

**Senate Natural Resources & Energy
Rob Evans - Rivers Program
Testimony on Resilience Work
December 5, 2023**

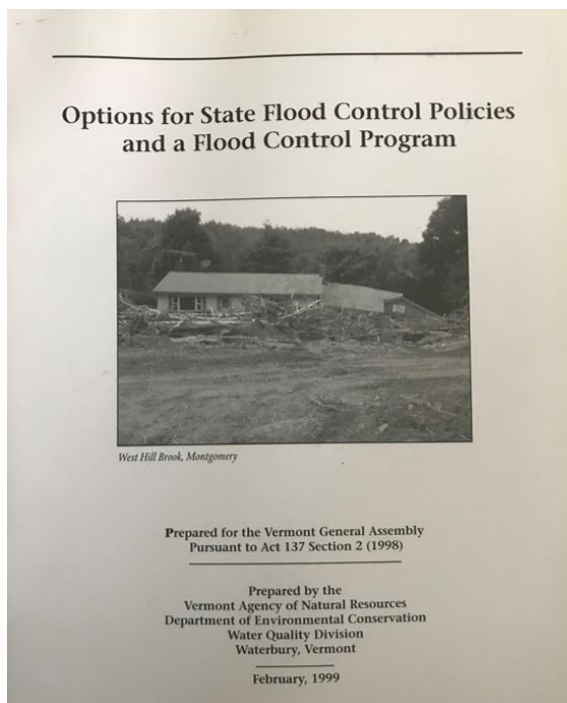
Good Afternoon Chair Bray and Committee Members,

I am Rob Evans, Rivers Program Manager within the ANR/DEC Watershed Management Division.

I am here to speak about the primary resilience work we do in our program with an emphasis on our regulatory work and technical assistance with respect to instream work and land uses in floodplains and river corridors. My team works with landowners and communities to manage conflicts between existing human investments and river processes and to avoid or minimize the impacts of land uses in river bottom lands.

Background/Context

To understand where we are today, we need to sum up key findings and progress over the last 25 years. After the devastating floods of the 1990s, the General Assembly asked why we were experiencing damaging recurring floods if so many communities were enrolled in the federal flood insurance program and regulating development in floodplains. The post-mortem report – known as the Act 137 report of 1999 – essentially found that much of our flood damages are due to flood related erosion. The National Flood Insurance Program maps and floodplain management regulations administered by most communities do not consider this type of hazard.



“Expert opinion is converging around one central theme: establishing long-term river stability will provide both protection from flood damage and a healthy riverine environment

Many of our rivers and streams are particularly unstable due to a legacy of channelization practices. Channelization in the form of straightening, dredging, berming, and armoring our rivers resulting in energized river systems making them more erosive during flood events. Channelized rivers erode vertically, or downward, and the stream channel becomes disconnected from its floodplain. Instead of floodwaters spreading out and slowing down on the floodplain, larger and larger flows are contained within the deepened and widened channel and cause tremendous destruction to human investments.



Figure 1: Many of Vermont's rivers are still unstable and recovering from past practices


Through the 2000s, with the aid of federal and state funding, detailed assessments were conducted to document the physical condition of thousands of miles of rivers and streams, and found that ~75% of Vermont's stream miles were in a channelized condition; straightened, deepened and disconnected from their floodplains. This information and better understanding of our flood risk resulted in changes to programs that exist today.



Figure 2: Excessive dredging after floods puts rivers back to an unstable condition ahead of the next flood. More water in the channel equals more stream power equals more destruction to adjacent buildings and infrastructure.

Intact Rivers and How They Work:

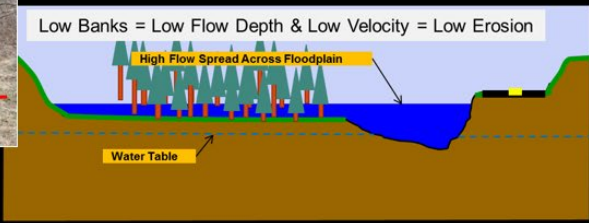
Energy Dissipation via
Floodplain Connection




Low Banks = Low Flow Depth & Low Velocity = Low Erosion

High Flow Spread Across Floodplain

Water Table

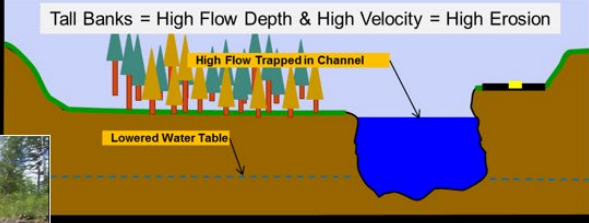




Tall Banks = High Flow Depth & High Velocity = High Erosion

High Flow Trapped in Channel

Lowered Water Table




Courtesy: Shayne Jaquith 

Figure 3: More floodwater in the river channel is not the solution. River systems are assets when they have functioning floodplains.

Stream Alteration Regulation

First is the Stream Alteration Permit program. For decades this had very limited jurisdiction and only regulated the larger rivers and streams, leaving the majority of stream miles unregulated by the state. Act 110 of 2010 changed the jurisdictional trigger to regulate all perennial streams and rivers.

Further refinements to the Stream Alteration Permitting program followed after Tropical Storm Irene. Act 138 of 2012 addressed a lack of authority regarding emergency work. Specifically, it codified in statute and ultimately rule the ability to regulate emergency work in rivers and streams to ensure the work is the minimum necessary to protect infrastructure and other human investments, without reverting back to the large scale channelization practices of the past that destabilized our rivers.

Another significant change coming out of Irene was getting formal recognition of our standards in the Stream Alteration Rule related to the sizing of bridges and culverts. ANR, in partnership with VTrans and Vermont Emergency Management engaged in a years-long painstaking process to get approval of our standards to be recognized formally as “codes and standards” under FEMA’s Public Assistance Program. This means that when a bridge or culvert is destroyed due to flooding, FEMA will pay for the replacement structure to meet our sizing criteria. Unlike the standard sizing practice of years past that looks at how much water a structure can pass, our standards require consideration of the size needed to pass sediment, rock, and woody material, as well, resulting larger much more resilient stream crossing structures. As we witnessed in grand fashion this past summer, our high gradient watersheds contribute a lot of material during large floods.



Figure 4: Undersized culverts fail because they have not been sized to pass sediment and debris which are always mobilized by floodwaters

Key Principles Structure Width and Opening Height



Old – 7' Pipe



New – 16' x 8' Precast Arch

Figure 5: Stream Alteration Rule standards require sizing to the bankfull stream width to allow for sediment and debris to pass, as well as aquatic organisms...

Rivers and Roads

Another requirement coming out of Act 138 in 2012 was the requirement for ANR to stand up a training program focused on building resilient infrastructure and reducing impacts to Vermont's rivers during flood recovery. The Rivers and Roads multi-tiered training program was created in collaboration with VTrans and the Department of Fish and Wildlife with the goal of improving flood resilience when rebuilding devastated roads, culverts and bridges. Trainings are offered annually to a wide range of state, municipal and private sector transportation staff, consultants and construction contractors working on roads in the flood recovery context. Since 2012, we have provided 48 training events to 860 individuals.



Figure 6; Rivers and Roads Training includes classroom and field time to educate those involved in the design, construction and repair of transportation infrastructure to better understand river processes.

To close on stream alterations, we have made significant gains over the past decade. The post flood permitting authority we now have, coupled with broader understanding of flood recovery best practices provided by the Rivers and Roads training has made a difference. We have not seen large scale unauthorized over-working and channelization of our rivers after floods like we did after Irene and floods prior. This is important progress made on shifting the paradigm and practice away from those of the past.

River Corridor and Floodplain Protection

Let's shift to the work of our River Corridor & Floodplain Protection section. Over the last 2 decades, there have been incremental gains dialing up standards related to land uses in floodplains and river corridors. These land uses are regulated under a patchwork of municipal and state authorities.

DEC Flood Hazard Area and River Corridor Rule

The DEC Flood Hazard Area and River Corridor Rule, required by Act 138 in 2012 and effective in 2015 regulates development exempt from municipal regulation and was needed to ensure the state's compliance with the National Flood Insurance Program. The rule regulates a narrow set of activities that include State-owned buildings and facilities, Required Agricultural and Silvicultural Practices, and power generation/transmission facilities subject to the PUC Process. The rule is framed under a set of *No Adverse Impact* standards with the goal of not just protecting new development from flood hazards, but also ensuring that new development does not exacerbate flood hazards by increasing risk to pre-existing development and infrastructure.

River Corridors as part of a No Adverse Impact Regulatory framework

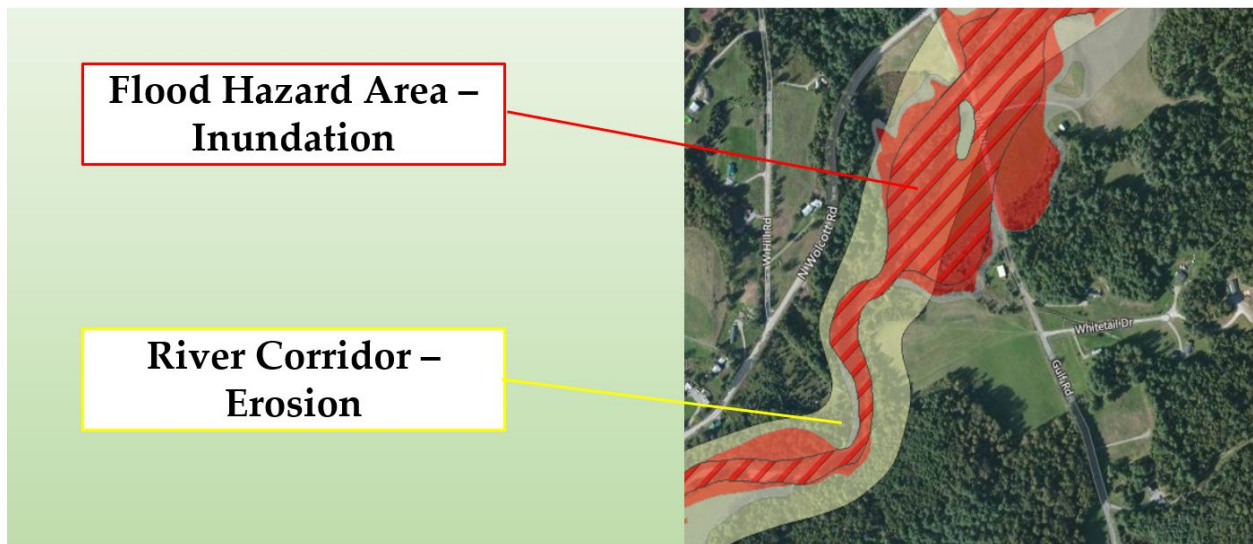


Figure 7: River Corridors depict the minimum valley space needed for rivers to meander through the erosion and deposition of sediments. The meandering process allows rivers to establish and maintain connection of the river channel to the floodplain.

Municipal Regulation

Most land uses in floodplains are still regulated at the local level. 90% of Vermont towns are enrolled in the National Flood Insurance Program and must regulate land uses in federally mapped flood hazard areas to at least federal minimum standards. The federal minimums do not result in resilient communities. In 2008, our program began offering municipal model flood hazard regulations that recommended higher standards, including river corridor protection (Figure 7) in consideration of riverine erosion hazards. The model regulations were significantly updated in 2017 to align with the No Adverse Impact framework employed in our state rule. At last count, 97 communities have adopted some combination of higher standards that exceed the federal minimum criteria.

Act 250:

And the longstanding state jurisdiction is Act 250. Criterion 1D covers flood hazard areas and river corridors. Our program provides regulatory recommendations to District Commissions for developments proposed in flood hazard areas and river corridors. The Woodford Packers State Supreme Court decision in 2003 was significant as it affirmed ANR's ability to consider erosion hazards in addition to flood inundation hazards. The DEC procedure that guides our recommendations to District Commissions was updated significantly in 2015 to align with the No Adverse Impact framework employed in our rule and recommended in the model municipal regulations.



A large component of river corridor regulation is about avoiding new bank armorment to protect to new encroachments...

More armorment equals more instability to the river system, as that erosive energy is transferred and impacts adjacent properties and infrastructure.

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Figure 8

River Corridor Mapping:

In 2015, we published the first statewide river corridor map layer which is publicly available on the ANR Natural Resources Atlas for over 14,000 miles of river and stream. The River Corridor map is an important planning and regulatory tool to inform the siting of new development. The federal inundation-based flood hazard maps only cover about 20% of rivers and streams in Vermont. The River Corridor map, on the other hand covers ~75% of stream miles.

River Corridor Mapping

factors the dynamic
nature of rivers into
planning and regulation



Figure 8: Limiting new encroachments along undeveloped river corridors allows for rivers to maintain or restore a least erosive condition and maximize natural and beneficial floodplain functions, including the storage of floodwater and sediment.

Restoration and Conservation

Lastly, I would be remiss if I did not highlight the non-regulatory work of my team to restore floodplain functions and to conserve these functions in river corridors. We provide myriad partners river science technical assistance to support restoration and conservation projects, funded by both hazard mitigation and clean water funding. Our oft-repeated statement related to river stability and erosion hazards is “what is good for flood resilience is good water quality and vice-versa.”



Figure 9: Rivers that are disconnected from their floodplain transport excessive nutrient laden sediments downstream. Reconnecting rivers to floodplains allows for sediment deposition instead of excessive transport.

Some of the best projects implemented in recent years were supported by a combination of hazard mitigation and clean water funds, to do buy-outs of flood-prone buildings, reconnect river channels to floodplains, plant riparian trees and upsize stream crossing infrastructure. We created a novel River Corridor Easement program in 2008 to facilitate the passive restoration of river process and floodplain function. To-date, largely with state clean water funds, and with our land trust and conservation partners, we have executed 120 easements, conserving over 3000 acres of river corridor.

There is a lot of talk about nature-based solutions and the importance and effectiveness of restoring floodplain functions. The single most effective way to restore floodplain function at scale is to provide time and space for the river to restore itself. The restorative work done during floods far exceeds what we can achieve with yellow machines. Through the meandering process, rivers will reconnect to floodplains and reestablish a least erosive form. Continuing our collective work to restore and protect floodplain functions is critical to making Vermont more flood resilient.