A Path Toward More Resilient Culverts

1. **Adequate funding:** Despite the long-term cost savings of improved culverts and the many benefits, the initial investment is a major deterrent to highway departments that are short on cash. While the installation cost for an improved culvert can be 15% to 100% higher than that for a more traditional design, delaying the redesign of the most problematic road-stream crossings will result in higher cumulative costs over time than the incremental additional cost of right-sizing the culvert now. Sustained, sufficient funding streams—including grants and low-interest loans from federal and state sources (e.g., environmental funding, transportation funding, and disaster mitigation funding)—are essential to help highway departments make cost-effective investments.

2. **Improved information:** It would be impossible and impractical to upgrade every stream crossing under every roadway; also, it is unnecessary. Community leaders can make informed decisions about where to invest in enhanced stream crossings, setting priorities based on ecological and social importance. On-the-ground expertise, coupled with efficient record keeping, can help highway departments track the costs and performance of their culverts, including maintenance and replacement. Creating a feedback loop to assess and evaluate culvert designs—and weighing these against costs and benefits—can help towns and highway departments be more strategic.

3. **Standards, regulations, incentives and plans:** Local and state governments can adopt science-based standards for stream crossing design, and the standards can be incorporated into regulations and permit requirements to ensure their application. Financial incentives should also be provided for towns and counties that adopt and effectively implement adequate codes and standards for stream crossings. By ensuring that priority culverts are clearly identified in key planning documents such as hazard mitigation plans, communities can ensure their eligibility for potential funding.

In the face of more extreme storms and other climate-related changes, communities will encounter many challenges. Improving our stream crossings is a cost-effective and concrete action that can prepare communities for a changing climate while also benefiting our streams and rivers.

Photo: John Eldridge

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Where the River Meets the Road

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Investing in Improved Stream Crossings Benefits Communities and Natural Systems

Road-stream crossings, which include culverts and bridges, are an essential element of our transportation networks, allowing roads to pass over rivers and streams. Our communities and our economies depend on functioning road networks, safe crossings, and healthy rivers and streams.

Undersized or poorly designed crossings fragment streams and disrupt the natural movement of water, sediment, and aquatic organisms, causing erosion and degraded habitat. The most problematic of these crossings prevent aquatic organisms from accessing the upstream habitat they need to survive and reproduce. Increasing temperatures make these upstream sites, which provide cooler pockets of habitat for cold-water dependent species such as brook trout, even more important for survival. Crossings may also restrict the natural flow of the stream, which can lead to clogging and flooding, as well as erosion, especially during major storms.

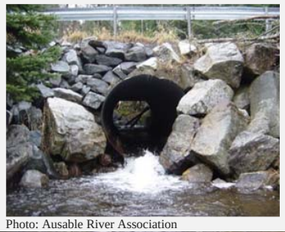

Photo: Ausable River Association

Photo: Ausable River Association

These undersized culverts are "perched" above the stream and act as barriers to the movement of fish. The depth of water through these culverts is too low for many organisms to move through them.

The good news is that stream crossings can be designed to avoid these problems. Improved crossings deliver ecological, economic and social benefits, and they are a key element of adapting our infrastructure to a changing climate.

Strengthening the Highway Department Bottom Line

Upgrading culverts to the right size and design provides a long-term economic benefit to communities. Undersized culverts require more frequent maintenance and replacement than upgraded designs. Accordingly, when maintenance and replacement are factored in, **the average annual cost of a right-sized culvert can be lower over its lifetime than that of an undersized culvert** over the same time frame.[i]

Photo: Ausable River Association

During major storms, undersized culverts fill with water, clog with debris and worsen flood impacts. Over time, water passing through poorly designed culverts scours away surrounding soil and increases the likelihood of sudden failure during large storms. Culvert failure causes road collapse, impairing safety and degrading water quality. Failure of culverts may result in long-term road closures and severe flooding. The repair of damaged culverts and roads is costly and inconvenient.

Climate scientists predict a continued increase in the frequency of extreme storms, which will result in the need for more frequent repairs and replacements of undersized culverts.[ii] Under these conditions, which we are already experiencing, undersized culverts are becoming even more costly, since they require yet more maintenance and replacement, whereas upgraded, properly sized culverts can withstand these storms without major damage.[iii]

For example, in a single 512 square-mile watershed in the Adirondacks, towns and counties paid an estimated $3 million to repair damaged stream-carrying culverts and adjacent roads following Tropical Storm Irene. In Vermont, where Irene also caused severe flooding, two upgraded culverts (see photo) mimicking natural stream conditions withstood the storm with little damage, while flood damages were extensive and costly at the sites of undersized culverts in nearby communities.[iv]

Photo: USFS. Green Mountain National Forest

Benefitting People and Nature

In addition to saving public dollars over the long term, improved road-stream crossings benefit natural areas and communities. These benefits include:

- **Healthier rivers and streams:** Improved stream crossings lead to healthier rivers and streams. People value healthy aquatic systems. A recent survey by the U.S. Environmental Protection Agency found that households in the Northeast are willing to pay an average of $9 per year for a 1% improvement in aquatic ecosystem condition.[v]
- **Enhanced river-related recreation:** As "barrier" crossings are replaced with upgraded structures, fish can access the food, cool water, and spawning sites they require. Healthier fish populations can result in better opportunities for recreational activities that, in turn, often bring money to local communities. For example, in the eight counties that make up most of New York's Adirondack Park, anglers spent an estimated $56 million while on fishing trips in 2007.[vi]

Photo: Lisa Godfrey

- **Improved safety and mobility:** Well-sited and adequately sized stream crossings are more likely to allow water to pass during high flows and are less likely to sustain damage from large storms. Culvert failures can lead to road damage from washouts, and in extreme cases, road closures that can sometimes last for days. This can isolate households and prevent emergency services from reaching people in need of help. Road closures also cause travel delays, loss of tourism revenue, lost income for local businesses, and lost income for those who cannot access their places of employment.
- **Avoided flooding:** While crossing design is not the only cause of flooding during extreme storms, it can be a key factor. Flood damage to homes and businesses can be avoided with road-stream crossings capable of withstanding high water flows. The physical and mental health impacts associated with flooding and the disruption of everyday life can be substantially reduced through avoided flooding.
- **Improved water quality:** Right-sized and well-designed stream crossings are less likely to cause erosion and scour in the stream, and they are less likely to fail. Erosion, scour, and culvert failure all degrade the quality of water in our streams.

Photo: Ausable River Association

Photo: Scott Jackson

These culverts are large enough to handle flood flows, the depth and speed of the water within the culvert match the natural conditions upstream and downstream, and the natural bottom creates suitable conditions for stream-dwelling organisms to move.

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