Institutionalizing the option of dam removal: the New Hampshire initiative

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Abstract For two years, the State of New Hampshire has worked to institutionalize the option of dam removal. The high gradient streams that flow through the granite hills and mountains of this small northeastern state provided ideal conditions for dam construction, particularly during America’s Industrial Revolution of the 1800s when mills were constructed throughout the area. With more than 4,800 dams in the state’s database, there are many opportunities for the removal of dams that no longer serve a useful purpose, have become a public safety hazard and impact the river environment. Efforts to facilitate removal of dams in New Hampshire include the formation of a River Restoration Task Force and the creation of a dam removal program within the state agency responsible for regulating dams. This has led to the removal of two dams in the past year, with approximately ten additional projects in various stages of planning. A history of this agency-led initiative, as well as a discussion of the program’s strengths, challenges and goals for the future are presented.

Keywords Dams; New Hampshire; permits; planning; program; removal; restoration; river; safety

Introduction
The State of New Hampshire is located in the northeastern United States, and is one of six states that are typically referred to as New England. With a total area of 24,097 sq km, it is ranked as the 46th largest state in the nation. New Hampshire is bordered on the north by the Canadian province of Quebec, on the east by the State of Maine and the Atlantic Ocean, on the south by the State of Massachusetts, and on the west by the State of Vermont.

Forested, granite hills and the White Mountains provide the geology that allows New Hampshire to serve as the headwaters for five of the great rivers of New England: the Connecticut, the Merrimack, the Piscataqua, the Androscoggin, and the Saco rivers. New Hampshire’s nearly 42,000 miles of rivers have significant drops in gradient and provided ideal conditions for harnessing the power of water through dam construction. More than 4,800 dams are listed in the state’s dam database. Of these, 3,200 dams are considered “active” while the remainder are in a condition that does not require regulation under state or federal law (e.g. very small, incomplete, in ruins, breached). The regulatory responsibility for the vast majority of dams rests with the New Hampshire Department of Environmental Services, Water Division-Dam Bureau. A small portion of the state’s dams (i.e. large-scale hydropower, flood control) is regulated by federal agencies.

Many New Hampshire dams were built during the Industrial Revolution, and they played central roles in the state’s economic and societal growth during that period. Many were constructed to provide mechanical power, and later hydropower, for industrial mills or to provide water for log drives, which made New England famous in the 1800s and early 1900s.

Today, few of these dams still perform their original function. Of the 3,200 active dams in New Hampshire the uses are as follows: fire protection (8% of active dams statewide), hydropower production (5%), water supply (3%), and flood control (2%). The remaining are mostly impoundments that may enable and enhance valued recreational uses such as
boating, fishing, and swimming. While some dams still may serve a useful purpose, many are obsolete and rapidly deteriorating, representing financial and legal burdens to their owners, posing a safety hazard to the public and impacting the health and quality of rivers and riverine species. Many of these dams are excellent candidates for removal.

In less than three years the State of New Hampshire has successfully institutionalized the option of dam removal. This paper discusses the state’s significant advancements that include the formation of the New Hampshire River Restoration Task Force, the creation of a dam removal program within the state agency responsible for regulating dams, the removal of the first dam expressly for the purpose of river restoration, and the establishment of a process for complying with the National Historic Preservation Act, in addition to a variety of state and federal environmental laws.

**Methods**

In the winter of 2000, nearly forty people representing a variety of state and federal government agencies, local interests and conservation groups convened with the objective “to exchange information regarding dam removal experiences, regulatory requirements and funding sources.” This meeting resulted in the conception of the New Hampshire River Restoration Task Force.

This gathering confirmed the belief that a high level of interest in dam removal existed in the state, and provided the momentum for the formation of a dam removal program within the New Hampshire Department of Environmental Services (NHDES). The agency felt that it was best situated to provide the critical role of providing assistance to dam owners, communities and others throughout the dam removal process, and received a two-year grant to pilot the program from the U.S. Environmental Protection Agency New England Regional Office which included funds for a full-time program coordinator.

Initially the agency had the goal of hiring a professional engineer who was familiar with the technical aspects of dam removal but realized that engineering is only one component of dam removal and therefore should not be the critical qualification. The author of this paper was hired for the program coordinator position because of her experience in the interdisciplinary nature of dam removal (i.e. engineering, ecological, economic and societal issues), as well as her experience with conflict resolution in public decision-making processes, fundraising, media relations, public education and the management of multiple projects. In June 2001, the program was officially launched.

New Hampshire is only the second state in the United States to formally develop such a program, Massachusetts being the first to do so. The program is housed within the NHDES Water Division-Dam Bureau, which has the mission of ensuring all dams in the state are constructed, maintained and operated in a safe manner. The Bureau conducts dam safety inspections, permits dam construction and reconstruction, and serves as the primary source of information regarding dams. The Bureau also owns approximately 113 dams, 13 of which generate hydropower, and is responsible for maintaining the 260 dams that are owned by New Hampshire’s state agencies. The Dam Removal Program provides the public with information on dam removal, technical assistance to dam owners and the consulting community in planning a project, assistance in obtaining the necessary permits for a dam removal project, and assistance in developing a funding package to offset dam owners’ costs of removal.

A key component of the program is the assistance and guidance of the River Restoration Task Force, which explores opportunities to selectively remove dams, usually for the purpose of restoring rivers and eliminating public safety hazards. The Task Force is made up of a variety of stakeholders (see Table 1), which speaks to the interdisciplinary nature of dam removal.
After nearly three years of existence, the Task Force meets regularly to discuss specific dam removal projects as well as state-level policies and procedures concerning dam removal. Task Force members often serve on local teams that are created for specific projects. This helps provide consistency among projects and expands the Task Force’s cumulative base of experiential knowledge.

Results and discussion
During its first year the River Restoration Task Force developed a set of objectives that shaped the direction of New Hampshire’s dam removal efforts, and laid the foundation for the subsequent development of the NHDES’s Dam Removal Program. The initial objectives were to: identify potential dam removal project sites; assess the ecological, historical, public safety, and local interest issues associated with each dam removal proposal; and seek ways to improve the regulatory process (Levergood, 2001).

Initial identification of potential projects
The initial identification of potential dam removal project sites was a four-part process that identified: 1) run-of-river dams (i.e., non-flood control) with no identified beneficial use; 2) dams on rivers with existing fisheries restoration programs, specifically for migratory fish; 3) dams with known safety concerns or high potential for future NHDES enforcement action; and 4) dams where the benefits of removal appeared to outweigh the negative impacts. For the dams identified using these criteria the Task Force then applied a series of yes/no questions to gauge owner willingness, hazard mitigation and public safety, ecological value, cultural value, recreational value, and project feasibility. The systematic process allowed the Task Force to objectively select potential projects and demonstrate that the initial selection of projects was neither random nor that specific dams, or dam owners, were targeted for removal without putting them in context with other dams in the state (Levergood, 2001).

Approximately 30 dams were identified statewide, ranging from one to nine metres in height, and under various types of ownership (i.e. public, private and ownerless). A data-
base was developed to catalog these dams, including facts about the structure and dam ownership, and information on the predicted impacts specific to each dam removal. Fifteen of the dam owners were approached to determine their interest in dam removal. Ten initially expressed interest in pursuing removal with the assistance of the Task Force. The Task Force chose to direct its energies toward these projects. To date New Hampshire has removed two of these dams – both on the Ashuelot River (one project is discussed in more detail below). The owners of three dams, whose projects appeared on the initial list but who had not been approached by the Task Force, have since begun to pursue the removal of their dams. Meanwhile, the owners of several dams not appearing on the original list have requested information about dam removal and are seeking assistance in the removal of their dams. The increased interest in dam removal is clearly due to the successful and publicized removal of two dams, and the creation of a Dam Removal Program.

As with many organized efforts, when beginning to pursue the removal of dams, New Hampshire decided to narrow the universe of potential project sites by identifying candidates that met a variety of criteria. This process assisted the Task Force in focusing on a small number of potential projects. While this can be a valuable method of beginning a dam removal effort, it can also be a risky endeavor. If dam owners and/or the general public feel that dams are being targeted for removal (e.g. a “hit list” of dams to remove) the process could cause very strong reactions against the prospect of dam removal. This could not only impact efforts for a specific dam removal, but could also be detrimental to the effort in general.

Despite the intrinsic delicacy of the four-part process, it was useful for identifying initial projects in New Hampshire and led to two successful removals. The Dam Removal Program is currently in the process of expanding and formalizing the criteria in order to prioritize the allocation of limited time and resources available for dam removal projects that have been proposed by dam owners.

**Development of a dam removal permit application**

Task Force members recognized that the existing permitting process for dam-related projects in New Hampshire would not adequately address specific concerns that can be unique to dam removal. Experiences in New Hampshire and other states suggested that the requirement of a variety of separate permits for one project could be confusing and serve as a disincentive to pursuing the option of dam removal. Therefore, NHDES personnel and Task Force members collaborated in the development of a single permit application specific to dam removal projects.

The Standard Dam Removal Permit Application addresses a variety of issues, including some that are unique to dam removal. The applicant is required to provide well-founded answers to questions regarding anticipated project impacts to wetlands, fish and wildlife, navigation and commerce, aesthetics, water supply and quality, historic resources, sediment, riverine ice regimes and the floodplain.

The permit application requires proof of consultation with the State Historic Preservation Office, the state agencies that oversee protected species, and the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory which monitors riverine ice jam incidents. Each of these agencies must decide whether it has an interest in the project. If so, the applicant must comply with the applicable regulations. Other agencies and NHDES Water Division bureaus may review the application materials as necessary for related issues such as water quality, water supply impacts, sediment quality, and impacts to existing infrastructure. The application covers the requirements for state-regulated dams, regardless of size, but does not meet federal requirements for the removal of hydropower dams under Federal Energy Regulatory Commission jurisdiction.
First project, first lessons

Dams located on the Ashuelot River in southwestern New Hampshire rose to the top of the list generated by the Task Force. Since 1995, the New Hampshire Fish and Game Department and the U.S. Fish and Wildlife Service have been working to restore and enhance anadromous fish populations to the Ashuelot River. The Ashuelot, a tributary to the Connecticut River, historically supported runs of Atlantic salmon, American shad, blueback herring, and sea lamprey. These fish populations were severely impacted by the construction of dams, which block access to critical spawning and nursery habitats. While stocking has helped, installation of fish passages on three small-scale hydropower dams as well as the elimination of non-natural fish barriers were seen as essential elements of a restoration plan. In 1999, New Hampshire Fish and Game Department identified three dams on the Ashuelot as candidates for removal, and, with the assistance of the newly formed Task Force, the McGoldrick Dam was the first dam to be removed in New Hampshire for river restoration purposes.

The McGoldrick Dam was a privately owned dam. It was a 1.8 metres high, 46 metres long timber crib dam, capped in concrete. Built in 1828 to impound water for a canal that supplied water to eight manufacturing facilities until 1950, the dam has since served no purpose. There was a minimal amount of sediment accumulated in the impoundment, and what was there was free of contamination. Through late 1999 and early 2000, the Task Force developed a permit application, and set July 2000 as an estimated removal date.

In Spring 2000, project partners learned that the McGoldrick Dam removal project could not be permitted without coordination with the State Historic Preservation Office—the state office charged with ensuring adherence to the requirements of the National Historic Preservation Act of 1966 (NHPA). Upon coordination, project partners were notified that the project was subject to the NHPA and would require an historic resource inventory of the dam and associated properties to determine if the proposed undertaking (i.e., the dam removal) would impact resources of historic significance. The need to comply with the NHPA is triggered when federal funding is provided or when federal permits are required for a project. As both federal funds were to be used and a federal permit was required for the removal of the McGoldrick Dam, it was clear that the project must adhere to the NHPA. Because compliance with NHPA had not been forecast, the removal was postponed by one year and slated for removal in July 2001.

The historic inventory found the dam and canal to be eligible for listing to the National Register of Historic Places. According to the State Architectural Historian, the dam and canal were found to represent a rare survival of an early attempt to harness waterpower on a moderately large scale. In accordance with the NHPA, a Memorandum of Agreement (MOA) was executed between the New Hampshire State Historic Preservation Officer (SHPO) and the U.S. Fish and Wildlife Service, the lead federal agency on the project. The MOA stipulated specific actions that would be performed to mitigate the project’s impact to historic resources. These included taking archival quality photographs to be stored with the SHPO and the local historical society and the installation of interpretive signage concerning the significance of the dam and canal at the former dam site.

The NHDES Dam Maintenance Crew carried out the deconstruction of the dam. The removal was completed through the use of a hydraulic hammer mounted on a backhoe to break up the concrete portions of the structure. A second excavator transferred the rubble concrete and much-deteriorated timber crib to a dump truck that moved them off-site to be used by a local farmer for filling eroded areas of his property. Rocks found within the timber crib structure were redistributed throughout the river channel at the project site. The project was entirely completed in three weeks, at a cost of US$52,300. Financial and technical assistance was provided by the following: U.S. Environmental Protection Agency, U.S. Fish and
Program strengths and challenges

New Hampshire’s dam removal program is rather new but several strengths and challenges can be identified thus far.

The NHDES’s decision to place the program within the Dam Bureau, as opposed to other bureaus that may have a more direct link to river restoration activities, has paid many dividends. The program’s development has allowed for the centralization of information and assistance related to the issue. This has been helpful for the general public, consultants, government agencies and others. It is also the most likely place dam owners will look to for information about dam removal. The location of the program within the Dam Bureau also provides the program coordinator direct access to the dam safety information and to dam safety engineers, who have technical expertise and the personal knowledge of specific dams, such as information about their recent history and their ownership. Likewise, the Dam Bureau staff has the opportunity to learn about the value of dam removal, appropriate methods for removing dams and the value of free-flowing rivers.

Another noteworthy strength is that the Dam Bureau has a Dam Maintenance Crew that operates, maintains and repairs the 260 state-owned dams. This crew removed the McGoldrick Dam, and future projects will be removed with their assistance. This has served two important purposes. First, based upon cost estimates for similar projects, the State’s crew can conduct the physical removal of a dam at considerably less cost than contracting to private parties. The costs of the removals are not borne by the Dam Bureau budget; the expenses (e.g. labor, materials, equipment) are paid through funding packages that are developed for each project. Secondly, by using the State’s crew, the NHDES has been able to closely coordinate the design and implementation of these first removals in New Hampshire, allowing regulators to directly determine appropriate methods for removal, and learn valuable lessons in the process.

Given the number of dams New Hampshire plans to remove in the future it is clear that the Dam Maintenance Crew will not be capable of handling all the projects. Nor will the program coordinator be capable of managing the number of potential projects that have arisen since the formation of the program. Therefore, dam owners and others will become increasingly dependent upon the private consulting and contracting community. However, it is clear that the consultant community is in need of training on the issue. To date, conceptual project plans and cost estimates developed by consultants have included questionable methods and have been very expensive, even in comparison to similar privately-conducted projects in other states. Firms with an interest in dam removal have tended to be large engineering firms with significant experience in dam building and repair. Most of these firms lack expertise in fluvial geomorphology and lean toward planning projects with a focus on the dam structure and on stabilizing the site, as opposed to restoring the river to a naturally dynamic state.

Consultants are certainly not the only ones in need of training and education on dam removal and natural river processes. Of equal importance, state and federal agencies with various authorities relevant to dam removal permitting and design processes tend to lack experience and understanding about dam removal. There is a need for education and training related to dam removal and its impacts to rivers, wetlands, existing infrastructure and flooding regimes. To help meet this need, the Dam Removal Program has assisted in planning a four-day technical course on dam removal and fish passage techniques, to be held in New Hampshire in October 2002. A second four-day technical course on natural channel design methods in river restoration is also tentatively scheduled for Spring 2003.
Every dam removal project provides lessons, ranging from the decision-making process to the method of physically removing a dam. New Hampshire’s first experiences have highlighted the need for early inter- and intra-agency coordination with all relevant state and federal agencies. The most important lesson learned through the McGoldrick Dam removal was that, in the pursuit of restoring rivers, the cultural and historic value of the property must be considered. It is now well understood that historic preservation interests must be involved early in the planning of the project. A lesson of this type could only have been learned through experience.

In the case of the McGoldrick Dam removal, the project was postponed for a year because of the unplanned need to comply with laws pertaining to historic preservation. The State Historic Preservation Office (SHPO) is now part of the Task Force and is routinely consulted early in the project planning process. In an effort to standardize the process, the SHPO and NHDES have developed generalized guidelines for conducting architectural and archaeological resource reviews specific to dam removal projects. However, a learning curve remains, and projects continue to experience delays, largely due to the fact that dam removal is new to the state. The Dam Removal Program and the SHPO are working to develop a standardized and predictable process.

Coordinated efforts between the Dam Removal Program and the SHPO are an example of how the Task Force enables valuable relationships. The Task Force has played a critical role in building trust, fostering mutual respect and increasing understanding of the multiple interests that converge on the issue of dam removal. The Task Force generates a culture of learning about the various issues related to dam removal decisions, planning and implementation, and helps to direct the future efforts of New Hampshire’s Dam Removal Program.

A more fundamental challenge – for both New Hampshire and the nation – is that many existing state and federal environmental regulations triggered by a dam removal project focus on environmental protection, rather than the associated environmental restoration activities. There is a combination of challenges. Some regulations are not easily adapted to restoration activities. Some include guidance on restoration activities, but are not commonly applied or enforced as such by the relevant regulatory agencies. And, some laws actually discourage environmental restoration efforts because they deviate from the status quo (Bowman, 2002).

To date, the New Hampshire experience suggests that an increased understanding of dam removal and its impacts to rivers allows for accommodation of different requirements than those that are standard for implementing traditional development projects (e.g. construction of dams, bridges, pipelines). A key difference is that traditional development projects often require maintenance for years to come, resulting in repeated impacts to the environment. Requiring similar construction methods during restoration projects, because they are required for development projects, may actually exacerbate temporary project impacts and/or cause long-term impacts to rivers. An example of this would be requiring that a temporary trap-rock road or pad be installed in the river channel in order to keep equipment off the stream bottom and out of the water during construction. This might be necessary given some site conditions (e.g. a stream with silt substrate during certain flow conditions). Given other site conditions, this might be unnecessary (e.g. a stream with cobble substrate during low flow conditions), and the goal of alleviating impacts to the river might be better served by shortening the project’s time period and not requiring a trap-rock road/pad, which impacts the river twice – when it is installed and when it is removed.

Certainly, broad-brush exemptions from environmental protection laws for restoration projects are not advisable because environmental restoration projects do have impacts that need to be reviewed and minimized. The author concurs with Bowman’s (2002) recommendation that
A better approach may be to provide regulatory direction or guidance that allows a decisionmaker to provide some accommodation for projects with restoration as their primary purpose. For example, a state or federal agency could establish a policy that enables flexibility in the interpretation of permitting requirements when a proposed project’s primary purpose is environmental restoration. An agency could also direct permitting officials to consider the long-term benefits of a restoration project as mitigating factors in determining whether the short-term impacts of a project are acceptable. The challenge is to develop this in a fashion that avoids the appearance (or reality) of unfair treatment or relies so heavily on professional judgment that it renders the regulations unpredictable or unenforceable. And if restoration activities are given special accommodation, it will be especially important that the project proponents demonstrate that the restoration goals were actually met.

There are discussions underway in New Hampshire to create certain exemptions to the State standard of not allowing equipment in the water. With an ever-increasing number of restoration projects on the horizon in both New Hampshire and nationwide, future discussions are likely regarding revisions to, and the application and enforcement of, existing regulatory policies.

Conclusions
The New Hampshire initiative has shown that there are many benefits to an agency-led effort to institutionalize the option of dam removal. It can enable efficiencies for both statewide and project-specific efforts. It can provide valuable public education and outreach opportunities regarding the interdisciplinary nature of dam removal. It can result in creative approaches and solutions through public-private partnerships, and it can play a critical role in building relationships among parties that must work together to achieve successful projects.

The NHDES recently underwent a five-year strategic planning process through which many goals were set for the Dam Removal Program, including: developing new Dam Bureau rules regarding procedures for dam removal; developing a guide to the regulatory requirements associated with dam removal in New Hampshire; developing a system of prioritizing dam removal projects; establishing guidelines to appropriate dam removal methods, in collaboration with all relevant NHDES bureaus; providing training opportunities on dam removal and river restoration for both public agency personnel and the private sector; creating a staff position that provides agency expertise on fluvial geomorphologic concepts; and monitoring the effects of dam removals on three river systems through partnerships with academic institutions, local stakeholder groups, agencies and other interests.

The State of New Hampshire’s accomplishments in the first years of its initiative have created a strong foundation for the future of dam removal in the state. In the coming years the many partners of the Task Force look forward to restoring rivers and making New Hampshire’s waters safer for the public through the selective removal of dams.

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