The Streamside Sentinel

News Making Waves on Vermont Waters

Wood Ducks

The Rapport in a Riparian Buffer

Trees and Shrubs Along Streams Foster Healthy Ecosystems

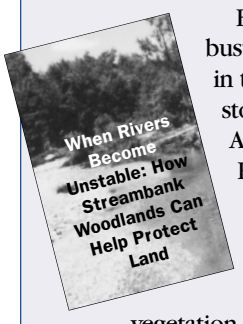
A belted kingfisher smacks the water and emerges with a fish still squiggling in its bill. Old silver maples cast pleasant streamside shadows on a hot summer day. And a family of minks scampers along the shoreline before slipping into the river.

These are images from healthy rivers and streams with adjacent shrubs or woodlands known as riparian buffers.

These are not exotic places. Although they can have rare or endangered species, riparian buffers tend to be composed of common plant species. They might include box elder, red maple, black willow, speckled alder and dogwood. Older riparian zones may have mature tree species much more tolerant of

"Riparian Buffer" continued on page 10

New Video Illustrates Importance of Streamside Woodlands



Here's a block-buster you won't find in the local video store: The Vermont Agency of Natural Resources is distributing a video about the importance of streamside vegetation. "When Rivers Become Unstable: How Streambank Woodlands Can Help Protect Land," is designed for landowners, town officials, schools, watershed groups or any citizen interested in Vermont rivers and water quality. It illustrates how streamside vegetation maintains stable river banks, protects property, reduces flood damage and phosphorus pollution and improves water quality.

Featuring interviews with river experts, landowners and community members, the 20-minute video offers practical advice on the preservation and restoration of streamside buffers.

To get your copy, contact:

Agency of Natural Resources
Division of Water Quality
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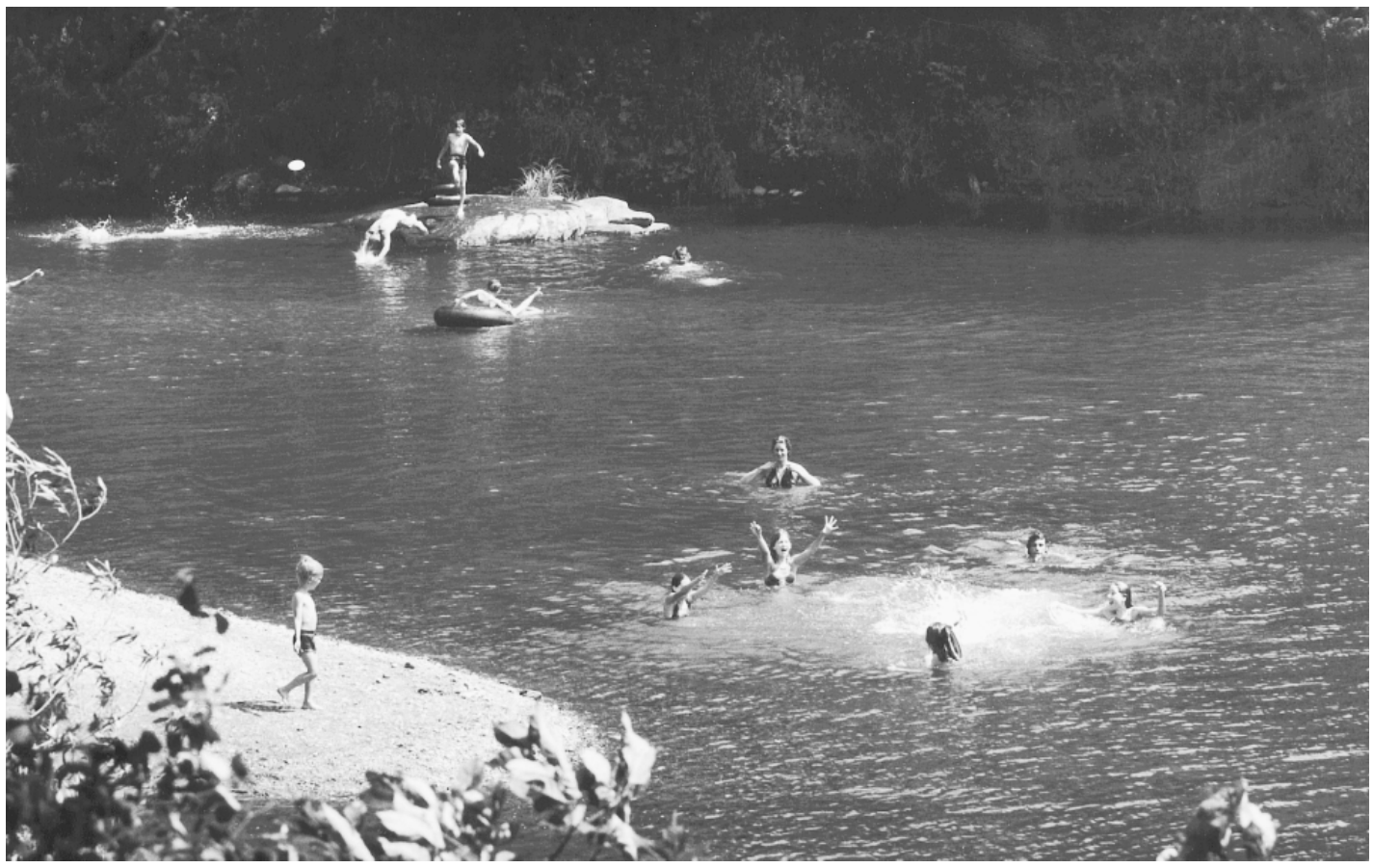
A Healthy River is More than Water

Streamside Woodlands Offer Countless Benefits



Vermont Travel Division

Many of Vermont's most useful and valuable properties include the wooded or shrubby areas beside rivers and streams. These streamside woodlands are among our best-kept secrets. Few people know of their many benefits – everything from reducing flood damage to providing habitat for wildlife, from filtering pollutants to giving privacy to landowners.

But streamside woodlands haven't always been valued or protected. The state and towns cleared these areas and built roads alongside river banks. Farmers often replaced strips of streamside vegetation with crops. And loggers cut trees to the water's edge. The results were unstable streambanks and unpredictable rivers.

But our view of rivers is beginning to change. Vermonters now know that native streamside vegetation is as important to a healthy river as water itself. Ask an angler looking for the best fishing spot. Ask a farmer who wants to keep land from eroding and washing away. Ask a road commissioner who can expend half his annual budget on a single washout. Ask a hunter, tracker, trapper or naturalist looking for wildlife. Or ask anyone who wants nothing more than to doze in the shade by a stream as songbirds warble above and mink swim below. Streamside woodlands are critical to them all.

Neglected for far too long, streamside woodlands, often called riparian buffers, are now recognized for their economic and environmental values. They stabilize stream banks. They protect waterways from pollutants and shield land from flooding. They provide shade and food for fish and travel corridors for wildlife. They reduce damage to private property and public roads and bridges by

"A Healthy River" continued on page 10

Money *Can* Grow on Trees

Barry Cahoon

Tyler Branch, Enosburg, 1997

Streamside woodlands aren't only critical for stable rivers and healthy wildlife populations, they are sound investments as well.

When a family fertilizes the front lawn or a farmer turns cows out to pasture, rainwater washes the harmful nutrient phosphorus into Vermont rivers and lakes.

When rivers lose their trees and shrubs, Vermont's tourism-dependent economy – from boating to birdwatching – suffers a loss of scenic and recreational quality and value.

And when torrential rain fell across Central Vermont in June of 1998, the rivers rose to wash out roads and bridges, damage agricultural land and sweep away several homes – at huge public and private expense. And this is one of many floods.

Streamside vegetation can't always prevent disasters, but it certainly curbs the cost of pollution control or flood damage and contributes overall to the quality of life in Vermont. In short, stable rivers help create a more stable economy. And one of the most cost-effective ways to maintain a stable river system, to keep it free of pollutants and full of fish, to keep its water safe to drink and clear for swimming, is to protect or restore its vegetated buffers.

"Left to grow up naturally, riparian buffers are a free investment in stabilizing our rivers and protecting water quality," says Stephan Syz of the Vermont Agency of Natural Resources.

The financial benefits and the avoided expenses from streamside buffers are difficult to estimate. It is hard to put a figure on a healthy trout stream or a streamside forest that filters pollutants.

But flooding is an awesome and quantifiable expense. Between 1995

"Money" continued on page 9

The Angle on Angling

Streamside Forests Offer Great Fishing

Anyone whose heart beats faster at the thought of hooking a trout or salmon from pristine waters knows that the riverbank can be as important as the river itself.

Chris Owen is one of them. A fly-fisherman and fly-tier, he lives for the second Saturday in April. Given the choice, Owen would probably spend more time in a river than in his office.

And given the choice of fishing spots, Owen knows to cast his line in stretches of river with a healthy streamside forest.

"It's a roof over the fish's head – it gives them a sense of security and safety from predators," Owen says. "Fish are always hiding out; they spend their life hiding out; they live long for it. Without that canopy of trees they really are exposed to the elements."

Or ask someone like Rich Kirn, district fisheries biologist with the Vermont Fish and Wildlife Department. When Rich talks about stream fisheries, he emphasizes the overall health of the stream – especially the riparian buffer.

"Particularly for the trout population in Vermont, I think it's the single most important habitat protection feature we have in the state for stream fisheries because it does so many things," Kirn says.

Overhanging trees provide shade and cooler waters when stream temperatures might otherwise rise to 80 degrees or more on hot summer days. Brook trout, Vermont's only native stream trout and one of the most popular fish species sought by resident anglers, are particularly vulnerable to increased water temperatures.

Moreover, insects that fall from overhanging vegetation become instant fish food. And falling vegetation itself is food for the aquatic insects that are ultimately eaten by the fish higher on the food chain.

And finally, riparian buffers stabilize stream banks, which is also good for fish and other aquatic wildlife. A collapsed stream bank sends sediments into a river. Those sediments can settle in and fill deep water holes favorable to fish. They can also fill rocky river bottoms, depriving fish of good places to lay their eggs. Undercut banks, maintained by root systems, are prime habitat features for trout and other fish species.

"Streams are constantly changing, and those where the riparian zones have been disturbed are much more prone to having collapsing banks and change from year to year – it creates an unpredictable fishery," Owen explains. "Whereas something that's well braced by good vegetation is not inclined to shift and change and is going to be more predictable for fishing."

"The best fishing is commonly where there's good vegetative cover," Owen adds. "If you've got a stretch of river that really is farmed right to the stream bank it often is not going to be as productive as a well-covered stretch of water."

A Wild Place for Wildlife

It often takes you by surprise, perhaps while you're fishing or out with the family at the lake. You might do a double-take. But there is no mistaking the white head and white tail, the immense yellow beak and the imposing posture. A bald eagle.

And when you're lucky enough to find an eagle on a perch somewhere in Vermont, thank a riparian buffer.

Bald eagles, which feed mostly on fish, need streamside woods for nests or perches – a silver maple along the Otter Creek, for example, or a big old pine beside the Winooski River. But eagles are hardly the only wildlife species that frequent vegetated zones along rivers or lakes. From dusky salamanders to belted kingfishers, from river otters to black bears, you can find a rich blend of wildlife in streamside buffers. At least, what's left of these crucial habitats.

One admirer of streamside buffers, John Buck, a biologist with the Vermont Fish and Wildlife Department, put it this way: "Streamside buffers are an important component in the landscape and we've reduced them to sidewalks. We've reduced them to nothing of their former selves."

Perhaps the best way to think of a riparian buffer is as an ecosystem in itself – a rich mixture of plants and animals at a place where water meets land. Healthy streamside woods contribute to healthy waters – providing food and shelter for everything from caddis flies to brook trout. Insects and fish are in turn food for mammals and birds – river otter and belted kingfishers, for example, or mink and bald eagles.

Crawling, scampering, jumping, walking or flying in streamside woods are mice and squirrels, frogs and salamanders, flycatchers and warblers. The Louisiana waterthrush, a warbler with an explosive song and a funny, bobbing walk, nests almost exclusively in woods along rushing streams. Where there are no woods, there can be no waterthrushes.

Wood ducks and hooded mergansers nest in tree cavities in swampy bottomlands. And the woodcock, or "timberdoodle," is often seen in wild breeding displays above wet, open fields, yet it depends on vegetated zones near wetlands or rivers for feeding and nesting habitat.

Streamside woods are also vital to wildlife not normally associated with rivers – including game species. Riparian zones are corridors for wildlife to move from drier, less diverse uplands to richer, riverside bottomlands. Black bears, for example, won't visit a streamside to feed without some vegetative cover. White-tailed deer can use streamside woods as connecting routes between patches of habitats separated by housing development, parking lots, farmland or open spaces.

Green Heron

So even though a particular riparian zone may not include rare or abundant wildlife, it nevertheless can still be important wildlife habitat if it connects fragments of habitat.

Similarly, many species of reptiles and amphibians need streamside woodlands to travel to new habitats. This kind of dispersal is key to maintaining a species' genetic diversity and resilience to disease and other threats. Vegetated corridors allow them to travel safely by land from one habitat to another.

Finally, some species simply need both water and woods. The wood turtle spends much of its life in brooks and streams, hibernating in winter in the sandy or muddy bottoms. But wood turtles move to surrounding upland habitats during the warmer months of the year.

Vermont's wood turtle population has been dropping in the last few decades. And one possible reason is the loss of wide streamside woods, particularly in agricultural areas.

Higher on the food chain, bald eagles are recovering nationally – thanks not only to the banning of the pesticide DDT in the 1970s but also to preservation of their habitat. It's one reason Vermonters are beginning to see eagles along lakes and rivers.

But even a high-flying eagle needs a perch now and then – not necessarily a perch that swims but certainly a perch in a riparian zone.

"Streamside buffers are an important component in the landscape and we've reduced them to sidewalks. We've reduced them to nothing of their former selves."

– John Buck,
Vermont Fish and Wildlife
Biologist

The Streamside Sentinel is a publication of the Vermont Agency of Natural Resources. Its purpose is to inform Vermonters about the importance of streamside shrubs and woodlands, which are often called riparian buffers.

This publication has an accompanying video, "**When Rivers Become Unstable: How Streambank Woodlands Can Help Protect Land**," explaining for all audiences the value of riparian zones. Additional copies of ***The Streamside Sentinel*** or the video can be obtained from:

Agency of Natural Resources
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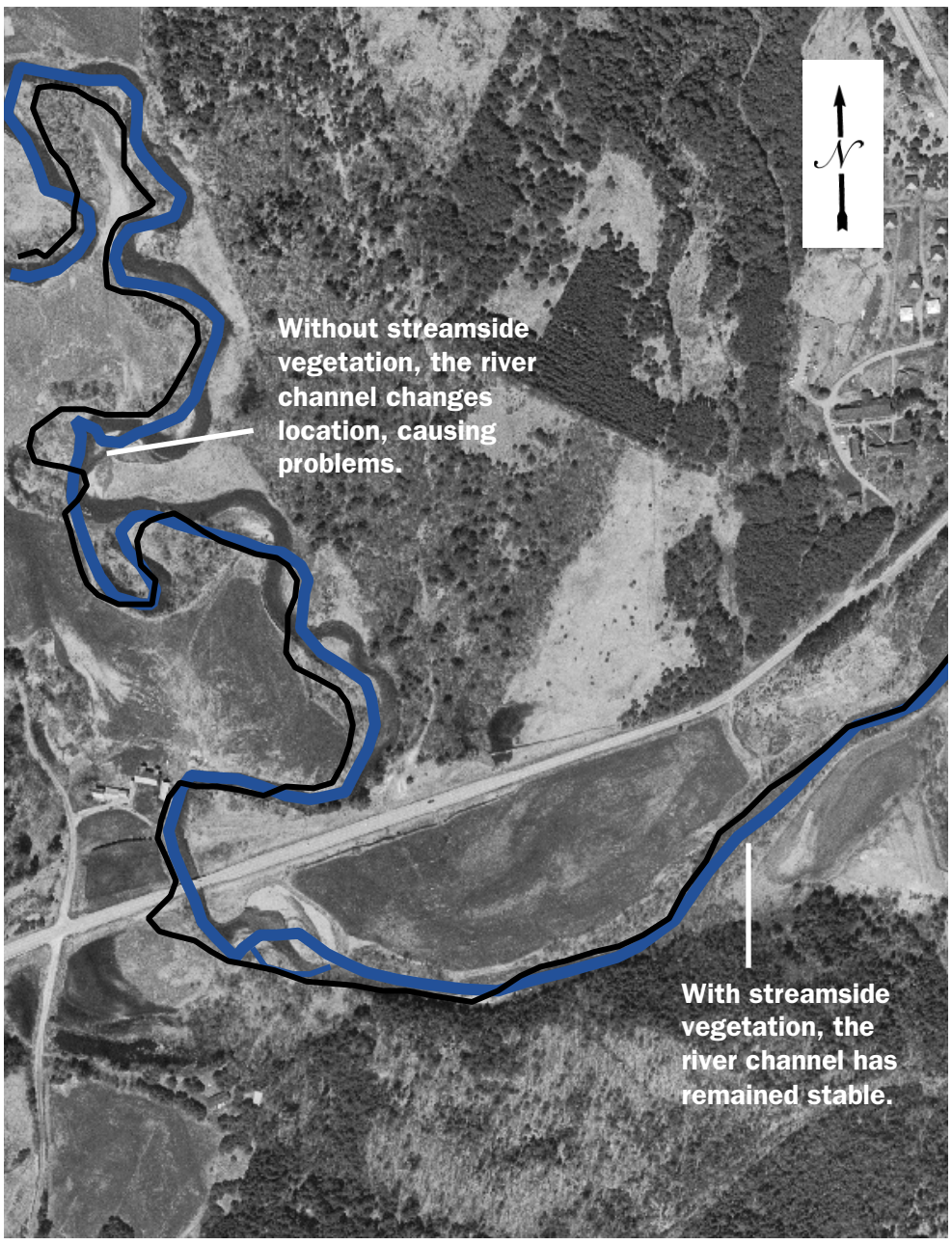

The Winooski River west of Plainfield, Vermont, has experienced massive changes in the area without streamside vegetation. Aerial photographs from 1942 and 1979 were overlaid on this 1998 photo of the river. The river in the lower part of the photo has had trees and has stayed in the same channel since 1942. In the upper part of the picture the river has cut new channels and changed its course by up to 400 feet.

Winooski River, Plainfield
1998 Digital Ortho Photo with overlays

Sarah Albert

Keeping Cows Out of Streams Reduces Phosphorus and Bacteria in Waterways

The sight of cows grazing on a lush, green pasture is an appealing part of Vermont's landscape. But if a stream runs through the pasture, this scene may not be so good for Vermont's waterways.

Livestock in streams and rivers can destroy riparian vegetation, erode banks and put waste directly into the water. As a result, more sediment, nutrients and bacteria enter Vermont's streams, rivers and lakes – ultimately harming wildlife and posing a threat to swimmers.

Can Vermonters improve water quality by fencing cows away from streams and letting the stream banks and riparian zones heal with natural vegetation? To answer that question a river scientist chose to study three adjacent small watersheds draining into the Missisquoi River in northern Vermont. Farmers in two of the watersheds fenced their streams and farmers in the third did not. The results have been encouraging. Inexpensive measures, such as fencing and allowing natural vegetation to grow along streambanks, protected streams from the effects of grazing livestock and significantly reduced the amounts of phosphorus, nitrogen and bacteria entering waterways.

"Some of the riparian zones were quite narrow, " says Don Meals, director of the study. "Even a small amount of fencing and a narrow, natural riparian zone results in a strong improvement in water quality. We found approximately 20 to 40 percent reductions in phosphorus loads and 40 to 60 percent reductions in bacteria counts. These are significant results from a small investment in land and money."

Lori Barg

"Even a small amount of fencing and a narrow, natural riparian zone results in a strong improvement in water quality."
– Don Meals

Stopping Phosphorus the Natural Way

Nothing can live without phosphorus. Although it's one of the most abundant elements on earth, phosphorus, along with nitrogen and potassium, are the three essential nutrients commonly added to croplands and gardens.

But too much of a good thing is not so great for rivers and lakes. And despite the reduction of phosphate in most detergents years ago, phosphorus remains an expensive problem, particularly in Lake Champlain and its tributaries.

Phosphorus and other nutrients can cause blooms of algae, which cloud water and suffocate fish and other aquatic life. Algal blooms can even grow thick enough to snag a fishing line. As a result, phosphorus reduces the economic and recreational values of the state's rivers and lakes. So much of a problem is phosphorus that municipalities and farmers spend millions of dollars to control it.

Riparian buffers help curb the cost and clear the water.

Lakes are storage areas for phosphorus. Waste treatment plants send their share of phosphorus into lakes. But phosphorus also gets there attached to soil particles that are either eroded or washed by rains into waterways. Surface runoff, sometimes called non-point source pollution, is particularly hard to control and a huge source of phosphorus in urban, suburban and agricultural areas.

A 1999 study of phosphorus movement into Lake Champlain found that urban areas are a disproportionate source of the problem. Urban land constituted 5.5 percent of the Champlain drainage basin, but contributed 37 percent of the phosphorus.

Riparian buffers can stop phosphorus in its tracks. Vegetation and plant stems slow the flow of water rushing over land, allowing heavier, phosphorus-laden soils to settle out before they can reach a river. Plants in riparian buffers can also take up the phosphorus.

It would appear that farmland is a great place to start controlling non-point source phosphorus. After all, farmers apply tons of fertilizer to their land each year, including manure, which is a major source of phosphorus. It therefore makes sense to focus control efforts on farmland.

But new research on the Lake Champlain basin indicates that urban areas are also a significant source of phosphorus. Pavement – driveways, streets, parking lots – can't absorb water and its phosphorus-laden sediments. Indeed, pavement gives polluted water speedy passage to rivers and lakes. Other urban sources of phosphorus include lawn fertilizer, disturbed soils during construction and, a significant concern, pet droppings.

In fact, a 1999 study of phosphorus movement into Lake Champlain found that urban areas are a disproportionate source of the problem. Urban land constituted 5.5 percent of the Champlain drainage basin, but contributed 37 percent of the phosphorus. Agricultural land, 17 percent of the land area, accounted for approximately 56 percent of the phosphorus. (Forests made up 66 percent of the land area but contributed only 7 percent of the phosphorus.)

The lesson is that phosphorus control not only begins on the farm, it begins at home and in the neighborhood as well.

"We made a convincing case that agriculture is the lion's share of the problem, said Don Meals, water quality project manager who first analyzed sources of phosphorus in the Champlain basin in the mid-1990s. "But at the same time you can't ignore the urban component. It's a big factor."

How to Read a River

What Makes A River Unstable?

Anyone who wants to understand the amazing forces in a river can count on two truths: water flows downhill and rivers always change. Although we tend to think rivers carry only water, they actually carry water and sediment. A river channel develops – and changes – in response to the amount of water and the sediment load it typically carries.

Water and sediment can exert awesome force on a riverbank. The study of those forces is known as fluvial geomorphology. But Vermonters don't need a college degree in geology to understand the science. In one sense, rivers can be easily viewed in two distinct ways:

Stable Rivers – A stable riverbank changes very little, with minimal change in location from year to year. Stable rivers have no large deposits of sand or gravel. There is minor natural erosion, and the river has the ability to move its water and sediment load in balance.

Unstable Rivers – Unstable river systems can change their course by many feet per year, and sometimes cut new channels altogether. Unstable river systems have large sections of collapsing banks; the river widens and/or cuts deeper into its channel, and sand and sediment fill natural pools. The deposited sediment chokes aquatic life and can re-direct the course of the river, causing even more erosion.

Unstable River Systems

Vermont has many miles of unstable rivers. They are not hard to identify. Just look for telltale signs: eroding banks, for example, or large gravel bars. The changes in a river that signify instability are divided into four categories:

► **Changes in Planform –** These are the changes that can be seen from the air when looking down at the river. The river's pattern has changed. This happens due to human intervention (such as straightening the bends of the river with heavy equipment). Planform changes also occur during floods. When there is no streambank vegetation, with roots to hold soil in place, rivers cut new channels in the weak part of the bank during high water. (See page 3 for additional example.)

► **Widening** – Banks collapse, and the river becomes wider and shallower. A wider, shallower river does not have the same capacity to transport sediment. So sediment builds up in the channel.

► **Degradation** – The river cuts deeper into the land. One result is that bridge footings are undermined and exposed. Degradation is sometimes caused by straightening a channel, which increases the slope of the river. The water flows faster down this steeper slope and has extra energy to move sediment, causing the river channel to cut deeper or degrade.

► **Aggradation** – Sediment loads pile up in the river. This happens when the sediment load increases and the river lacks the capacity to transport it. Piles of sediment in a river can re-direct flow against the banks, causing yet more erosion.

Rivers and their movement become easier to understand once we realize that the volume of water and amount of sediment are in a dynamic balance as they move downstream. If one changes, then the other changes in response. The Lane Scale on page 5 shows how changes in slope, sediment size and the load (or amount) of sediment and water can swing the balance of the stream from aggradation to degradation and back again.

Activities that shift the balance shown in the Lane Scale cause the river to adjust to the changes. Rivers can adjust within normal limits. But some activities are beyond "normal" and cause the river to become less stable. Activities on land within the watershed can alter a river's channel. Housing and commercial development is one example. More pavement reduces the amount of water that infiltrates into the ground, forcing more of it to run quickly off land and into the river. Similarly, when woods are clear-cut,

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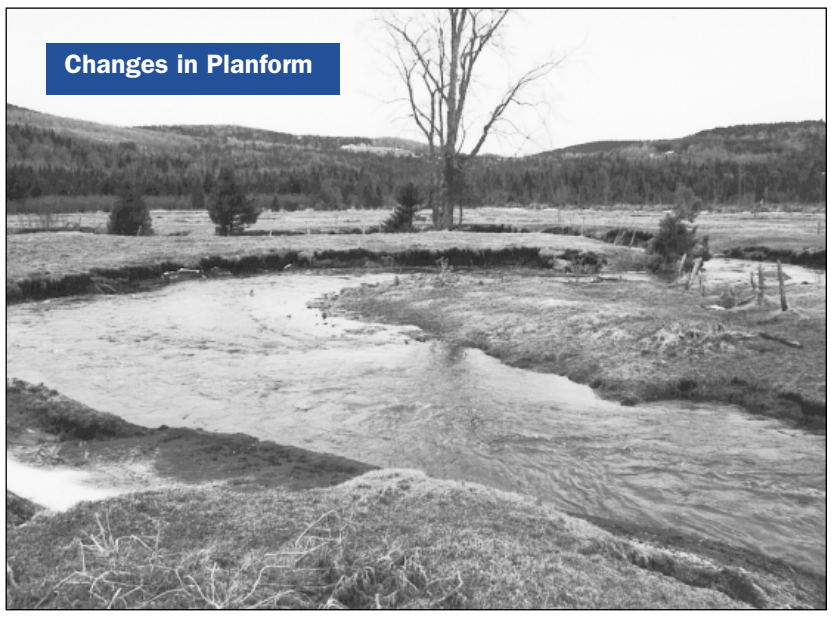


Barry Cahoon

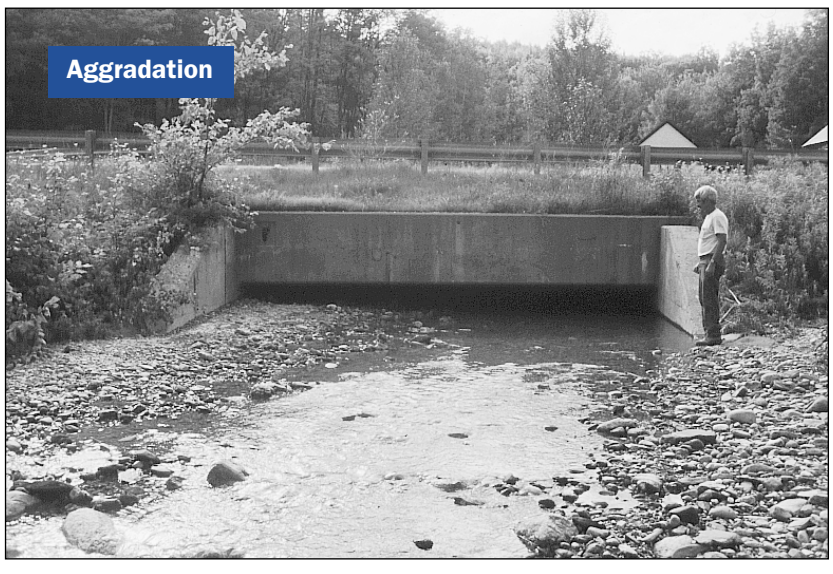
As a result of unstable stream banks, a new chute is beginning to be formed in the lower left of the photo.

Jim Ryan

The river has over-widened and can no longer effectively carry water and sediment.

Barry Cahoon

The bed of the river is lower in the landscape than it was previously. The person shown in the middle of the photo has to scale high banks to reach the land. Older channel deposits are exposed in the bank of the river.



Barry Cahoon

Sediment deposits in rivers clog a bridge.

Stable

Jim Ryan

Even during floods stable streams can carry large amounts of water without significant damage.

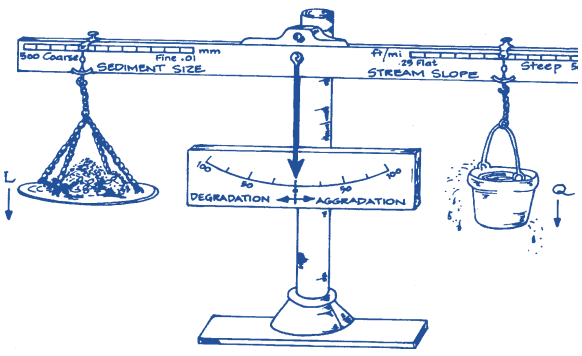
Unstable

Lori Barg

As banks erode and rivers widen, infrastructure such as this small bridge collapses.

Stable River Systems

The Lane Scale



This scale, known as the Lane Scale, shows how rivers are in a dynamic balance. The quantity and size of the sediment is proportional to the amount of water in the stream and the channel slope. If channel slope, for instance, is increased by straightening or channelization, streambed degradation will occur. If sediment load is increased by excessive erosion upstream, aggradation will occur.

water that once trickled through forest soil and leaf litter now runs quickly over land and into a river. The river adjusts to these changes, usually by widening or deepening to accommodate the increased flow. These changes are called hydrologic changes.

Vermont rivers are very sensitive to land use changes in the river basin. One recent study by the Vermont Geological Survey concluded that rivers begin to become unstable with as little as two percent of the basin developed. Rivers actively change their shape when development or logging exceeds eight percent of the basin. As development increases in Vermont, rivers adjust to these hydrologic changes, generally by widening. The Vermont Geological Survey found that rivers under these conditions can widen by as much as two to three times their former width.

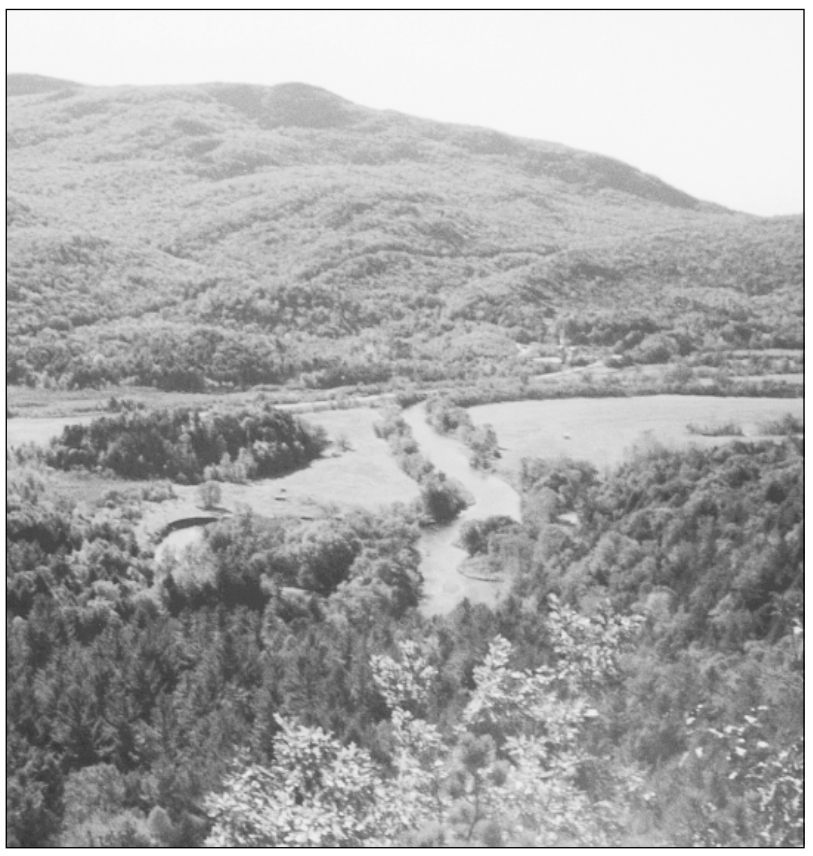
Instability in a river can also result from changes to the channel itself. Channelization and gravel mining are two examples of physical changes to the river that stress the system. Straightening or channelizing a river will increase the slope because the river has to travel a shorter distance to descend the same amount. As the slope increases, the water and sediment velocity increases and this extra force causes the river to degrade. Often downstream of a straightened stretch of river the sediment that used to be in the bottom of the river is re-deposited and builds up downstream of the channelized reach.

As we mentioned earlier, rivers are dynamic systems. Even stable rivers can move up to a few feet per year. The outside bends of a river will migrate slightly down stream and slightly towards the outside of the meander bend. The movement occurs mostly in this area because it is where flow is concentrated; the force of the water pushing against the bend moves the soil particles little by little.

The factors responsible for a stable river, interestingly enough, reach beyond the channel. A river is more than just the channel and its contents. It is also the streamside vegetation along the banks of the channel, the flood plain and the entire watershed that contributes water and sediment to the river. Stable rivers share two critical characteristics: healthy streamside vegetation and access to the flood plain. They are as much a part of a healthy river as the channel itself.

► **Access to the Flood Plain** – The flood plain serves as a pressure release valve during floods. During a flood, a river will leave its channel, spread out in the flood plain and reenter the channel again as the water level drops. The shallow water spilling over the flood plain does not have much erosive capacity. In a stable channel, after most floods, the channel will look much the same as it did prior to the flood, although the vegetation may be temporarily flattened, wet or rearranged.

► **Riparian Buffers** – If rivers are the arteries of our landscape, then streamside plants are the bones. The roots of vegetation along the channel bind soils in place. Trees and shrubs are generally better at stream bank stabilization because their roots extend deeper than those of grasses (which generally penetrate less than a foot deep). The binding capacity of plant roots makes stream banks resistant to the erosive forces of flooding.



Jim Ryan

Even a narrow border of trees along a river can help to keep a stream stable.

The importance of streamside vegetation, also known as riparian buffers, cannot be overemphasized. The aerial photograph on page 3 illustrates their benefits over a 60-year period. They show that the channel has remained in place in areas with healthy riparian buffers. In contrast the channel has moved up to hundreds of feet in the areas lacking riparian buffers.

If rivers are the arteries of our landscape, then streamside plants are the bones

The absence of riparian buffers, leading to widening rivers and increasing sediment loads, can have huge consequences to property and the river alike. The Natural Resource Conservation Service has found that most of the sediment in the Third Branch of the White River appears to be from stream bank erosion in a tributary, Ayers Brook, and from stream bank erosion downstream of Randolph. A study for the Vermont Geological Survey of three unstable urban streams, Moon Brook in Rutland, Stevens Brook in St. Albans and Potash Brook in Burlington, found that, at most, one-third of each stream possessed an adequate riparian buffer. Vermont has thousands of miles of streams without adequate riparian buffers. The results are collapsing banks, over-widened rivers and property loss.

Restoring and protecting riparian buffers is probably the single most important thing that can be done in Vermont to restore stability to river systems.

Buffers are Better

To better understand some of the forces acting on Vermont's land and rivers, data from state and federal agencies was analyzed in close to 300 stream channels. The goal was to see how the presence or absence of riparian buffers affected the shape of the stream channel.

The results of the analysis are clear: For every stream type in Vermont, *a river without riparian buffers is almost half again as wide as a similar stream with riparian buffers.* That's significant because wider streams carry environmental, ecological and economic costs.

Many factors influence the form of a river: the size of the drainage basin; the slope of the channel; the sand, cobble or rock that constitute the sides and bed of the river; and the land uses in the watershed. River scientists, fluvial geomorphologists, further classify streams into various types: steep bedrock controlled streams in the upper basin, for example, or shallow, meandering streams in the lower basin.

A series of measurements determine the type of stream. Three measurements – the **bankfull width,** the **depth** and the level of **entrenchment** – were analyzed. The ratio of two of these measurements – the bank full width and depth – is the **width-depth ratio.** This number describes a relationship that is independent of the actual sizes of the rivers. For example, wide and shallow unstable rivers have a high width/depth ratio, while the same river in a stable form will have a lower width/depth ratio. Every stream type (steep headwater, mid-basin semi-steep stream, shallow slow-moving lower basin stream) will have a different range of width-depth ratios.

The analysis found that streams with riparian buffers have a much lower width/depth ratio than streams without riparian buffers. Streams with riparian buffers of all types were more stable than streams without riparian buffers.

The results are clear. A river without adequate riparian buffers is an unstable river system. Federal and state agencies, towns and landowners have spent millions of dollars trying to keep rivers from doing what rivers do naturally. Rivers are dynamic systems. A stable river will move through the landscape without causing damage.

Historically, engineers have tried to control the river by channelizing it or placing rock rip-rap to stabilize banks. These actions increase the force of the water and the erosive force on the beds and banks of the river.

An alternative is to learn to work with the river, rather than trying to control it. What we perceive as the problems, gravel loaded up in rivers, collapsing banks, undermined bridges, lost cropland, lost aquatic habitat are actually the results of unstable river systems.

Gravel deposits, the widening of rivers, the deepening of the riverbed and the changes in the course of the river are the results of channel instability. Removing the gravel or rip-rapping the banks will not solve the problem. An important and relatively simple start for Vermont streams would be to restore the riparian buffers along stream banks. Thousands of miles of rivers in Vermont lack adequate riparian buffers. From their own personal experiences, farmers in Lamoille County and the Missisquoi basin, the Mad River Valley and throughout Vermont know that one of the best and cheapest actions they can take to protect their land is to maintain a riparian buffer.

Glossary

Bankfull Width – A river forms its channel in response to a storm event that occurs on a fairly regular basis, every year to year and a half.

Depth – Depth is measured as the mean depth from edge to edge of the river at the bankfull level.

Entrenchment – Entrenchment measures whether or not a river has access to its flood plain. A flood plain can be viewed as a pressure release valve. (High stress areas are at the bottom of the river, and one-third of the way up the banks.)

The tables below show that streams without vegetation on their banks have higher width/depth ratios than streams with vegetation. A stream with a high width/depth ratio is shallow and wide with eroding banks and poor fish habitat. Conversely, a stream with a lower width/depth ratio is narrower and deeper, making it stable and hospitable to wildlife.

Width/Depth Ratios on Streams With and Without Streamside Vegetation

	Streams with access to flood plain				Entrenched streams			
Data source	With Riparian Buffer		Without		With Riparian Buffer		Without	
	# of x-sections	w/d ratio	# of x-sections	w/d ratio	# of x-sections	w/d ratio	# of x-sections	w/d ratio
Project Impact, Lamoille County	65	**27.3**	27	**40.7**	15	**27.1**	17	**25.8**
Natural Resource Conservation Service: White River	3	**19.2**	6	**20.3**				
White River VGS	3	**26.1**	9	**43.4**	2	**21.4**		
Vermont Geological Survey (VGS) disturbed stream study	15	**23.3**			7	**16.2**		
Green Mountain National Forest	26	**15**	3	**20.0**	17	**21**	5	**26.0**
Agency of Natural Resources USGS gages,	6	**24.6**	1	**9.6**	1	18.4	2	**19.7**
Total number of sections	119		45		42		24	
Average w/d ratio		**23.7**		**36.5**		**22.3**		**25.3**

– Data set (279 cross-sections) only includes streams with slopes under 4%.

– Riparian buffers were defined for this analysis as the presence of woody/shrubby vegetation on both sides of a stream channel. The absence of a riparian buffer was defined as the presence of lawn, field, pasture or crops, or an occasional tree on one or both sides of the channel.

Width/Depth Ratios on Streams With and Without Streamside Vegetation Divided by Stream Type

Stream Description	Rosgen stream type	#of sections	Width/Depth Ratio with Riparian Buffer	#of sections	Width/Depth Ratio without Riparian Buffer
Semi-steep (2-4% slopes), fairly straight, moderately entrenched.	B	106	**17.3**	9	**22.00**
Wide, meandering, low gradient, not entrenched.	C	48	**27.9**	21	**41.23**
Narrow, valley bottom, tight meanders, not entrenched.	E	18	**15.1**	8	**10.45***
Entrenched, wide, meandering, mid-low basin.	F	2	**22**	9	**33.69**
Total # sections		174		47	
Average Width/Depth Ratio			**20.1**		**30.9**

– Data set (221 cross-sections) includes only streams typed using Rosgen classification system. A & G channels all had riparian buffers and were not used. The Rosgen classification system divides streams into seven major stream types, with many sub-types. Dave Rosgen of Wildland Hydrology developed this system.

**Three streams classified as E>G, or entrenched with very low w/d ratios (<6.6)*

Positive Steps:

- The Natural Resource Conservation Service is working with farmers along the Mad River to replant and restore riparian buffers.
- The City of South Burlington established buffer zoning over 25 years ago to protect its rivers and streams.
- Over 75 percent of the watershed restoration groups in Vermont are working with landowners to plant trees and restore stream banks.
- The State of New Hampshire passed buffer zoning to protect shorelines and streambanks.
- In Lamoille County, the Natural Resource Conservation Service provides landowners with planted trees along the streams for a minimal cost of $1 per tree.
- A Barton River community planning project out of the Lake Region Union High School is stabilizing banks with natural methods and planting trees and shrubs along the banks.
- The Poultney-Mettawee Watershed Partnership is working with farmers to fence cattle away from streams and plant trees and shrubs along streams.
- Vermont has more than 35 river watershed associations and 86 lake watershed associations. To get involved, get a listing of the watershed associations from the Vermont Division of Water Quality.
- The Lake Carmi Watershed Committee in Franklin and the Lake Parker Association in Glover are conducting shoreline revegetation projects in which native plants will be supplied to shoreland owners for re-establishment of a natural buffer strip.
- The Silver Lake Association in Barnard worked with an owner of the largest stretch of undeveloped shoreline on the lake to set aside the development rights of the property to keep it in a natural state.

Truckloads of Sediment Enter Trout River

Imagine the public outcry if someone were to back up a dump truck to the water's edge in Montgomery and empty a ton of phosphorus into the Trout River.

Consider the outcry if someone were to do it seven times.

Now consider the major flood that hit Montgomery in 1998. Surging floodwaters cut channels into riverside land, sending about 8,600 cubic yards of earth, encompassing more than an acre and a half of farm fields, into the Trout River. That's about 1,300 dump trucks full of soil and gravel. And bound up in all that earth were about 6.9 metric tons of phosphorus, a nutrient that causes big problems when it enters rivers and lakes.

Well-vegetated riverbanks would have helped to stabilize the Trout River and prevent the new channels from being cut. Stable river banks also help ease the tremendous public expense of keeping phosphorus out of Vermont's waters.

Vermont cities and towns will have spent more than $25 million on upgrades to wastewater treatment plants between 1979 and 2001 – all for phosphorus reduction. In addition, municipalities and developers spend millions on phosphorus reduction through stormwater management. Add to that the dollars spent to control phosphorus on farms in the Lake Champlain and Lake Memphremagog Basins – and the overall cost is significant.

To be sure, streamside vegetation won't avert all those expenses. But dollar-for-dollar, riparian buffers are among the most cost-effective way to control phosphorus. The 6.9 tons of phosphorus that entered the Trout River from that single storm was a significant percentage of the total amount of phosphorus, about 82 tons, that winds up in the Missisquoi basin each year. And over time, the 6.9 tons of phosphorus from the Trout River flood will stay in the system, causing damage to lakes and ponds farther downstream.

River restoration efforts after the flood for this mile of the Trout River have cost about $120,000 to date. Maintaining riparian buffers would have avoided much of the damage and cost.

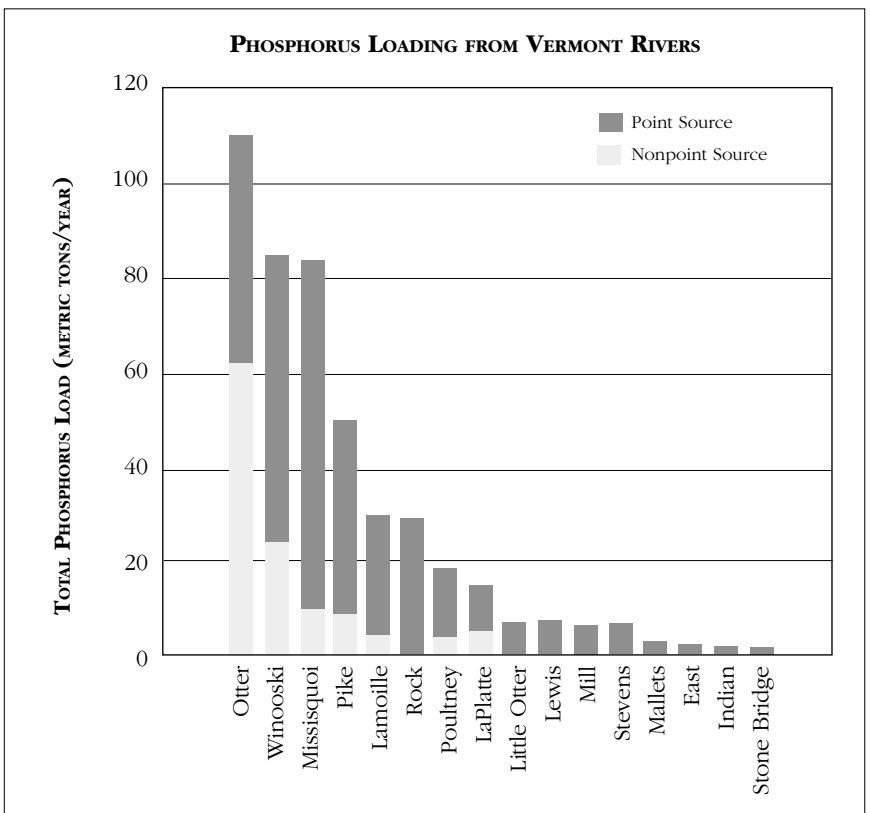
During the flood a farmer lost use of approximately five acres of land when 8,600 cubic yards of his land's soil and sediment went into the river.

But Vermonters lost more than land in the flood because the costs of phosphorus reduction are ongoing. A study by the Vermont Department of Environmental Conservation predicts that targeted reductions of phosphorus will cost around $1.1 million per metric ton of phosphorus per year. This means that the potential cost for removing the phosphorus from the Trout River is more than $7 million dollars.

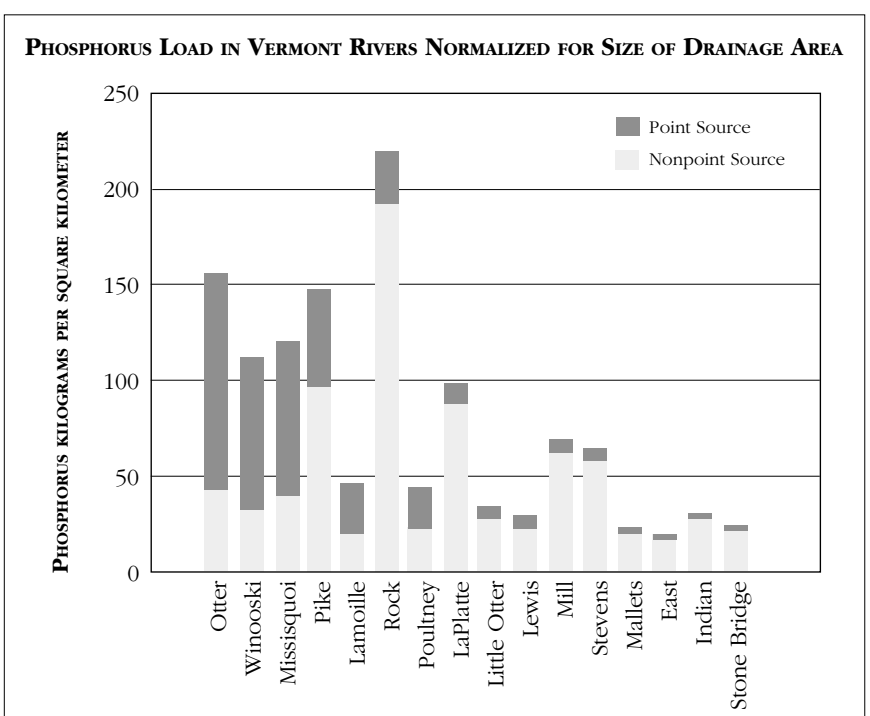
And this dose of phosphorus was only one small portion of what occurred during the 1998 flood; the basin has miles and miles of streams, many without adequate riparian buffers.

Mike Kline, river restoration ecologist with the Vermont Agency of Natural Resources, says, "It's not inconceivable that ten times this amount of phosphorus moved out of the length of the Trout River as a result of both the flood and subsequent smaller rainstorms."

A study by the Vermont Department of Environmental Conservation predicts that targeted reductions of phosphorus will cost around $1.1 million per metric ton of phosphorus per year. This means that the potential cost for removing the phosphorus that entered the Trout River is more than $7 million dollars.



This graph shows the rivers that are contributing the highest total load of phosphorus in metric tons per year to Lake Champlain. The Otter Creek and the Winooski and the Missisquoi Rivers contribute the highest loads.



This graph shows the rivers which have the highest concentration of phosphorus in the water. The Rock River and Otter Creek have the highest concentrations of phosphorus.

SEDIMENT AND PHOSPHORUS (TP) LOSS FROM NEW CHANNELS IN TROUT RIVER

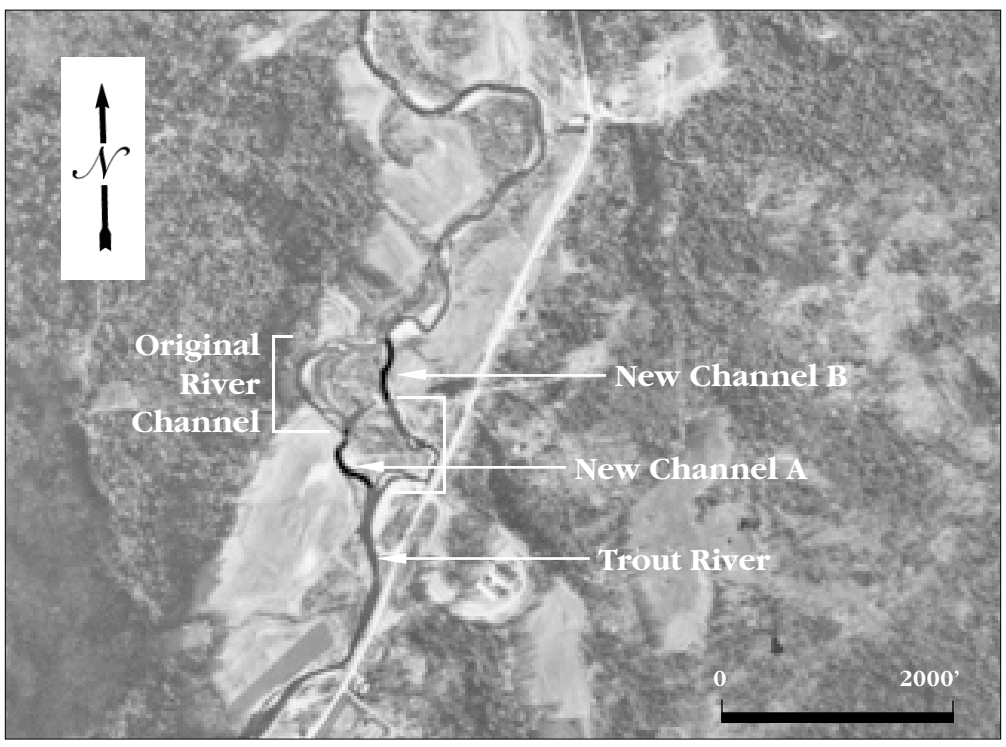
		Length (ft)	Width (ft)	Cross-section area (sq ft)	Volume (cubic yards)	Volume (cubic meters)
New Channel A		524	~80	46,826	5,500	4180
New Channel B		308	~50	26,289	3,100	2356
Total		832		73,115	8,600	6536

Average weight of soil (metric tons per cubic meter)	Volume (cubic meters)	Total weight (metric tons)	Concentration of Total Phosphorus Kg TP /kg soil			
1.5	6536	9804	Topsoil	0.0013*		
			Subsoil	0.0006**		

Amount of sediment lost, channel ~ 3.5 feet deep Kg soil	Kg/TP Kg soil	Total P (Kg)	Total P (Kg)	Total P (metric tons)
Topsoil, high phosphorus	1,400,571	0.0013	1820.7	1.8
Subsoil, low phosphorus	8,403,429	0.0006	5042.1	5.0
SUM TOTAL PHOSPHORUS LOST			6862.8	6.9

*NRCS/UVM **Unpublished data NRCS/UVM

The table above explains what happened in the photo below. New Channel A contributed 5,500 cubic yards of sediment to the stream, and New Channel B contributed 3,100 cubic yards. The combined total of 8,600 yards of sediment that was washed away contained 6.9 metric tons of total phosphorus. The Vermont Agency of Natural Resources estimates removal costs for phosphorus at $1.1 million per metric ton. The flood was not only a cost to the farmer who lost land, but to the entire state as well.



Two new channels were cut by the Trout River downstream of Montgomery Center. This resulted in the loss of land to the farmer, over $100,000 in restoration work, and a huge load of sediment to the river. Much of this loss could have been prevented if trees had been left along the stream channel to help stabilize the river.

Wise Words From the Past

"Before the country was cleared, the whole surface of the ground was deeply covered with leaves, limbs, and logs, and the channels of all the smaller streams were much obstructed by the same. The consequence was that, when the snows dissolved in the spring, or the rains fell in the summer, the waters were retained among the leaves, or retarded by the other obstructions, so as to pass off slowly, and the streams were kept up, nearly uniform as to size during the whole year. But since the country has become settled, and the obstructions, which retarded the water, removed by freshets, when the snows melt or the rains fall, the waters run off from the surface of the ground quickly, the streams are raised suddenly, run rapidly, and soon subside. In consequence of the water being thus carried off more rapidly, the streams would be smaller than formerly during a considerable part of the year, even though the quantity of water be the same. It is a well known fact that the freshets in Vermont are more sudden and violent than when the country was new."

Osprey

– Zadock Thompson,
Natural History of Vermont, 1853

"It is a well known fact that the best fishing is where a forest is near the shore, and best of all where the limbs overhang the water. Not only do the trees afford shelter, furnish food and prevent evaporation, but at the same time they keep the water clear and cool in the summer. In the winter the forests afford protection by lessening the severity of the winter frosts, and in all forest regions the changes of temperature are not so severe as in treeless countries and on the open plain: and the effect upon the water is even greater... But the forests not only regulate the flow of water, as above stated, but they purify the water."

River Otter

– Frank H. Carleton
from the Fifteenth Biennial Report of the Commissioners of Fish and Game of the State of Vermont, 1899-1900.

The importance of natural vegetation to healthy streams is hardly a new discovery. Vermont's first State Naturalist, Zadock Thompson, wrote about how rivers changed as a result of clearing the land. Frank Carleton, Commissioner of Fish and Game in 1900, wrote about the importance of streamside trees for aquatic habitat and improving water quality.

In 1927 and in 1938, Vermont experienced two devastating floods. The damage was great, in part owing to the lack of streamside trees. The Soil Conservation Service experimented along the Winooski River with the use of natural vegetation to stabilize river banks. The photo series below shows the success. This bend on the lower Winooski River near Richmond shows an eroding bank in 1938 prior to the installation of plants for bank stabilization. In the most recent photo, taken in 1993, mature trees on the same bend have replaced the eroding bank.

Eroding bank, Winooski River, June 1938

Bank shaping prior to installing soil bioengineering practices, Winooski River, September 1938

Three years after installation of soil bioengineering practices, 1941

Soil bioengineering system, Winooski River, June 1993
(55 years after installation)

Photos: Natural Resource Conservation Service

Money

continued from page 1

and 1998, a series of powerful floods resulted in approximately $57 million in public and private losses in Vermont. Floods do much of their financial damage to public infrastructure – roads, culverts and bridges.

The actual cost is even higher. The figures do not account for the loss or degradation of natural resources, nor can they put a price on human suffering or, in the worst case, the loss of human life.

"Instability creates a major threat not only to infrastructure investments but also to public safety," says Barry Cahoon, river management engineer with the Vermont Agency of Natural Resources. "The value is infinite, really."

Rivers are far more complex than the notion of a channel carrying water. In fact, another critical role of a river is to transport sediments that wash into tributaries from uplands or are carried across lowlands during storms. A healthy river, one with riparian buffers, is in a dynamic balance – transporting water and carrying and depositing sediments naturally.

A river without a vegetated buffer is a river out of balance. And a river out of balance can be costly. It can dramatically widen its banks, washing away productive agricultural land. It can cut deeply into its channel, undermining bridge footings. And it can lose its ability to filter pollutants before they can reach water.

Riparian buffers alone won't stop a flood or save a bridge. Any number of factors can undermine the integrity of a river, including gravel extraction, straightening a channel or filling a flood plain. But streamside vegetation is one of our most economical and effective flood-control measures.

"Floods have always occurred and always will be outside of human control. But flood losses occur because of choices we have made," says Cahoon. "We need to do a better job of recognizing where the only economically and ecologically sustainable land use is a revegetated riparian buffer."

Jim Ryan, who studies rivers in Lamoille County, has found that the most common source of river instability, particularly in lowlands, is a lack of streamside vegetation.

Barry Cahoon

Vermont has many bridges that have been undermined as rivers have cut into the landscape in response to hydrologic changes in the watershed and modifications such as gravel mining or straightening of the stream channel. The Federal Highway Administration in 1995 wrote that federal funds are not available for bridges damaged by gravel mining.

Farmers, trying to maximize the use of their land, sometimes cut riparian zones and plant crops to the river's edge. But Ryan advises farmers that it can make more sense to take some of that streamside cropland out of production, replacing it with a vegetated buffer. He has a well-practiced lesson for farmers:

"You can take out 25 feet of agricultural production now along the river, and we can stabilize the bank by planting trees and restoring the riparian buffer, which in the long run will protect more of your land," he explains. "Or you can grow corn up to the edge and lose 10, 15 feet of land a year. You do the math. You can set it aside now or you can lose it to the river later."

To be sure, taking agricultural land out of production can be a major, up-front expense to farmers. It's simply asking them to take a pay cut. Fortunately, state and federal governments, as well as local conservation districts, offer programs that reduce or eliminate costs for restoring riparian buffers on their land.

The Natural Resource Conservation District for the Winooski River watershed runs a program, with funding from the Environmental Protection Agency, that pays farmers who agree to replace crop land with either a wooded buffer or a grass filter strip, which still produces a hay crop. (See page 11 for more information about such programs.) It recognizes that farmers sometimes need compensation when they give up productive land to streamside buffers.

"In the Mad River Valley, cropland acreage is a limited resource and giving up high producing prime agricultural land to permanent buffers is a serious economic consideration for the farmer," says Ellen Sivret, a soil conservationist with the Natural Resource Conservation District for the Winooski River watershed. "Our project is designed to demonstrate that a cost share program can address the economic considerations of the landowner and still be a cost-effective means of implementing conservation practices."

While costs to farmers are obvious, the benefits of buffers aren't always so easy to calculate. But here are some numbers from studies done in other states:

- Retaining forest area and buffers has reduced stormwater costs in Fairfax County, VA, by $57 million.
- Observations made after the 1993 floods in the Midwest showed that where forests were retained in the flood plain or where levees had overgrown with trees, damage to the levee system and the river were less than areas only maintained in grass or farmland. Although these benefits are difficult to put a price on, property damage exceeded $50,000 to $250,000 per mile.
- Housing values were 32 percent higher when located next to a greenbelt buffer in Boulder, CO.

Deborah Stoleroff

This road washed out during a flood on the Great Brook in Plainfield in 1990. This is an all-too-common event along rivers throughout Vermont.

"Left to grow up naturally, riparian buffers are a free investment in stabilizing our rivers and protecting water quality,"

– Stephan Syz, Vermont Agency of Natural Resources.

Riparian Buffer

continued from page 1

Bull Moose

flooding – silver maple and green ash, for example.

But trees and shrubs are hardly the only components of a riparian buffer. Indeed, the zones bordering a stream or river can host all sorts of wildlife: from tiny micro-organisms, insects, amphibians and reptiles to fish, mammals and birds – all thriving with algae, lichens, fungi, mosses, ferns and, of course, flowering plants and trees to form a vibrant community of life.

This growing, breathing, crawling, swimming, squiggling, flying, photosynthesizing and, most importantly, interacting assemblage of life all comes together when water meets land at a healthy riparian buffer.

One huge question for policy makers and landowners is this: How wide is a good riparian buffer?

The answer isn't simple. A green frog hardly strays from the shoreline. But a mink might hunt far from the water's edge. And a buffer's capability to stabilize streambanks, filter pollutants or prevent flooding depends on its soils, vegetation, topography, surrounding land uses and most importantly, width.

In general, the wider the buffer the better the buffer.

It is the goal of the state of Vermont "to protect and restore streamside and lakeshore vegetation as part of the state's long-term surface water quality, recreation, fisheries and wildlife management programs" (Vermont Agency of Natural Resources Procedure on Streamside and Lakeshore Vegetation Management, Adopted June 16, 1996). The policy generally:

- discourages the cutting of trees and other vegetation on streamsides;
- encourages the revegetation of streamsides with native shrubs, grasses and trees;
- protects streamside buffers by limiting the access of livestock and by excluding dumping, filling, operation of construction machinery and other disruptive activities; and
- limits encroachments with set-backs for buildings, roads and paved paths to the greatest extent possible.

A Healthy River

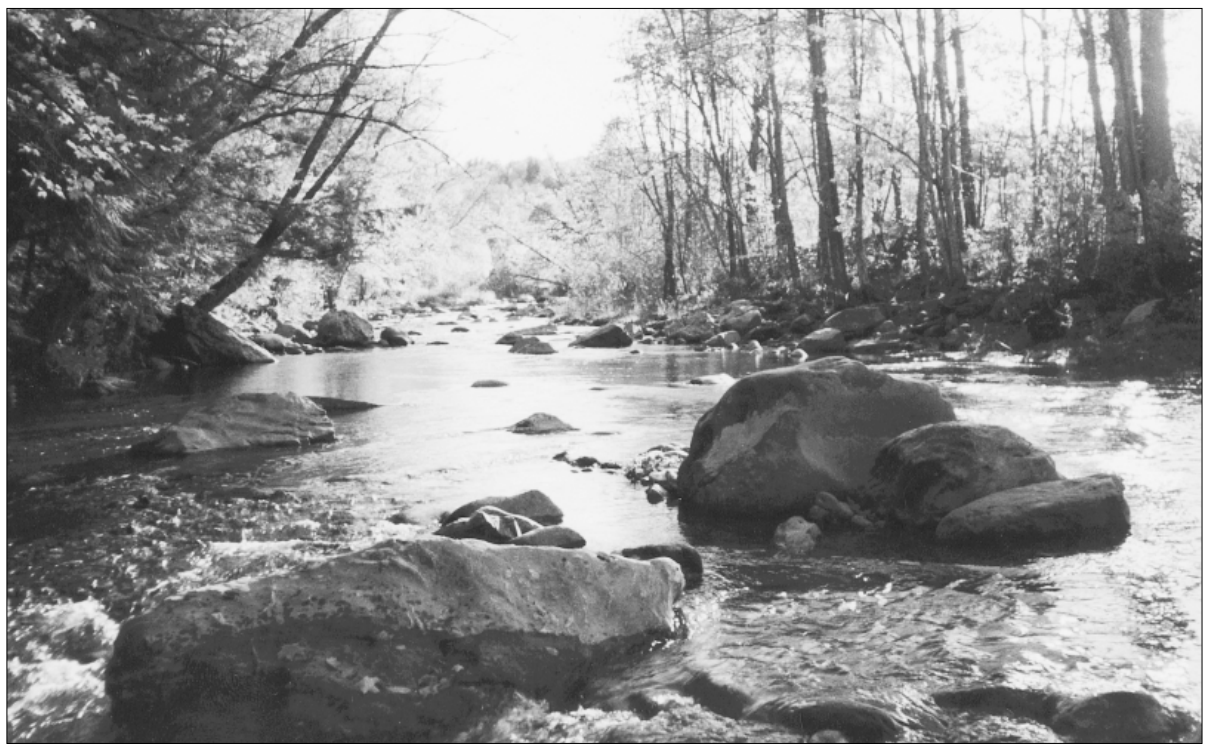
continued from page 1

maintaining the stability of the stream channels. They even strengthen Vermont's economy.

In short, streamside shrubs and woodlands keep a river healthy and in balance and help protect human investments on the landscape.

"The glue that keeps a stream in balance is the riparian zone," says Michael Kline, river restoration ecologist with the State of Vermont. "We're hoping that more and more people understand that we need to work together to keep this buffer of vegetation, that it's in our collective best interest from an economic and natural resources standpoint."

Here are a few examples of what a little streamside vegetation can do for people, the economy and wildlife.



JIM RYAN

Healthy River and a Riparian Ecosystem

Riparian buffers:

Stabilize Stream Banks

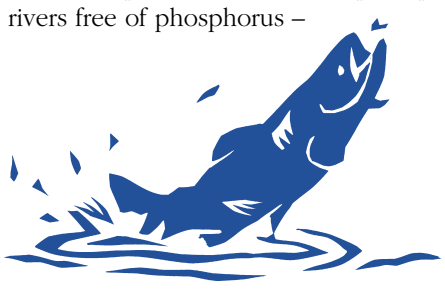
Eroding or collapsing stream banks can gobble up agricultural land and backyards and send sediment into a waterway. Sediment harms fish and other wildlife, degrades water quality and can fill river beds, valuable wetlands or even lakes and reservoirs.

In riparian zones, plant stems protect a streambank from the erosive force of flowing water, and plant roots hold soil in place so that it doesn't wash into the river.

Filter Sediments and Pollutants from Land

Rivers receive harmful pollutants such as sediments and animal wastes washed from roads, housing subdivisions, streets or agricultural land as a result of rainstorms.

Plants in a riparian buffer slow the flow of water rushing over land, allowing heavier sediment to settle before it can reach a river. Riparian vegetation and roots stabilize soils, which can then remove disease-causing microorganisms, pesticides and other pollutants that can harm people and wildlife. Riparian zones also help keep rivers free of phosphorus – a nutrient that causes algal blooms (explosive growth of algae) which suffocate fish and harm other aquatic life.



Provide Shade, Shelter and Food for Fish and other Aquatic Life

A bare stream with no shade trees on its banks is inhospitable to fish and other wildlife.

Shade trees in streamside wood-lands keep the water temperature from climbing too high for cold-water fish such as trout and salmon. Insects falling from overhanging streamside vegetation are an important summer food source for certain fish species. And fallen leaves themselves are a source of food for aquatic insects, which are in turn eaten by fish. Toppled trees or leaning branches also provide underwater cover for fish.

Provide Critical Wildlife Habitat

A barren streamside is an opportunity lost for wildlife, depriving birds, mammals, amphibians and reptiles of food and shelter and a safer zone for feeding and drinking.

Riparian zones offer food and cover to songbirds and game species such as ruffed grouse and wild turkey. Wooded buffers also provide food and critical travel corridors for white-tailed deer, black bear, river otter and mink.

Protect Agricultural Land from Flood Damage

Floods are expensive for farmers. They can force a river to jump its channel and cut a new one into agricultural land.

A river with trees and shrubs along the top of its banks is stable and generally doesn't threaten agricultural land. Plant stems slow down floodwater and reduce its erosive power, and they keep stream debris from flowing onto cropland and pastures. Roots hold stream banks and their soils in place.

Provide Economic Benefits

Rivers can cost money. They can collapse bridges, wash out roads, cut new channels and take agricultural soil and land downstream costing millions of dollars.

Riparian buffers are the single most effective way to avoid these costs. Ironically, farmers can lose riverside land when they clear it and use it for growing crops. A city, town or upland development will spend more money on bank stabilization, stormwater control and water quality improvements than it would by simply leaving or replanting riparian vegetation. Rip-rap, large stones used to stabilize river banks, is expensive, unsightly and often fails to protect land. Riparian buffers eliminate the need for some rip-rap.

Finally, controlling phosphorus is a huge expense for municipalities and taxpayers. Riparian buffers, which are natural phosphorus filters, help save the public expense of preventing phosphorus from reaching rivers.

Little else can stabilize banks, protect water quality and agricultural land, maintain cool stream temperatures for fish, and benefit belted kingfishers, wood turtles, mink, river otter and so many other species, including human beings, as cost effectively as maintaining or improving riparian buffers.

The fate of Vermont's rivers and all the life that enjoys them is in the hands of landowners, community groups and policy makers. Simply leaving or restoring a riparian buffer is a small, simple step with minor costs and huge benefits. Streamside vegetation is what makes a river a ribbon of life across our landscape.

On the road, Charles Kuralt once put it this way: "I started out thinking of America as highways and state lines. As I got to know it better, I began to think of it as rivers. Most of what I love about the country is a gift of the rivers. ... America is a great story, and there is a river on every page of it."

"I started out thinking of America as highways and state lines. As I got to know it better, I began to think of it as rivers. Most of what I love about the country is a gift of the rivers. ... America is a great story, and there is a river on every page of it."

– Charles Kuralt

Interested In More Information? Here's a Resource List

► Fish and Wildlife Department Publications

These Department of Fish and Wildlife publications are available by calling (802) 241-3700

- How to Include Fish and Wildlife Resources in Town and Regional Planning.
- A Landowner's Guide: Wildlife Habitat Management for Vermont Woodlands.
- Backyard Wildlife Habitat in Vermont.

► Water Quality Division Publications

A complete list of documents is available from the Water Quality Division, (802) 241-3770. Some of the highlights are:

- **Planning for Lake Water Quality Protection.** A Manual for Vermont Communities. Vermont Department of Environmental Conservation, August 1990, 113 pages
- **Re-establishing a Lakeshore Buffer Strip.** 1992, 4 pages
- **Native Vegetation for Lakeshores, Streamsides and Wetland Buffers.** 1994, 43 pages
- **Streambank and Lakeshore Vegetation Management Procedure.** June 1996
- **Local Planning and Zoning Options for Water Quality Protection.** September 1997, 28 pages
- **Buffer Strips for Riparian Zone Management.** January 1991, US Army Corps of Engineers for the Water Quality Division
- **Local Planning and Zoning Options for Wetland Protection. Chittenden County Regional Planning Commission and Water Quality Division.** 1997
- **Sources of Native Plant Materials in Vermont.** May 1999, 13 pages
- **Recreation Path and Trail Planning to Protect and Enhance Lakes and Rivers: Values and Considerations for Water Quality and Aquatic Habitat.** October 1994, 9 pages
- **Act 137. Recommendations for Flood Control Policies and Program.** Febuary 1999
- **Geomorphic Impacts of In-Stream Management Practices.** Vermont Geological Survey, 1999

► Videos

These are available from the Vermont Agency of Natural Resources Water Quality Division at (802) 241-3770:

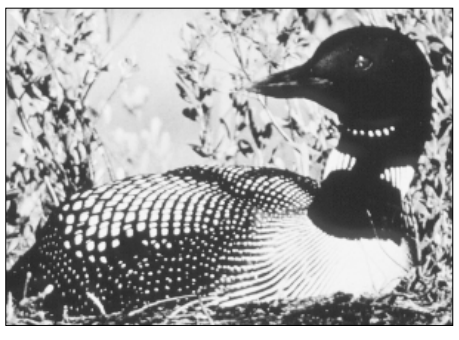
- "When Rivers Become Unstable: How Streambank Woodlands Can Help Protect Land"
- "Unstable Rivers: Using a Geomorphic Watershed Based Approach to Restoration"
- "Riparian Forest Buffers: The Link Between Land and Water" – A 21-minute video describing riparian buffer functions and values.
- "The Living Shore: Best Management for Shoreland Vegetation" – A 17-minute video produced by the University of Minnesota. An excellent video on the value of plants along and above the shoreline of lakes.

► Funding Sources

- **Partners for Fish and Wildlife** – US Fish and Wildlife Service, Essex, VT, 802-951-6313. Funds water resource and restoration projects.
- **Conservation Reserve Program** – Natural Resource Conservation Service, Berlin, VT, 802-828-4493. Funds trees for streams.
- **Wildlife Habitat Incentive Program**–Natural Resource Conservation Service, Berlin, VT, 802-828-4493.
- **Lake Champlain Basin Program Local Implementation Grant** – Lake Champlain Basin Program, 800-468-5227. Watershed groups and municipalities have received grants to implement practices that reduce nonpoint source pollution and pay for the project coordinator's time.
- **Clean Water Act Section 319 Nonpoint Source Project Proposals** – Vermont Department of Environmental Protection, Water Quality Division, Waterbury, VT, 802-241-3770. Five types of projects are funded: watershed resource restoration, technical and financial assistance, monitoring, demonstration and enforcement projects.
- **Conservation License Plate Watershed Projects** – Vermont Department of Environmental Protection, Water Quality Division, Waterbury, 802-241-3770. Funds water resource and restoration projects.
- **Connecticut River Partnership Program** – Connecticut River Joint Commissions, 603-826-4800. Funds small projects that are innovative and community-generated and address conservation and economic challenges.
- **Vermont Better Backroads Small Grants Program** – Northern Vermont Resource Conservation and Development Council, Berlin, VT, 802-828-4595. Funds town or private road projects to repair erosion site or identify and rank problem sites.
- **The Sustainable Future Fund** – The Vermont Community Foundation, 802-388-3355. The foundation supports projects that help people and communities think creatively about challenges of building a sustainable society.

► Watershed Associations

For a list of watershed associations near you contact:
Vermont Agency of Natural Resources
Division of Water Quality
103 South Main Street
Building 10 North, 2nd Floor
Waterbury, VT 05671-0408.
Phone: (802) 241-3770.



Common Loon

A Watershed Perspective on Community and Protection of Social and Economic Well Being

by Barry Cahoon
River Management Engineer
Vermont Agency of Natural Resources

I've always wondered how people's attitudes and perceptions about their place in the environment might be different if, instead of living in political jurisdictions with artificial boundaries (towns and counties) drawn by land speculators in the 1700s who had never set foot in Vermont, we lived in communities defined by watershed boundaries.

Instead of Caledonia or Essex counties we would live in Passumpsic or Upper Connecticut County. Our communities would be Sleepers River, Miller Run, Moose River or Calendar Brook.

Our neighborhoods would be defined as the natural systems define them. Wouldn't we think much more carefully, sensitively and compassionately about our personal actions and how they ultimately affect the natural systems upon which we, our neighbors and the vitality of our communities depend?

There need not necessarily be regulatory approaches to guiding watershed land use and development patterns in order to reduce future flood losses. Rather, public education and implementation of a comprehensive system of community incentives can accomplish a lot over time.

A Simple Solution

Natural Resource Conservation Service

◄ As we travel through Vermont the same scenes occur again and again. Eroding river banks are a common sight along rivers without streamside trees, shrubs, and other natural vegetation.

► In contrast, a stable river with well-vegetated banks can contain flood waters without any major damage.

Natural Resource Conservation Service

Farm Programs Help Vermont Waterways

The State of Vermont created the Best Management Practice Cost Share Program in 1996 to provide financial assistance to farmers for voluntary construction of on-farm improvements designed to control nonpoint source agricultural waste discharges into the state's waterways.

Since the program's inception, $2.7 million has been committed to build 737 BMPs. In fiscal 2000, 74 grants totaling just under $750,000 were awarded across the state. Funding increased to $1.2 million in fiscal 2001.

In addition to the traditional waste management structures, the program has funded construction of 2 stone-lined waterways, 16 livestock exclusion projects to reduce animal access to streams, 5 stream bank and shoreline stabilization projects and 1 grassed waterway. The program has also helped to fund the development of alternative water sources that further help to divert farm animals away from the state's streams.

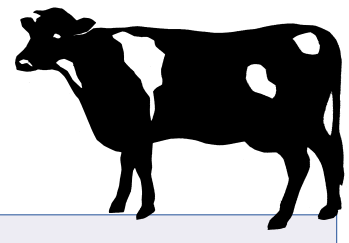
As a direct result of the BMP program, phosphorus loading to water courses statewide has been reduced by nearly 32,000 pounds. Of that total, an estimated 24,000 pounds of phosphorus has been eliminated in the Lake Champlain Basin, enabling agriculture to meet the phosphorus reduction targets required by the Lake Champlain Basin Plan.

The state-funded grants have made BMP construction possible for many farmers who would have otherwise not been able to afford the improvements. By adhering to BMPs, farmers are able to more cost effectively use nutrients, handle agricultural wastes, and comply with state and federal water quality regulations. The Agriculture Department's BMP Cost Share Program has gained widespread support from the agricultural and environmental communities.

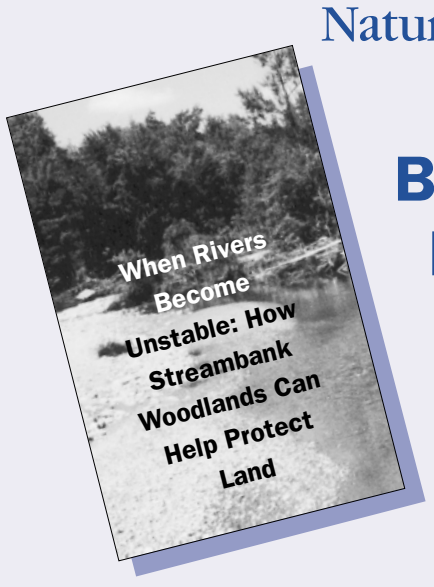
The Agriculture Department in conjunction with federal Farm Service Agency is also developing a Conservation Reserve Enhancement Program (CREP) for the Champlain Basin. Under the CREP funding plan, farmers will be paid to sign 15-year agreements to develop perennial buffers along cropland and forested buffers along pastureland. Over the 15-year period, farmers will receive compensation for the lost crop value of these lands for agreeing not to plant in these areas.

If the Vermont Legislature concurs, the Department of Agriculture and the Farm Service Agency in July 2001 will enter into contracts with farmers for 750 acres of pastureland and 250 acres of cropland. The total cost of the program will be just under $2.1 million over the 15-year period, with the state contributing $640,000 of that total. Based on the level of success in the Lake Champlain Basin, the state will launch CREP programs in the Lake Memphremagog and Connecticut River Basins beginning in 2003.

Those interested in the BMP program should contact Jeff Cook at the Vermont Department of Agriculture, (802) 828-3474.



The Vermont Agency of Natural Resources *Presents*



"When Rivers Become Unstable: How Streambank Woodlands Can Help Protect Land"

"Wet and Wild!"
– Scott Johnstone, Vermont Agency of Natural Resources

"A Real Fish Story!"
– Ron Regan, Vermont Fish and Wildlife Department

"Two Thumbs Up!"
– A Vermont Landowner and a Vermont taxpayer

Most folks have never heard of "riparian buffers," but they are some of the most valuable real estate in Vermont. Here's a new video (getting rave reviews from Vermonters) about the values of streamside shrubs and woodlands, often called riparian buffers.

The video is designed for landowners, town officials, watershed groups or any citizen interested in river quality and land conservation. It illustrates how streamside vegetation can stabilize river banks, protect fisheries and property, reduce flood damage and phosphorus loading, and improve water quality.

But there's more:

A second video shows how to protect property by working with the river using a Natural Channel Design approach. It's called "Unstable Rivers: Using a Geomorphic Watershed Based Approach to Restoration."

To get your copy of these two videos, call or write:

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