Stream restoration techniques draw pushback

Some scientists, environmentalists, residents question wisdom of tree removal

By Timothy B. Wheeler

During dry weather, two little streams in Hollin Hills trickle gently downhill, shaded by a thick canopy of oak, hickory, beech and tulip trees. Heavy rain can quickly turn those trickles to torrents, though. As a result, portions of both streams have eroded badly over the years. In places, steep gullies 12 feet deep or more have been carved into the ground by runoff from roofs and pavement in this neighborhood of glassy contemporary homes just south of Alexandria, VA.

Now, Fairfax County is preparing to embark on a $3.6 million project to re-engineer the channels of both streams. Many Hollin Hills residents welcome it, fearing that someone could be hurt falling into the gullies.

But some oppose the plan, arguing that it will destroy the woodsy nature of the two small community parks through which the streams flow. Nearly 80 large trees will be removed, and vegetation along stable stretches of both waterways will be cleared to access eroding areas. Critics contend the fix is worse than the problem.

"Look at the diversity here," botanist Rod Simmons said as he strolled through the streamside parks. "You've got Solomon's seal there, you've got blue-stemmed goldenrod."

Simmons, a natural resources manager with Alexandria's Department of Recreation, Parks and Cultural Activities, has in his spare time become an outspoken critic of many urban stream restoration projects, including one in his own municipality.

Pausing to admire a towering white oak, Simmons said, "these old-age trees are toast. It really is a crime to trash this place."

County officials say that they're trying to repair damaged, potentially dangerous streams. Some disruption is inevitable, but temporary, they insist.

"We're not in the business of cutting down trees to cut down trees," said Meghan Fellows, the Hollin Hlls project manager with the county's stormwater planning division. "We do the best we can to replace the entire stream corridor's function," she added, noting that plans call for replanting more trees and shrubs than are be removed.

It's a debate playing out in many places across the Chesapeake Bay region as urban and suburban governments increasingly turn to stream restoration projects to meet their obligations to reduce nutrient and sediment pollution fouling the Bay.

But critics argue that a heavy-handed approach to stream restoration in such settings often does little if anything to restore the waterway's ecological health. In the process, they argue, precious patches of riparian forest are being sacrificed in what the Chesapeake Bay Foundation's Rob Schnabel calls a "gold rush" by local and state agencies to accumulate credits toward meeting Bay restoration targets.

It's a complicated and passionate debate. And there isn't enough research yet to settle it.

A growing, evolving practice

People have been degrading streams since colonial times by clearing trees, building dams and adding a host of other insults to the

Photo: Nearly 80 large trees like the tulip tree in the foreground are to be removed for a pair of stream restorations in Goodman and Brickelmaier parks in Hollin Hills near Alexandria, VA. (Dave Harp)

landscape. Natural resource managers have been trying to restore them since at least the late 1800s, when they began putting in small dams and sills in an attempt to boost fish habitat.

One approach to stream restoration that's popular today began about 45 years ago. That's when a former U.S. Forest Service hydrologist from Colorado, Dave Rosgen, developed a stream classification system and began promoting what he called "natural channel design." The technique involves re-engineering the stream to create bends and meanders that slow down the current and reconnect the stream to its floodplain to absorb storm-swollen flows. It also calls for putting woody debris in the water to support fish and aquatic insects.

Rosgen's method has grown into a widespread practice nationally. Other techniques also have been developed, including one pioneered in Maryland known as regenerative stormwater conveyance. That involves raising an incised stream bed with sand, mulch and rocks and installing a series of shallow pools and rocky riffles to capture or slow storm-driven runoff.

To date, about 340 miles of streams across the Bay watershed have been re-engineered by one method or another, according to the state-federal Chesapeake Bay Program. Since 2014, Maryland has permitted more than 600 projects and Virginia more than 300.

Most of the restored stream miles are located on current or former farmland, but a growing number are in developed areas, done by local and state agencies to satisfy regulatory requirements that they reduce stormwater pollution. Runoff from buildings and pavement accounts for 16% of the nitrogen, 18% of the phosphorus and 24% of the sediment washing into the Bay, the Bay Program estimates.

The number and scale of projects has grown over the years as states and localities scramble to meet their obligations for restoring the Bay's water quality. States and localities once anticipated doing 655 miles of stream work by 2025 but are now planning to complete 900 miles by that time, Bay Program data show. The estimated total cost: $500 million.

Local and state officials and restoration specialists say the goals for stream restoration vary from place to place, but it is one of the most cost-effective ways to reduce pollution from stormwater, especially in developed areas where other options are limited. Projects are undertaken, they say, only after careful technical analysis of the stream's condition, its range of flows, the number and types of fish and insects in it and the vegetation bordering it.

Researchers with the Appalachian Laboratory of the University of Maryland Center for Environmental Science found that restored streams generally do achieve more stable banks and channels, so they're dumping less sediment into the water.

Questions have arisen and persisted, though, about the effectiveness and durability of such projects and about the trade-offs involved in removing trees and vegetation.

A lack of 'ecological uplift'

In addition to reducing sediment and nutrient pollution, stream restoration projects are supposed to provide "ecological uplift" to degraded streams, bringing back long-lost aquatic insects and fish like trout, which need cold, clear water to maintain their populations.

In reviewing 40 different projects across Maryland, researchers at the University of Maryland laboratory didn't find many ecological benefits. The number and type of aquatic insects — food for fish and key indicators of stream health — didn't improve.

According to ecologist Bob Hilderbrand, the study's lead author, there's evidence that a stream's ecosystem can benefit from restoration if the stream wasn't severely impaired to begin with. But in badly degraded urban and suburban streams, he added, "there's not much evidence … that we can bring the ecology back."

And in some cases, he said, his research suggests the aquatic habitat and life in streams that have undergone restoration work actually wind up worse off than if left alone.

Hilderbrand said his team's study didn't look specifically at how tree removal during restoration affected a stream's ecology. But he noted that even if contractors replace the cleared vegetation along the banks, which is customary in restoration projects, "it's going to take decades for those trees to become re-established."

With their root networks, trees help prevent stream bank erosion. They also soak up rainfall, helping to keep nutrients and sediment from washing off into a stream during a storm. In dry weather, they shade the water from the sun, keeping the temperature down to help sustain fish and amphibians.

But preliminary findings of another University of Maryland study suggest that when streamside trees are cut down during restoration, nutrient seepage into the water may actually increase. A review of five projects constructed since 1999 found elevated nitrogen levels in groundwater downslope from where trees had been removed.

Sujay Kaushal, an associate professor of biogeochemistry at College Park, declined to discuss the study's preliminary findings presented at a workshop last year. He said he's working with one of his graduate students who did the research to complete the analysis and write it up.

"It's such a hot button issue that we want to get all our ducks in a row first," he said.

Hilderbrand's and Kaushal's studies are among dozens funded by Maryland's Chesapeake Bay Trust. The science behind stream restoration is still relatively new, and practices have changed over the years, leading to debate and uncertainty about what's worked where and what hasn't.

Five years ago, in collaboration with other state and federal agencies, the trust began issuing grants to research the effectiveness of the various techniques being employed.

The trust also helped pull agencies together in a collective effort to gather information on how past projects had performed, because until relatively recently they were monitored for only a few years after completion.

Sadie Drescher, the trust's director of restoration programs, called the impact of tree removal "a burning question. We ask regulators, 'What are the key questions that keep you up at night?' This was one."

A 'temporary band-aid'

Many environmentalists support stream restoration, and some watershed groups actively engage in planning and executing projects in their communities. But some environmental groups have concerns.

The Bay Foundation recently joined some residents of Gaithersburg, MD, in questioning plans to rework 2,400 feet of stream through a city park, reconnecting it to a floodplain and creating 1.5 acres of wetlands in the process. The $1.8 million project would remove more than 100 large trees, though plans are to replant 120, according to the city's Department of Public Works.

"These days, site selection seems to be based more on landowners' willingness to let it be done than water quality considerations," said the Bay Foundation's Rob

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Botanist Rod Simmons stands in an unnamed tributary of Paul Spring Branch. When it's dry, this stream in the Virginia community of Hollin Hills is no more than a trickle. But portions of it and another nearby stream show evidence of erosion from flashy runoff during rainstorms. (Dave Harp)

The bank is eroding beneath this stormwater outfall that funnels runoff from homes and pavement into a stream in Goodman Park in Hollin Hills. (Dave Harp)

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Schnabel. Many projects, in fact, are sited on public land — particularly parks, where the city or county government already owns the property.

In Baltimore, there's pushback against plans by the city's Department of Public Works to re-engineer three streams in Gwynns Falls/Leakin Park, the second largest urban woodland in the United States. Opponents say 90 large trees are to be removed in just one project.

"What we are asking the city to do is what other cities like Washington, DC, and Philadelphia have done," said Jack Lattimore, a board member of the park's friends group. "They have prioritized small green infrastructure over these large hubristic manmade earth-moving projects. You get people to unhook their gutters, you build small ponds, you actually improve neighborhoods rather than wrecking parks."

But Baltimore officials are relying heavily on stream restoration to comply with regulatory requirements to reduce stormwater runoff. Though stream projects aren't cheap, they're far more cost-effective, at least on paper, than trying to curb runoff by planting trees in smaller patches or creating rain gardens.

Rosanna LaPlante, a city public works section chief, wrote last year that one stream project would cost $84,000 per acre versus $221,000 per acre to build a "bio-retention" basin elsewhere big enough to capture and soak up equivalent amounts of nutrient– and sediment-laden runoff.

To Schnabel, that's short-sighted. He has been on both sides of the debate, working on environmental mitigation for the Maryland State Highway Administration before joining the Annapolis-based environmental group. He said he's seen some projects that improved water quality, but they tended to be in rural areas, with fewer impervious surfaces to complicate matters.

"When you're jumping into a stream channel, you're not addressing the source of the problem," he said. "You're putting in a temporary Band-Aid." The problem is runoff, he said, and if it isn't somehow reduced, all of the restoration work can be undone over time by one or several storms.

Simmons, the botanist, argues that removal of the tree canopy and other vegetation also makes a stream corridor vulnerable to takeover by invasive plants. He acknowledges that erosion may need to be fixed, but he contends that can be done on a more limited basis.

As an example, he points to work at Arlington National Cemetery where, instead of trying to re-engineer an eroding hillside stream channel, boulders were used to armor its banks against the effects of flashy runoff.

Botanist Rod Simmons points out New York ferns growing in Goodman Park, near one of two streams targeted for restoration projects in the Virginia community of Hollin Hills. (Dave Harp)

Toward 'minimalist' restorations

Stream restoration specialists and state and local officials involved in planning them say they're sensitive to concerns about tree removal, and there's been a tendency recently toward what one called a "minimalist" approach, taking down as few as possible.

"When impacts to existing forest resources are unavoidable, the designers do the best they can to incorporate these resources into the project," said Mitch Keiler, president of the Maryland Stream Restoration Association. That often involves placing the roots and trunks of felled trees in the stream to provide habitat for fish, aquatic insects and beneficial bacteria.

"But there are realities," he said, "and the constructability of many projects are challenged by site constraints." Runoff does need to be controlled to help ensure the success of restoration projects, he and others acknowledge, but they have to work with a site chosen by the client — often a budget-conscious local government — and stick to the plan approved by regulators, even if they'd like to go back and tweak it.

Denise Keehner, assistant secretary of the Maryland Department of the Environment, said her agency only approves projects where there's evidence a stream is degraded.

"Stream restoration is a complex and challenging undertaking," Keehner said, "and an approach that works in one place may fail in another."

But in at least some cases, she said, the riparian forest needs to be replaced for ecological reasons. The trees that have grown up along the banks, she said, are upland species that won't survive once the stream is reconnected to its floodplain.

While acknowledging that there are past projects they'd like to have done differently, restoration specialists say they're confident overall that their work will help stabilize eroding streams and recover from damage wrought by decades of abuse. If nothing is done, they say, erosion will continue and maybe worsen, dumping sediment and nutrients downstream to impair water quality and fish habitat.

"We honestly believe that 100 years down the road, in 99% of the cases, these resource concerns wash out and you have a better site than before restoration," said Kirk Mantay, who oversaw stream restorations for the South River Federation, a watershed group, before becoming executive director of the nonprofit Green Trust Alliance.

The results so far, though, are not encouraging, said the researcher, Hilderbrand. The older projects he looked at showed no more ecological recovery than the recently finished ones, he said.

Hilderbrand said his research indicates that the amount of development in a stream's watershed controls how much recovery can occur. That doesn't mean some re-engineering isn't warranted to reduce sediment or nutrient pollution, he noted. But perhaps the criteria for judging ecological uplift needs to be adjusted for badly degraded urban streams, he said, to make expectations more realistic.

The Bay Program has taken notice of research by Hilderbrand, Kaushal and others indicating that stream restoration can have "unintended environmental consequences."

Its urban stormwater workgroup, made up of regulators, restoration specialists and researchers, proposed new guidelines earlier this year for evaluating stream projects. They recommend planners target the most degraded waterways and address upland runoff as well as channel erosion. They also urge the consideration of other, perhaps less disruptive options.

"I think there are going to be plenty of instances where stream restoration is the best solution for a particular site," said David Wood, coordinator of the workgroup, who's with the nonprofit Chesapeake Stormwater Network. "But I think there are many sites where it's not."

The workgroup's recommendations are just that, Wood noted. The decisions on where, how or even whether to do a stream project rest with local officials and state and federal regulators.

Meanwhile, the Bay Program has scaled back by about a third the amount of stream restoration that can be counted toward the Chesapeake's pollution-reduction goals — at least until state and local agencies can inspect and verify that projects finished years ago are still performing as intended.

The one point on which all sides seem to agree is that more research is needed, and more monitoring.

"These are tough issues," Keiler said, "and we're going to have to continue to learn." ■