Riparian repair

How can we put the West's broken rivers back together again?
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MILLTOWN, MONTANA

Brooks Priest stands next to a massive beaver dam 12 feet above the churning waters of the Blackfoot River. When workers breached the Milltown Dam on March 28 this year, falling water levels left the beavers high and dry. Armed with a mean hoedag swing and a resource conservation degree, Priest has worked to restore rivers across the West, and her latest project is here at Milltown.

"If only the beavers could teach the human engineers," the keen-eyed, wiry Priest says, looking up at the giant mound of sticks. She has a soft spot for "nature's engineers," she says: "They're the real restoration experts."

The Milltown Dam, built in 1907 at the Clark Fork-Blackfoot confluence near Missoula, once submerged about a mile of the Blackfoot's narrow floodplain and the Clark Fork's wide valley. After the dam went up, millions of tons of arsenic and toxic tailings collected behind it, washed down from copper, silver and gold mines near the Clark Fork's Butte headwaters. In 1983, 120 miles of the upper Clark Fork basin were designated as a Superfund site. The Milltown dam removal was a key part of the Superfund cleanup, and now that it's gone, a levee diverts the river into a straight, riprapped channel.

Behind the levee, bulldozers scrape toxic muck out of rectangular pits, and freight cars haul it 150 miles upstream to dump. Above the diversion, the river splits and reconverges in a tangle of silver threads around sandbars littered with toppled birches and alders. High flows this year ate away huge swaths of bank and obliterated several large islands.

The Clark Fork is sick, and no one is sure how to heal it. All agree on the need "to get the poison out of the wound," says Joel Chavez, an engineer with the Montana Department of Environmental Quality's abandoned mines program. But there's scant consensus on how to turn a sterile and mutilated floodplain back into a functioning river, here at Milltown or anywhere else in the West.

The $10 million Milltown project exemplifies the re-engineering approach, where crews will bulldoze a new channel after Superfund contractors remove tailings. But some river experts say we should devote more of the $2 billion spent yearly on U.S. river restoration to understanding how rivers like the Clark Fork work. Then we can take action that may not require re-engineering.

Sometimes excluding livestock from riparian areas, or removing key levees and dams to restore flood patterns and sediment movement, is enough to permit degraded rivers to heal themselves.

River experts point to Oregon's Sandy River, which quickly washed accumulated sediment downstream after Pacific Gas & Electric blew up Marmot Dam last fall. Coho salmon swam past the dam the day after it was breached, and spawning habitat has greatly improved.

Beginning this fall, bulldozers will cut a single channel across three miles of the Clark Fork and one mile of the Blackfoot floodplains. Natural-looking structures made out of logs, coconut-husk matting, and riprap will keep the river from cutting into the mine waste that remains. Black weed mat will suppress invasive tansy while 150,000 willow, cottonwood and bulrush seedlings, planted by Priest's crews and others, take root. Officials from the Environmental Protection Agency and the State of Montana promise that once the plants have established, the Clark Fork at the Blackfoot confluence will once again be a "real, dynamic river."

Surveying the scene, Priest says it's not that simple, reflecting the disagreement among river restorationists about whether we can return rivers to health by constructing stable, static channels. "Restoration cowboy", Dave Rosgen, the hydrology consultant who prescribed Milltown's meandering channel, says that carving a single, sinuous channel across a river's old path jumpstarts restoration. In the 1980s, in response to 75 years of Army Corps of Engineers "fixing" that straitjacketed thousands of river miles for flood control and navigation, Rosgen came up with a straightforward method for evaluating and redesigning streams. His techniques are now used by agencies from the U.S. Department of Transportation to the Forest Service.

But many geomorphologists, who study how rivers shape the landscape, fault Rosgen's method for using a simplified template instead of a detailed study of how rivers move sediment. They note that river channels evolve in a complex interplay of water flow and the bounce and skid of waterborne sand and gravel. Although the Rosgen method is based on the notion that river channels are stable, aerial surveys show they wind across landscapes unpredictably. Old meanders yield to new meanders, to oxbows, and often intermittently to braids. Season to season, year to year, few rivers stay in the same place. In fact, over-simplifying complex rivers can lead to catastrophe, scientists warn. On Cuneo and Uvas creeks in California, costly Rosgen-inspired reconstruction projects blew out during small floods in 1996 and '97.

The Clark Fork restoration plan recreates a river that never existed, says University of Montana geologist Johnnie Moore. He worries that the reconstructed Clark Fork will be "some kind of reinforced ditch," albeit a curving, natural-looking one. The Clark Fork was once "a true, multi-threaded alluvial river," says Moore. Government surveys dating back to the 1840s depict five distinct channels. Beginning in the 1870s, a mining boom spurred logging, and railroads constricted the channels. Snow melted faster on newly clear-cut slopes; log drives scraped willow-covered islands away, and the river braided even more. Then, in 1908, a massive flood swept across the poisoned wasteland around Anaconda, carrying mountains of tailings that settled in the new Milltown reservoir.

One hundred years later, the river branches across the valley like the veins in a butterfly's wing. So why build a single channel? Money -- and aesthetics. Doug Martin, restoration project manager for the Montana Natural Resources Damage Program, says building a multi-thread channel at Milltown would be trickier, and not cost-effective. What's more, it would mean removing all 6.6 million cubic yards of mine waste. The EPA plans to let ARCO, the company

that inherited the Superfund cleanup, leave a third of the waste behind. Besides, a meandering channel fits a cultural ideal of what rivers should look like, says UC Berkeley landscape ecologist, Matt Kondolf.

The bigger issue in restoration, though, isn't single channel versus multiple threads; most rivers left alone will display sections of both. Rather, it's the question of strict human control over the intricate and gradual patterns of natural processes. Over-controlled rivers stop functioning some scientists say, becoming what University of Colorado geomorphologist, Ellen Wohl, calls "virtual rivers," because floods and crucial processes like beaver damming and log jamming are thwarted.

The Clark Fork restoration plan aims for a delicate balance of control: Hold the banks in place until plants grow in, about 15 years, then allow the river to migrate slowly across the reconstructed floodplain. Moore and fellow University of Montana geologist, Andrew Wilcox, worry that the rigid banks will prevent spring flooding. While the reconstructed channel may look natural, Wilcox says that it won't act like a natural river. Without floods, cottonwoods won't establish and weeds could choke out native shrubs; the diverse ecosystem that nurtures trout and migratory songbirds might never appear. However, if even a minor flood strikes before plants stabilize the banks, Martin says the river could scour out thousands of tons of arsenic and copper-contaminated mud. Toxic sediment released in a 2006 reservoir drawdown caused massive fish kills.

Silver Bow Creek, the Clark Fork's most contaminated tributary, presents a study in miniature of what Milltown might look like some years down the line. In 2000, Brooks Priest helped start a 25-mile, 11-year restoration project on Silver Bow. Workers excavated mine tailings, dumped hilltop soil on the floodplain, and carved a gracefully curved channel. Pockets of tailings remain, marked by aqua or rust-orange crystals. Even so, last year's restoration reach looks pretty good. Bunchgrasses, currants and sagebrush cover most of the soil. A few fish are back, and killdeer fly between ponds. Downstream, islands of bright green trees erupt from gray clay. State officials consider the Silver Bow Creek restoration a resounding success -- "almost a miracle," according to Greg Mullen, the restoration coordinator for the state's natural resources damage program.

But other restoration experts see plenty of room for improvement in the attempt to return Silver Bow Creek to full health. Karin Boyd, a geomorphologist and consultant on the project, wants to incorporate branching sections, to mimic the way beaver dams once split the creek's flow. In the project area, actual beaver are trapped and removed to protect new trees. Along the Silver Bow, restoration leader Priest surveys this year's restoration reach, with its fabric-armored creek banks and bulldozers stuck in the mire. "This will look how most people think a river should look ... but it's not a dynamic ecosystem." Dynamic rivers, with their wandering channels and complex floodplains, seem chaotic to people, but require less long-term maintenance and support more species diversity.

With a fleet of Bobcats and ATVs at hand, Priest speaks wistfully of the humble beaver, which evolved with North American rivers and is largely responsible for their pre-European settlement flows. Beavers by instinct follow the prime directive of process-based restoration: You can't

make an instant river. What you can do is provide ample detritus and room for the river to wander and recreate its own stability and health. In the late 1990s, the Zuni Fish and Wildlife Department in New Mexico relocated 23 beaver to a reservation stream. Within three years, the beavers built a series of dams that raised the water table, flooding out invasive tamarisk and regenerating the willow forest. On Utah's Provo River and California's Cosumnes River, flood-control levees cut off the rivers from their floodplains. Over the past decade, state agencies have purchased floodplain land, then breached the levees. On the Cosumnes, native fish populations rebounded, flood risk declined, and willow and cottonwood survival has improved. Breaches and multi-thread channel reconstruction on the Provo show similar improvements.

But despite their success, such long-term strategies are generally out of sync with government funding cycles. Finding money to buy floodplains is difficult, so single-channel reconstruction "quick fixes" predominate.

Our predecessors streamlined crooked streams with dynamite and built thousands of dams. Now, some scientists and restoration practitioners envision a new kind of stewardship wherein we modify infrastructure to survive wildfires, droughts, and floods, then let natural processes take their course. But on most Western rivers, the dams, railroads, highways, and floodplain development that constrict river floodplains will remain. River restoration design will simply have to adapt. Ecological restoration experts wonder just how much we've learned from our earlier meddling.

"We might do a $10 million remedy at Milltown, then realize that's not where the river means to be," says Pat Munday, professor of history at Montana Tech University in Butte. "The question is, will we have the money to re-do it?"

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