# Looks Like We Might Need to Do Something about That Old Dam of Ours!

*by Randall J. Passmann*

New York's dams are aging and there are over 5,500 of them. The New York State Department of Conservation (DEC) records indicate that 58 percent of the dams around the state are at least 50 years old and 30 percent are at least 80 years old. A majority of the over 5,500 dams known to the DEC are privately owned, followed by local government, New York State, public utilities, and the federal government, in descending order. Many existing dams were designed and constructed using now superseded standards and practices. The lifespan of a particular dam is often a function of the level of ongoing repair and upkeep effort. Smaller dams, without adequate expenditure for proper repair and maintenance, seem to suffer the most from neglect and deterioration.

DEC regulations separate dams into three hazard classifications: High Hazard (Class C), Intermediate Hazard (Class B), and Low Hazard (Class A). The hazard class is essentially a function of a dam's threat to public safety due to its potential to cause loss of life and downstream damage if it were to fail. The higher the dam's hazard class, the greater the design flood event it needs to safely convey.

The Environmental Conservation Law (ECL) emphasizes that the safety of dams is of paramount importance and it is the dam owner's responsibility to operate and maintain their dam in a safe manner. The ECL gives the DEC regulatory authority over dams in the state. The DEC's Dam Safety Section (DSS) is currently working through the regulatory process for revising New York State's dam safety regulations to clarify what is required of dam owners to routinely inspect and maintain their dams in a safe manner. The revised regulations, when adopted, are expected to prompt owners of deficient dams to either repair their dams or to review other alternatives to address the identified deficiencies. The no-action alternative is increasingly unacceptable due to safety issues and regulatory requirements.

The evaluation of financial alternatives to fund dam repair projects is beyond the scope of this article but can include:

- Selling the dam to a responsible owner capable of addressing any dam safety deficiencies
- Forming a Lake Association or Special Taxing District to fund repair, inspection and maintenance costs
- Partnering with a Non-Government Organization (NGO) to promote fish passage through partial breach of a dam, or fish passage addition
- Installing hydroelectric power generating equipment or repairing an existing system to provide a revenue source

## Experienced Engineers Needed

There are a number of engineering methods to address a dam's spillway capacity and stability deficiencies. Commonly used methods to address these deficiencies include enlarging spillways, tension anchoring, and adding structural mass; however, partially or completely removing a dam can also be a cost-effective solution. The particular method chosen requires careful planning and reevaluation throughout the design process, from the project concept stage to design completion.

From the time when conceptual project approaches are developed, it is important to consider the amount of existing engineering data available for a given dam and the potential effect on project cost. These data can include original design record documents; the results of previously completed engineering site investigations; and hydrologic, hydraulic, and structural evaluations. The investigation and design cost, to demonstrate that the dam meets dam safety criteria, may be substantial. A consultant with specific experience on similar projects can help define the overall project and prepare an accurate total project cost estimate. The life-cycle-cost of different alternatives, using a net present value type analysis, can be used for comparison. As the design progresses, the construction cost estimate can be updated, so there is no big surprise when the work is bid.

## Dam Breaching Options

A partial or full breach of a dam is an approach that is being considered by many dam owners to significantly reduce or eliminate future dam liability. The approach selected must lead to a long-term stable situation. For example, just opening a dam's low-level drain and walking away, often leaves a condition that is prone to blockage by debris, and the dam can unexpectedly begin retaining water again.

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*Photo courtesy of NYSDEC*

*Photo courtesy of NYSDEC*

**Example of a dam before and after a partial breach project: the remaining low-level drain outlet is discernable along the right edge of each photo.**

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This may create an uncontrolled situation where a "developing emergency" is created, possibly causing the local municipality to take emergency action to protect the public. This could potentially expose the owner to legal and regulatory liability.

A ***partial breach*** of a dam, sometimes referred to as partial removal, can increase spillway capacity and can sometimes be done by modifying an existing undersized spillway. If the maximum impounded water volume is decreased, resulting in a reduced potential floodwave and associated downstream inundation area, the potential hazard to downstream properties may also be decreased. A partial breach project could be limited to lowering the primary spillway elevation to reduce the volume stored in the dam's normal pool. The project could be expanded to include constructing a larger breach in the dam so that no water is impounded during normal flow, yet some structure remains. Portions of the hydrologic and hydraulic analyses can be conducted using computer modeling programs such as the Army Corps of Engineers' HEC-RAS to determine and compare the pre- versus post-modification downstream impacts of a hypothetical dam failure. Lessening the impact of the hypothetical dam failure can sometimes result in a lower hazard classification. The analysis can provide conclusive data to substantiate it as well as modification of an existing emergency action plan or declaring an existing emergency action plan to be no longer necessary. The analysis results can also be used to support a reduction in the required spillway capacity, or an increase in the calculated stability factors of safety, due to reduced design loads.

Another approach is a ***full breach*** of a dam. What distinguishes this type of project from a partial breach is that no structure of the demolished dam significantly remains to affect the hydraulics in the former dam location. A full breach project would likely include removal of the dam structure, down to the existing downstream streambed elevation, and excavating sediment in a controlled manner, proceeding in an upstream direction from the former dam location. The excavation would be done to create a stream reach with an engineered grade line and route that minimizes further erosion of sediment. For a full breach project, computer modeling programs can be used to evaluate the stream dynamics in the area of the dam, both upstream and downstream, to demonstrate the stability of the remaining streambed. The reconstructed streambed would be hydraulically similar to the existing upstream or downstream reaches.

In New York, an Article 15 Dam Safety Permit is required for partial or full breach of a dam. A Dam Safety Permit application needs to include the items listed in 6NYCRR Part 608 and additional information as deemed necessary by the DEC. For this type of project, the application should include the following:

- Completed Joint Application Form and Supplement D-1
- Construction Plan Set, including for example:
  - plan, section, and detail drawings sufficient to show the work
  - demolition plan
  - control of water plan, to demonstrate a dry breach approach
- Construction Specifications including, for example:
  - disposal of debris/materials
  - size and placement of rip-rap and other materials
- Engineering report including, for example:
  - downstream hazard assessment for the proposed configuration
  - pre- and post-modification hydrologic and hydraulic analyses with an assessment of the need to revise flood insurance rate maps
  - geotechnical investigation data and design
  - structural stability evaluation

■ Emergency Action Plan (EAP) for "C" and "B" Hazard dams, and
■ Inspection and Maintenance Plan for "C" and "B" Hazard dams.

Some other considerations unique to partial and full breach projects, which may require engineering attention, include these:

- Limits of earthwork and remaining channel configuration
- Hydraulic properties of spillways functioning as fish passages
- Channel reconstruction or restoration so as not to leave a head cutting condition
- Updating or even closeout of existing EAPs, which are no longer applicable

Dam safety concerns and scope of review does not cover the full range of environmental issues. Some other issues that may need to be considered include:

- Not removing invasive species (i.e., Lamprey eel) barriers
- Sediment testing, characterization and disposal
- Stream health determination, downstream macro invertebrate monitoring and geomorphic assessment

The stakeholders involved with these and other environmental issues are identified by the DEC regional Division of Environmental Permits staff during the application process.

Guidance, including references for technical assistance and tools to help guide applicants through the dam removal process is planned to be released later in the year. The NYS Department of Transportation, the Thruway Authority/Canal Corps, the US Fish and Wildlife Service, numerous NGOs and the DEC are participating in this effort.

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