dam's earthen embankment, but it was abandoned.

For several years the dam's ownership was in question. In May 2003, the MDEQ wrote a DSR calling for a number of structural and operational improvements at the dam. This dam was recently repaired using funds from the Muskegon County Road Commission (MCRC). The MCRC agreed to pay $25,000 from its operating budget for the MDEQ Dam Safety Unit's mandated repairs. A special assessment district was sought by affected property owners fronting Brown's Pond was formed, and Blue Lake Township was willing to take over ownership after the repairs were completed. Costs to the special assessment district for the dam repairs were $13,383.00. The MCRC received an MDEQ permit for those repairs and completed them in late 2004. Future obligations at the dam will be handled by the 20-parcel special assessment district.

The repairs do not include improvements for fish attempting to migrate upstream in Sand Creek, a designated trout stream. Sand Creek empties into the White River about one mile after it flows over the Brown's Pond Dam. The MDNR Fisheries Division claims that the dam has a devastating effect upon fish populations in Sand Creek. Sand Creek is impounded by this dam, and the White River is located one mile downstream of the dam.

Because the dam is an attractive nuisance there is always the danger of a drowning there. In spite of the MCRC's best efforts, children and anglers can access the dam's spillway. There is also a campground downstream.

Owner: Muskegon County Road Commission (pre-2004), Blue Lake Township (2004)
MDEQ Dam Safety ID: No. 228, significant hazard rating
Dammed Water Body: Sand Creek
Dam Height: Approximately 11.5 ft.
Spillway Length: 260 ft. earth embankment and 20 ft. spillway
200-Year Flood Flow over Dam: 250 cfs.
Former Use of Dam: Mill
Current Use: Mill pond
Cost of Repairs: $25,000

Brown's pond dam (prior to repair), Blue Lake Township, Muskegon County, Michigan

Fallasburg Dam, Flat River, Kent County

During the early 1980s many Michigan retired hydroelectric dams were renovated to again generate electric power. This was in response to greater interest in renewable energy resources and enabling federal legislation, particularly the Public Utilities Regulatory Policies Act of 1978 (PURPA). PURPA allowed for the development of power purchase contracts for renewable resources, energy and business tax credits, and the transfer of power between utility companies that made capital investment in hydroelectric power attractive. Developers still had to acquire a Federal Energy Regulatory Commission license or exemption from licensing and meet state and federal dam safety requirements.

The Fallasburg Dam was the first private/public joint venture for the development of hydroelectric power in Michigan. Owned by Kent County and managed by its Parks Commission, the Fallasburg Dam had pending structural issues regarding its spillway and a deactivated powerhouse. In 1981, the DNR, under Act 184, P.A. of 1963 as amended, ordered repair or removal.

STS Consultants Ltd. (STS) of Northbrook, Illinois, in a joint venture with Kent County, worked out a lease agreement for STS to repair the dam and obtain a power purchase contract with Consumers Power Company. This provided the county the means to address the structural repair and future operation and maintenance of the dam, and allowed for a means to generate revenue for such operations and to meet its desire to keep the dam and its impoundment as a recreational resource in the county. STS during its exemption from licensing worked with the MDNR Fisheries Division to establish and maintain minimum flow release to protect the existing fishery habitat in the Flat River from the main dam to the outlet of the powerhouse tailrace, approximately two miles downstream.

STS owned the powerhouse, and leases the dam from the County. It is estimated the tax revenue over the 35 year contract to local government is approximately $500,000. Cost to operate and maintain the dam is borne by STS.

STS made similar developments at the Ada Dam and the Cascade Dam on the Thornapple River in Kent County; the Morrow Dam on the Kalamazoo River in Kalamazoo County; and the Belleville Lake Dam in Wayne County. Several other developers have renovated existing dams for hydroelectric power; to name a few: the LaBarge and Middleville Dams on the Thornapple River; the Smithville Dam on the Grand River; the Three Rivers Dam on the St. Joseph River; and the Alverno Dam (Black Lake) on the Black River.

Owner: Kent County
MDEQ Dam Safety ID: No. 506, high hazard potential
Dammed Water Body: Flat River
Dam Height: 34 ft.
100-Year Flood Flow over Dam: Unknown
Former Use of Dam: Hydroelectric
Current Use: Hydroelectric
Cost of Repairs: N/A

Leland Dam, Leland River, Leelanau County

Another dam inspected by the U.S. Army Corps of Engineers under the National Dam Safety Program (1975–1980) was the Leland Dam, which controls the level of Lake Leelanau, a very large inland lake. This dam was in poor structural condition in the mid-1970s. At that time the dam was owned by a private individual, the Leelanau Development Company. The MDNR ordered an inspection of the dam, and the inspection report found that the dam needed extensive repairs. In 1978, the MDNR ordered repair or removal of the dam, with Leelanau County assuming operation and maintenance of the dam under an agreement with the private owner.

Lake Leelanau is a valuable resource in Leelanau County and the County Board of Commissioners (CBC) was interested in protecting that resource and the property values it brought to the county. The CBC moved to establish a normal lake level under the Lake Level Act. The special assessment district created included a partial payment by the county for the costs incurred for repair of the dam.

The Leland Dam was again found to be in need of structural repairs in 2004. With the lake level established and the county involved, repairs again were completed in 2005–2006. The Leelanau County Drain Commissioner along with the CBC's Public Works Committee worked jointly on this project to arrange financing for the repairs.

Owner: Leelenau County
MDEQ Dam Safety ID: No. 510
Dammed Water Body: Leland River/Lake Leelanau
Dam Height: 19 ft.
Spillway Length: 75 ft.
100-Year Flood Flow over Dam: Unknown
Former Use of Dam: Retired Hydroelectric
Current Use: Lake Level Control
Cost of Repairs: Approximately $800,000 in 2005

Pontiac Lake Dam, Clinton River, Oakland County

The U.S. Army Corps of Engineers under the National Dam Safety Program (NSDP, 1975–1980) had initial dam safety inspections done on approximately 110 dams in Michigan with high or significant hazard potential. One of these dams was the Pontiac Lake Dam on the headwaters of the Clinton River in Oakland County. Pontiac Lake had a normal or legal lake level established under the existing Lake Level Act. The dam, built in 1921, which maintained the lake level, was operated by the Oakland County Drain Commissioner's Office. Though the initial NSDP report did not identify any significant structural deficiencies, review of the report by MDNR Dam Safety Program staff eventually lead the MDNR to issue a department order for the repair of the dam under Section 24 of Act 146, P.A. of 1961, as amended. The district court, which had continuing jurisdiction of the lake level, reconfirmed the level and established a special assessment district under Act 146. This allowed for the payment for the repairs needed to maintain the dam in a safe condition. Since the lake had public access, the MDNR was part of the special assessment district and was assessed 35 percent of the total cost of repairs of $443,000.

Owner: Oakland County Drain Commissioner
MDEQ Dam Safety ID: No. 265, significant hazard rating
Dammed Water Body: Clinton River, 615 acre impoundment
Dam Height: 19.7 ft.
Spillway Length: Unknown
200-Year Flood Flow over Dam: 150 cfs.
Former Use of Dam: Unknown l
Current Use: Lake level control, recreation
Cost of Repairs: Unknown

Wildwood Lake Dam, Wolverine, Nunda Township, Cheboygan County

Wildwood Lake is formed by the 305-foot-long Wildwood Lake Dam, built in 1961 prior to Michigan's first dam construction law (P.A. 184 of 1963, as amended). The dam was inspected in the 1970s under the National Dam Safety Program and received a high hazard potential rating. Other inspections were conducted under Part 315 of NREPA. The Wildwood Valley Property Owners Association and Club was first notified of its responsibilities for dam safety inspection requirement in 1990. Over six years and working with the Nunda Township Board, a special assessment district was formed to collect costs for the dam safety inspections. This special assessment district was established under Act 188, Public Acts of 1954. Inspections under Part 315 were conducted in 1997, 1999, and 2002.

The 2002 report identified concerns with the spillway. A more detailed report found major deficiencies involving access to the spillway for flood control, and the need to reconstruct the structure. Estimated costs were $500,000. The township was approached again to use the special assessment district (under Act 188—not Part 307 or county drain commission, which are other options for creating a special assessment district for derived benefits).

Public comments were received in June 2005, plans were prepared, and construction and improvements were completed by May 2006.

This project demonstrates how local government can work creatively with a private dam owner to use existing state law to spread costs among those benefited by the dam's continued operation.

Owner: Wildwood Valley Property Owners Association and Club
MDEQ Dam Safety ID: No. 249, high hazard rating
Dammed Water Body: Bradley Creek
Dam Height: 23 ft.
200-Year Flood Flow over Dam: 490 cfs.
Former Use of Dam: Lake establishment for recreation
Current Use: Recreation
Cost of Repair: $500,000

DAM REMOVAL SUCESSES

Big Rapids Dam, Big Rapids, Mecosta County

Before 1834 Big Rapids was known as the Village of Leonard. The name change recognized the active village's most prominent natural feature—the big rapids in the Muskegon River. The area was home to many sawmills and, with the Muskegon River's help, Big Rapids soon became a bustling lumber town. A dam constructed of wooden cribs filled with large field stones was built across the Muskegon River in 1866 to raise the water level so logs could float directly to the sawmills.

The 1866 rock crib dam survived until 1912, when a flood breached it. At that time, dams were converting many rivers into hydroelectric power generators, and so, too, was the fate of the Muskegon River. A new, 17-foot-high concrete dam was built over the failed rock crib dam in 1914 and it soon began generating power. It operated until 1955, when Consumers Power Company and its partners deactivated it.

In 1966 Big Rapids officials deemed the dam unsafe and contracted to have it removed. Unfortunately, the demolition contractor hired to remove the Big Rapids Dam went bankrupt before finishing the project, leaving an ugly, five-foot-high foundation remnant in the Muskegon River. Even worse, when the contractor demolished the upper portion of the Big Rapids Dam, a massive amount of mostly sand sediment was released from behind the dam and deposited itself for miles downstream over the next several years.

Big Rapids bought the dam remnant from Consumers Power for $6,000 in 1976.After a seven-year fundraising effort, the remnant of the Big Rapids Dam was completely taken out of the Muskegon River in 2001. The total project budget was over $1,500,000 although the actual project cost was about $1.2 M and the remainder was directed toward recreational improvements. It was 100 percent grant funded, obtained over a seven-year period by the City of Big Rapids from the following sources:

- Great Lakes Fishery Trust $350,000
- Great Lakes Protection Fund $755,000
- Michigan Department of Environmental Quality $200,000
- U.S. Fish & Wildlife Foundation $100,000
- U.S. Geological Survey $119,000

Since this was the largest and most high-profile dam removal project ever in Michigan, funders were eager to apply resources to this project as it presented an opportunity to study the results of a large-scale dam removal and restore fish passage to over 100 miles of a major Michigan river. This project has spurred great community pride in its greatest natural asset, the Muskegon River, and since the dam was removed the community has shown its overwhelming support by investing more than $1,700,000 in a nonmotorized trail system, called Riverwalk, that follows the restored Muskegon River on each river bank adjacent to the former dam remnant's location.

Big Rapids' Recreation Master Plan calls for increasing the public's awareness and use of the Muskegon River, and both the dam removal and the Riverwalk fulfill the city's

vision. Over $250,000 of the Riverwalk project's cost were raised by a local citizens group called Access for All. Riverwalk provides the community and visitors with a scenic path along the river, with handicapped access.

Owner: City of Big Rapids
MDEQ Dam Safety ID: Unknown
Dammed Water Body: Muskegon River
Spillway Length: Approximately 275 ft.
Dam Height: Approximately 5 ft.
100-Year Flood Flow over Dam: 12,000 cfs.
Former Use of Dam: Hydroelectric
Cost of Removal: $1,200,000

Big Rapids Dam (prior to removal), Big Rapids, Michigan

Dimondale (Wilson) Dam, Dimondale, Eaton County

The Wilson Dam on the Grand River was built in 1880. Consumers Energy and the Lansing Board of Water and Light were the most recent operators a hydroelectric dam on the Grand River in Dimondale. The 150-year-old dam was sold to Dimondale in 2001 and removed in the summer of 2006.

Dimondale officials chose to remove the dam and construct a "W"-weir of rock in its place to minimize sediment movement, provide fish passage and to lower the pool impounded by the former dam. A cross-vane rock weir was constructed in the old millrace, a single rock vane was constructed downstream of the existing dam, and approximately seven rock clusters were placed in the restored stream channel.

The MDEQ and MDNR plan to monitor the project's results in the areas of water quality and fishery and stream habitat improvements. They expect fish and mussel communities to rebound as a result of removing the dam. The Village has plans to construct a new riverside park and trails adjacent to this project.

Project funding came from the Village of Dimondale, the now-defunct MDNR Inland Fisheries Grant Program, and the U.S. Fish and Wildlife Service. Significant volunteer construction assistance was also provided by a local contractor.

Removing the dam, where a child drowned in 1995, also eliminated a serious safety hazard from the community. While it took nearly 15 years of background work for the Village of Dimondale to see its dam removed, it took only three weeks to complete the $500,000 project after it started.

Owner: Village of Dimondale
MDEQ Dam Safety ID: No. 53, low hazard rating (formerly)
Dammed Water Body: Grand River
Dam Height: 12 ft.
Spillway Length: 284 ft.
100-Year Flood Flow over Dam: 11,200 cfs.
Former Use of Dam: Hydroelectric
Cost of Removal: $500,000

Wilson Dam (prior to removal), Dimondale, Michigan

Hersey Dam, Village of Hersey, Muskegon County

The original Hersey Dam was constructed in 1858 for a grist mill and subsequently became a sawmill. The dam failed in the 1940s and was replaced by the current dam. The Hersey Dam's 1997 MDEQ Dam Safety Report found the dam to be in poor condition, with poor structural elements and inadequate hydraulic capacity to pass the 100-year flood. These findings were corroborated in a 1999 DSR update prepared by Wilcox & Associates.

At that time, Wilcox recommended replacement of the Hersey Dam at an estimated project cost of $1,400,000. The village balked at that price tag, and asked Wilcox instead to prepare an estimate for removing the dam. Removal was originally priced at about $425,000 as part of Wilcox's 1999 dam replacement study, but that figure soared to more than $650,000 when the subject was revisited in 2004. Hersey received an MDNR Inland Fisheries Grant to obtain a second opinion on the cost of dam removal, and learned that it could be accomplished for less than $300,000.

Dam removal is the course of action preferred by village officials. The Village of Hersey, received nearly 100 percent grant funds for the dam's removal from sources including the MDNR Inland Fisheries Grant Fund, the National Fish and Wildlife Foundation, the U.S. Fish and Wildlife Service, the Pine River and Paul Young Chapters of Trout Unlimited, and matching funds from the Wege Foundation. Fundraising took over five years to package, and was coordinated through the Muskegon River Watershed Assembly. This dam removal represented significant potential to improve brown trout habitat in the system.

An MDEQ permit for removal was issued and the dam was removed in September 2006. The Hersey River fishery upstream of the Hersey and Miller Dams is considered among the top 15 percent of Michigan's high-quality coldwater streams.

Owner: Village of Hersey
MDEQ Dam Safety ID: No. 319; significant hazard rating (formerly)
Dammed Water Body: Hersey River
Main Dam Height: Approximately 7 ft.
Spillway Length: 40 ft.
100-Year Flood Flow over Dam: 2,400 cfs.
Former Use of Dam: Mill
Cost of Removal: $300,000

Hersey Dam (prior to removal), Hersey, Michigan

Mill Pond, Mt. Pleasant, Isabella County

The original structure was built in 1870 as a power mill and then converted to a grist and saw mill. Remnants of Mt. Pleasant's Mill Pond Dam were removed in 2002 as part of a larger park improvement and stream restoration project. This project has been a community success story and has garnered both engineering and parks and recreation awards.

The project involved removal of the main dam remnant at Mill Pond Park, establishment of a waterway allowing for fish passage and canoeing, and the creation of a recreational area. Engineers created a series of man-made rock-and-sheet piling weirs below the old dam to lower the river's level gradually without lowering the impoundment created by the old dam. This design served two key purposes: it kept impounded sediments from mobilizing downstream, and it also allowed for fish passage. The project also included a pedestrian bridge over the river where the old dam once stood. The project effectively dealt with the aging and failing dam while restoring a portion of the Chippewa River downstream and creating a recreational and aesthetic resource for residents.

Greg Baderschneider, Mt. Pleasant's Director of Parks, Buildings and Grounds, said "This restoration project has not only met and exceeded our expectations, it embodies the spirit of Michigan and our commitment to its abundant natural resources."

This was a Michigan Natural Resources Trust Fund (MNRTF) grant project. The total project cost was $720,000, with a MNRTF grant of $500,000, the maximum available. The balance of the project was paid using local funds.

Owner: City of Mt. Pleasant
MDEQ Dam Safety ID: No. 119 (formerly)
Dammed Water Body: Chippewa River
Dam Height: 16 ft.
Spillway Length: 110 ft.
100-Year Flood Flow over Dam: 13,500 cfs.
Former Use of Dam: Unknown
Cost of Removal: $720,000

Chippewa River rapids (following dam removal), Mt. Pleasant, Michigan

Stronach Dam, Pine River, Manistee County

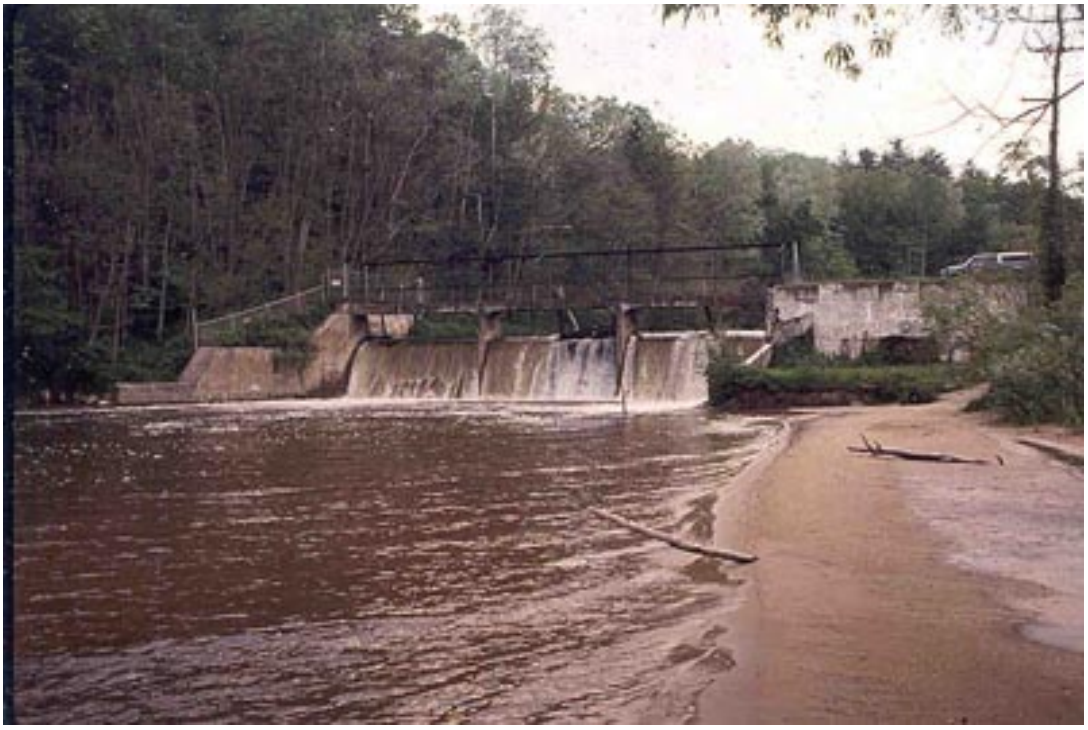
Stronach Dam, on the Pine River, Manistee County, Michigan, was built in 1912. It once generated hydroelectric power, but was decommissioned in 1953. It is an example of an aging structure for which removal made economic sense.

Creative negotiating led to the removal of Stronach Dam as part of an alternative licensing agreement for another of Consumers Energy's hydroelectric projects on the Manistee River. Due to the large amount of sediment behind Stronach Dam, a gradual, or "staged", removal process was decided upon in order to allow the Pine River to gradually restore its channel in the areas upstream of the dam while causing the least amount of downstream environmental impact. The staged removal was planned in 1996 and the drawdown process began in 1997. The dam head was lowered by two feet per year for six years. The final stage of dam removal was completed in 2003.

In 1995, Michigan State University, Department of Fisheries & Wildlife, and the MDNR began a long-term study into the effects of the dam removal and the river's rechannelization on its fish community

The Pine River is a coldwater stream, which flows for about 48 miles before reaching Stronach Dam. Downstream of Stronach Dam, the river then flows for approximately one and a half miles before emptying into another, larger, reservoir. The Pine River supports self-sustaining populations of brown trout, rainbow trout, and brook trout, which are highly valued as sportfish. During the period of dam removal, brown trout and rainbow trout densities have steadily increased, and are now 5–6 times higher than they were at the start of the dam removal. Connectivity has been restored by allowing fish to pass through the former dam site. Thirteen species of fish, found only downstream of the dam before removal, have now been found upstream of the dam. Species diversity has increased in the Pine River, upstream of the former dam.

Owner: Consumers Energy
MDEQ Dam Safety ID: No. 229 (formerly)
Dammed Water Body: Pine River, 66 acre reservoir
Dam Height: 15-18 ft.
Spillway Length: 87 ft.
100-Year Flood Flow over Dam: 850 cfs.
Former Use of Dam: Hydroelectric
Cost of Removal: $750,000



Stronach Dam (prior to removal in June 1996), Stronach, Michigan

Removal of Stronach Dam near completion, November 2003, Stronach, Michigan

Williamston Dam, Williamston, Ingham County

Williamston is named after the three pioneering Williams brothers who settled in the area in 1839. The original dam at this site was constructed in 1840 to run the community's first grist and saw mills; the dam was partially destroyed in a 1975 flood and considered abandoned. Efforts to maintain its impoundment by reestablishing the dam were discouraged by the MDEQ for environmental reasons due to contaminated sediments.

The remainder of the dam's removal took place by replacing the sharp drop-off at its former location by creating a series of stepped-down weirs. As a result, the City of Williamston made national news in 1998 by creating a rare whitewater rapids for a canoeing and kayaking course. The restoration design also provides for fish passage. In addition, this project raised the water level in the impoundment by three feet to restore recreational boating upstream. A $342,000 grant from the Michigan Natural Resources Trust Fund was coupled with $425,000 realized by the sale of Downtown Development Authority bonds to pay for the project.

This is another community success story. A wooden boardwalk now flanks the rapids, which are located a short walk north of Williamston's downtown area. A current project at the site is to restore native vegetation to the river banks, coupled with an interpretive display of native and invasive species.

Owner: City of Williamston
MDEQ Dam Safety ID: Unknown
Dammed Water Body: Red Cedar River
Dam Height: 9 ft.
Spillway Length: 168 ft.
100-Year Flood Flow over Dam: 1,445 cfs.
Former Use of Dam: Unknown
Cost of Removal: $767,000

Red Cedar rapids (following dam removal), Williamston, Michigan