Wetland Revival

By Kristen Evans '07

In an effort to prevent ecological calamity in the Chesapeake, F&M faculty and students usher in a new paradigm for ecosystem restoration.

Illustration by ROBERT CRAWFORD

Hanging on the wall of Dorothy Merritts' office in Franklin & Marshall's Hackman Physical Science Laboratories are two panoramic photographs of Big Spring Run, a stream valley located just south of Lancaster. The photos are a Christmas present from her scientific partner-in-crime—and, as it happens, her husband—Robert Walter '75.

In one of the panoramas, as Walter describes it, there's a landscape filled with invasive plants and a high, muddy bank towering above a narrow, shallow stream. The differences in the second

photo, taken a few years after the first, "couldn't be more stark," according to Walter. Where there was once mud and scraggly plant life, there's now a verdant wetland.

Under the watchful eye of Merritts, Walter, and a collaborative team of environmental engineers, geologists, botanists, landowners and F&M students, Big Spring Run is transforming into a new ecosystem, one that's helping to revive the Chesapeake Bay Watershed's ecology and challenging long-held, but ineffective, notions about stream restoration in Pennsylvania.

How did they do it? For starters: removing 20,000 tons of legacy sediment—"mud," confirms Merritts—from the restoration site.

At first, removing truckloads of dirt sounds like a drastic solution for fixing a stream valley struggling with erosion and loss of plant life.

"It does seem radical," Merritts, F&M's Harry W. & Mary B. Huffnagle Professor of Geosciences, admits of the Big Spring Run restoration plan. "On the other hand, it seems radical to us to go into those same valley bottoms and line the eroding stream banks with immense boulders."

Prior to her work with Walter, Merritts' stream-restoration efforts focused on adding elements to the landscape, like tree saplings or boulders, to prevent further erosion, rather than taking away existing soil. And, in the case of the Big Spring Run site, earlier efforts to plant trees along the stream had failed—saplings planted there died within a few growing seasons.

"Imagine you have this beautiful wetland, and we proposed to go in and dump 20,000 tons of sediment in it... You would think we were nuts."

"People think they're restoring [the stream valley] to some condition that used to exist," says Merritts, "that they're going to help put that system back to this naturally meandering stream. But, in reality, in the cases we're looking at in the mid-Atlantic region, there was no naturally meandering stream."

If you asked any Pennsylvania native to draw a picture of a river, they'd most likely draw a curved "S." That's the shape of the "naturally meandering stream" Merritts mentions, and it turns out that shape—as the professors have demonstrated in their groundbreaking research—isn't a natural one. It's the product of hundreds of years of human intervention, which have obscured naturally occurring wetlands under tons of dirt, silt and mud.

"Imagine the reverse," says Walter, associate professor of geosciences, when asked to explain the logic behind the stream-restoration efforts at Big Spring Run. "Imagine that you have this beautiful wetland, and we proposed to go in and dump 20,000 tons of sediment in it. You would think we were nuts, right? What we've done is actually reverse-engineer this. We've recognized that underneath the legacy sediment that shouldn't be there, is an ancient, buried wetland, and what we're trying to do is revive it."

This revelation threw the scientific community for a loop back in 2008, when the professors published their findings about the effects of human industry on stream valleys in the journal Science. Their discovery challenged every assumption about what river valleys were supposed to look like, and the research they've conducted at the Big Spring Run site—putting their theories to the test—is now providing alternative, cost-effective solutions for preventing stream bank erosion and high sediment loads into the Chesapeake Bay.

The restoration efforts combine the expertise of a diverse team of scientists from Pennsylvania and as far away as Oregon and California. Managed by the Lancaster Farmland Trust, the project is funded by the Pennsylvania Department of Environmental Protection (DEP), Environmental Protection Agency (EPA), U.S. Geological Survey, National Science Foundation, Pennsylvania Chesapeake Bay Commission and F&M. It has succeeded, in part, because the team was able to identify elements of the historical ecosystem buried deep beneath the 20,000 tons of sediment removed from the site.

Jeffrey Hartranft, a botanist by trade, works for the Pennsylvania DEP and is part of the Big Spring Run project team. In the course of partnering with Merritts and Walter, he was excited to discover that lying beneath the legacy sediment of Big Spring Run was a possible key to the environment that had thrived there in the past. "I was looking at this hydric soil saying, 'Wow, this is a paleo-environment that gives us a clue as to what was here beforehand,'" says Hartranft, who studied the evidence of seeds and other plant life unearthed once the sediment was removed.

Figuring out that the site should be restored as a wetland at all is an accomplishment in and of itself. "Conventional wisdom had always held that the landscapes adjacent to streams were forested," explains Hartranft. "We found evidence contrary to that." The team discovered, instead, a complex ecosystem involving many different stream channels and wetland sedge meadows buried beneath hundreds of years worth of muck.

In addition to harboring important wildlife species, thriving wetlands are integral to the recovery of the Chesapeake Bay Watershed, which is suffering from pollution caused by sediment runoff into streams and rivers. Large algae blooms cover parts of the bay, suffocating plant and wildlife in the bottom of the estuary. Problems with pollution in the Chesapeake Bay are so severe that President Obama signed an executive order in 2009, prioritizing efforts to "restore and protect the nation's largest estuary."

"There was a time in American history, not very long ago, when the wetlands were drained to create more farmland," says Walter. "But now we recognize that wetlands are extremely valuable on the landscape and are often called 'nature's kidneys' for their ability to filter out toxins." By restoring more areas like Big Spring Run to their original wetland-like conditions, Merritts and Walter hope to prevent sediment from polluting the bay in the first place.

For someone like Hartranft, who works to restore wetland losses in this region, the implications of Big Spring Run are huge. "Prior to this, our wetland restoration efforts were focused on plugging ditches that were dug into wetlands or removing drain tiles that were installed in wetlands," says Hartranft. "It turns out, our primary wetland loss actually came from burying them under legacy sediment. So we may have been trying to fix a problem without really understanding the mechanism for the loss, or even understanding the magnitude of that loss."

Runoff! Satellite imagery following Tropical Storm Lee in 2011 shows the enormous amount of sediment carried by rivers and streams into the Chesapeake Bay. Other pollution and algae blooms adversely affect the bay's native wildlife.

Right
Several years after the removal of legacy sediment, the newly restored wetland at Big Spring Run is thriving.

As Hartranft explains, not only has the Big Spring Run Project hit upon a more effective way to restore wetland areas to Pennsylvania, but the project has also identified many other possible wetland areas that could be restored throughout the state in the future.

This is part of the lesson provided not just by the Big Spring Run project, but also by the larger historical and geological research of Merritts and Walter. "We don't always know what the causes of something are," says Merritts. "We might think we do, but we have to be open-minded and look at lots of different types of evidence, not just the ones we're used to looking at."

Whether those pieces of evidence are historical maps showing the location of 18th-century mill dams or legacy sediment pointing to hidden wetland ecosystems, it's this kind of interdisciplinary thinking that makes both Merritts and Walter such successful scientists and teachers. "The kind of environment that we have at a school like Franklin & Marshall, which values teaching and scholarship as much as it does, [allows our research] to percolate much more readily than it would at a large research school," says Walter.

When the professors talk about the opportunities the project has provided for their students, budding researchers and scientists themselves, it's easy to hear how proud they are. "One of the best things has been that our students get to interact with multiple state and federal agencies and stakeholders," says Merritts. "They're learning how to communicate, they're learning how to collaborate, how to compromise."

"We've produced probably at least two dozen F&M senior theses out of this project, three master's theses, and one Ph.D. in progress right now," Walter adds.

Due to the hard work and care provided by the community of stakeholders at Big Spring Run, the newly restored wetland area is thriving. "The restoration, visually, is so successful," says Walter. "It looked fabulous after the first growing season. It's resilient, and it's performed as we hoped it would."

Jeffrey Hartranft and the DEP are equally impressed. "We are really excited about the results," he says. "We were able to detect change almost immediately, and that change was about a 100 percent reduction in sediment erosion."

These results spell good news for the improvement of the Chesapeake Bay Watershed and will directly affect other restoration efforts taking place across the country. In addition to their work at Big Spring Run, Merritts and Walter are in contact with scientists at Duke University, the University of North Carolina and the University of Louisville, hoping to impact similar ecological research incubating in the South. Closer to home, a new restoration site at Piney Run, Md., in collaboration with the Maryland Department of Natural Resources, will use the data from the Big Spring Run Project to inform its initial engineering design—a huge leg up in starting on a successful path to stream restoration.

As the new ecosystem at Big Spring Run thrives, the area's future may wind up looking a lot like its past—the verdant wetland in the photograph in Merritts' office that provides a little window into the site's 8,000-year-old history. **F&M**