Barrier Modification

There are five alternative types of barrier modifications. They are intended to eliminate either all or some of the negative physical, chemical and biological effects of barriers on rivers and streams by directly modifying or bypassing the structure and the impoundment. Early consultation with OMNR and the local conservation authority is recommended.

Barrier Removal

Removal involves the demolition and excavation of the man-made barrier and rehabilitation of the site to a more natural condition. It has been said by many professionals in the field of fisheries management that breaching dams and weirs is the single most important and essential step in restoring populations of species that have been degraded or on the brink of extinction. It may also be the most pragmatic alternative that protects public interest. Breaching of a barrier is intended where the structure is no longer safe, represents a significant risk of failure and environmental harm or not economically viable to maintain. Many of our aging dams are significant hazards to public safety. By removing the obstruction and restoring the area to a more natural condition, the natural physical, chemical and biological processes eventually recover. A renewed public interest in river recreation activities, such as canoeing, kayaking, fishing and rafting, sometimes evolves from barrier removal.

This alternative is well suited in situations where the planning process has identified that the dam or weir no longer serves the interests of the public. Technical concerns exist in relation to managing accumulated sediment, demolition, channel rehabilitation and long-term monitoring. Usually, the decision to move forward with this alternative is based on the economic analysis of the situation. An informed position is reached through the planning process where the benefits of the barrier have been found to no longer outweigh the harm it imposes. Recent studies in the United States have shown that removal typically costs 3 to 5 times less than the cost of keeping functionally obsolete barriers. When faced with the potential financial burdens of repeated dredging, dam inspections, maintenance, repair, safety hazards and liability, the economic benefit of dam removal far outweighs the cost of keeping the barrier in place.

Each barrier removal project has its own unique set of issues. Despite the benefits of dam removal, there will always be opposition within the community. Strong emotional ties, claims of historical significance and decreased property values are common issues raised during public consultation.

For dams and weirs greater than 1.0m high, this alternative is typically designed and implemented by professional contractors. With large dams, extensive channel reconstruction work is required. For smaller dams and weirs, it is possible to remove the structures using volunteers and hand tools. Costs can range from $500 for small weirs to over $200,000 for large dams. Sediment control and site restoration are important components of the removal plan that should be considered and adequately address prior to demolishing a barrier.

The demolition of beaver dams is generally not a recommended alternative for rehabilitating river

health. However, there are circumstances where public safety could be at risk and it is within these situations that removal is considered appropriate. Similar consideration should be given to the control of sediment during and after removal.

Partial removal of a barrier can restore some natural processes in a river.

Partial Removal

Partial removal allows a portion of the original structure to remain while also removing a sufficient amount of the obstruction to restore river health or fish migration. Partial removal of a river obstruction, such as a dam or weir, maintains a portion of the original structure. This includes weir notching. Depending on the degree of removal, some river processes will return but it is possible that this alternative only provides a partial solution to the problems identified.

This alternative is well suited for situations where the cultural heritage attributes of the barrier represent a regionally significant public interest. It is also a viable alternative where site conditions indicate a low risk of sediment discharge from the impoundment. Partial removal can restore sediment transport, link previously fragmented habitats, improve water quality and recreate a flowing river upstream of the barrier. It is feasible to combine partial removal of a barrier with a rocky ramp downstream of the structure to restore upstream fish passage. The cost to notch a weir or remove a portion of a dam varies depending on the scope of work involved. Partial removal projects on the Humber River in Toronto have ranged from $2,500 to $60,000.

Volunteers can implement this alternative when the barrier is small. Carving into larger barriers typically involves hiring a concrete cutting company to remove portions of the barrier. Sediment control and site restoration should be considered and adequately addressed in the project plan prior to modifying a barrier.

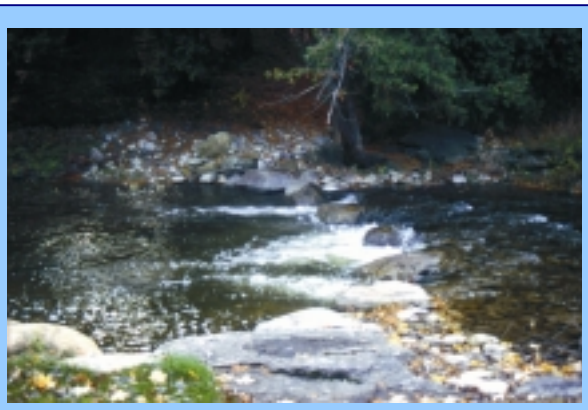
Rocky ramps are built to mimic a natural riffle and improve connection between habitats.

Rocky Ramps and Vortex Weirs

This alternative is typically used to mitigate the impacts of weirs that are less than 2m high.

The rocky ramp is a layer of rock placed over the obstruction in a manner that resembles a natural riffle. The rock can be placed over the obstruction to also form a longitudinal series of riffles and pools. By removing the vertical drop and replacing it with a shallow sloped riffle, fish migration and aquatic habitat is restored.

Where the channel form permits, rock vortex weirs can be built with large stones to help build the grade of the river below the drop structure or weir. This helps reduce the slope of the rocky ramp over the barrier.



Rock vortex weirs are used to help build the grade of the stream below a barrier.

This alternative typically maintains the characteristics of the barrier under a layer of round rock. It is well suited to small barriers on headwater streams. Costs are dependent on the size of the barrier and the river or stream. Cost can range from $200 on a small stream to $200,000 on a larger river. Stone size should match or exceed the size recommended in the sediment transport study.

Volunteers can design and implement this type of project, however, professional guidance is suggested.

Outlet Conversion

Outlet conversion modifies the route water takes through the barrier as it leaves an impoundment. Beaver dams and man-made dams that discharge surface water are similar in nature as they allow warm water in the summer to pass downstream. In winter, colder water passes downstream. Outlet conversions change the way in which water leaves the impoundment or pond so that the cooler water, found on the bottom of the reservoir, is discharged downstream in summer months. In the winter, the influence is the reverse, allowing the warmer waters from the bottom of the reservoir to continue downstream.

Outlet conversion is a practical and economical choice that can mitigate the temperature impacts of barriers where other alternatives are not feasible. Costs can range from a few hundred dollars to several thousand dollars based on the complexity of the outlet conversion and site conditions.

A bottom draw conversion on a dam can be effective where the depth of the impoundment is greater than 4 metres.

Beaver dams on a fragile stream can be damaging to a rehabilitation project. However, the wetland that is created by a beaver pond can be beneficial to wildlife. To mitigate the effects on water temperature, a "beaver baffler" device is a type of outlet conversion that can be used to help reduce the downstream water temperatures below a beneficial beaver dam. They can also be used to discourage beavers from building dams. Beaver bafflers are also known as Clemson Levelers. They cost about $400.00 to build and easy for volunteers to install.

Beaver bafflers can be used to help reduce downstream water temperature (CVC photo).

A temperature and oxygen profile study in the impoundment will help determine whether this alternative can provide benefits to downstream water temperatures. Obvious temperature layers, or stratification, should be evident in summer and winter in order to make this alternative beneficial. This is typically observed where pond depth at the outlet is greater than 4 metres.

Bypass Channels

Bypass channels involve the creation of a new stream or river channel around the barrier to connect upstream and downstream sections of a river. In most cases, the original barrier and impoundment are left untouched. River processes, such as sediment transport and fish migration, can be restored using this alternative.

However, where space is constrained based on native soils, topography or the size of the impoundment, a bypass channel may be limited to only around the barrier and connected to the impoundment. The volume of flow passing through the bypass channel may also be limited to a fraction of the river's flow. In this case, one can only expect to achieve fish passage and the design will not address the myriad of other river processes. It is therefore important that one consider the entrance location and velocity requirements of fishways in the design of this form of bypass channel.

The bypass channel is typically based on natural channel design principles and constructed with a series of riffles and pools on a 5% grade or less. The main constraint to consider in the selection of this alternative is character of the floodplain in relation to the impoundment. In some cases there will be insufficient space available to accommodate a bypass channel. Where space is available, grading plans will need to consider channel slope, soil type, timing of construction and sediment control measures. One of the benefits of building bypass channels is that they can be built "in the dry" to avoid sediment discharge into the stream.

Barriers on smaller streams are more easily rectified using bypass channels than larger rivers. The cost to construct a bypass channel can range from a few thousand dollars to several hundred thousand dollars depending on the size of the stream and the construction complexity. A recent bypass channel created for a small stream on the headwaters of the Humber in Caledon cost about $6,000 to implement yet a bypass channel for Toogood Pond in Markham cost over $150,000.

Where space is limited, a bypass channel may be restricted to only connecting the river with the impoundment. (Toogood Pond, Rouge Park photo)

As with the cases with most projects involving natural channel design, seek professional assistance in the design and bypass channels. Consultation with OMNR and conservation authority staff can be helpful in determining the appropriateness of a bypass channel for your local barrier management project.

Demonstrations

Barrier modifications have been applied in the following demonstration projects:

Barrier Removal

- Project #3, East Red Wing Creek
- Project #41, Devil's Creek
- Project #52, Mill Creek
- Project #54, D'Aubigny Creek
- Project #55, Rest Acres Creek
- Project #71, Humber Riffle Creation
- Project #86, St. Helen's Creek
- Project #89, Normandale Pond Removal

Partial Removal

- Project #113, Harvey Brown's

Rocky Ramps and Vortex Weirs

- Project #33, Pottery Road Weir Mitigation
- Project #35, Dunbarton Creek Rehabilitation
- Project #94, Martin Property - MacIntyre Creek

- Project #98, Orchard Creek Fish and Wildlife Santuary
- Project #102, Petticoat Creek Rehabilitation
- Project #134, Stoney Creek Enhancement Project

Outlet Conversion

- Project # 29, Scottsdale Farm
- Project #97, Boyne River Rehabilitation Project

Bypass Channel

- Project #2, Slabtown Bypass Channel
- Project #70, Palgrave Dam Aquatic Habitat Restoration Study
- Project #97, Boyne River Rehabilitation Project
- Project #110, Parkview Dam Bypass Channel
- Project #112, Toogood Pond Sediment Removal and Restoration Project
- Project #114, Curcio's Bypass
- Project #121, Christian Blind Mission

For More Information

Please refer to the following authors and their respective publications located in the bibliography:

- Dam Removal Success Stories: Restoring Rivers Through Selective Removal of Dams That Don't Make Sense (Friends of the Earth, Trout Unlimited and American Rivers, 1999)
- American Rivers Internet Web Site http://www.amrivers.org
- Options for Controlling Beaver on Private Land (OMNR, 1994)