



THE AFTERMATH: SEDIMENT THAT POURS INTO RIVERS AFTER A FIRE HAS MAJOR WATER QUALITY EFFECTS AND CAN CHANGE THE COURSE OF THE STREAM ITSELF.

■ Here Comes the Flood

Think the damage from last year's wildfires is done? The worst may be yet to come as rains run unchecked through vast burn areas.

By Casey Flynn

Jill Oropeza stood on the bank of the Cache la Poudre River while the rain came down hard around her. It was July 6, 2012, less than a week after the High Park fire had been fully contained. The fire had burned over 87,000 acres and 259 homes as it blazed for three weeks outside Fort Collins. Oropeza, a watershed specialist with the City of Fort Collins, was collecting samples to better understand how the fire was affecting water quality in the Poudre River.

Many rainstorms like this one had come through the canyon, but never had Oropeza seen the river respond so quickly. As the rain fell, the fast-flowing water darkened and shimmered with mica-rich sediment. Branches and small logs raced by in the churning current. "It was remarkable to see the river turn black and rise by a foot and then to settle back down after the rain had stopped," she says.

The fire destroyed large swaths of the forest canopy, understory vegetation and the protective duff layer on the forest floor, removing the landscape's ability to absorb and store water during rainfall events. As a result, water runs off the surface more quickly, carrying ash, soil and debris downslope and into waterways.

The rains of July 6 brought flooding and mudslides to the steep slopes and streams of the High Park burn area, closing Highway 14 and rerouting local traffic. Residents of the area lamented the rapid-fire series of disasters plaguing them. First fire, then flood. But the effects of wildfire on their watersheds were only just beginning.

WASHED OUT

Once the flames go out, the life-saving rain that everyone prayed for becomes the driver of change in the landscape. "Most of the erosion or flooding occurs in the summer time when we have strong convective thunderstorms that can produce a lot of rain in a short period of time," says John Moody, a research hydrologist at the U.S. Geological Survey who studies sediment transport and geomorphic response of burned watersheds. "If you don't have any rain, generally you don't have a problem after fire."

In Colorado, our fire season arrives before the monsoon—a recipe for large-scale flooding if a thunderstorm parks itself over a freshly burned area. "The recurrence interval of the rainstorm may not have changed, but the watersheds are destabilized," Moody says. "So what's considered a 1- or 2-year rainstorm event that normally wouldn't affect an unburned watershed can have a catastrophic effect on a burned one."

Sediment pouring into rivers during post-fire rain events drastically alters water quality and the river channel itself. These effects are magnified in much of the Front Range, where highly erodible granitic soils take longer to stabilize. A 2006 flood in the Hayman fire burn area reached depths of up to 15 feet and another large flood occurred in 2009, seven years after the fire.

Aquatic ecosystems experience drastic change in a post-fire landscape, as well. But for fish and other aquatic organisms, disturbance is normal. "We get sold a doom-and-gloom story in terms of fire and fish and aquatic systems," says

Robert Gresswell, Ph.D., a research biologist at the Northern Rocky Mountain Science Center and expert on the effects of fire on aquatic ecosystems. "Very few times do you see whole sections of streams where the fish die and are extirpated. In most cases, fish re-colonize and studies suggest that within a year or two, numbers and biomass of fish equal pre-fire levels." The ability of aquatic ecosystems to recover after fire is greatly inhibited when stream habitat is fragmented by human infrastructure, such as culverts, roads and dams.

"These kinds of disturbances aren't bad or good, except for in the eyes of the beholder," says Gresswell. "I think it's easy for us to place value that is related to our own human values. But in terms of ecological values, there are winners and losers all the time."

Post-fire waters often have higher turbidity, a measurement of clarity in the water that indicates the amount of suspended particles, and may entrain elevated concentrations of metals and organic compounds. All of these materials must be removed from the water during treatment, increasing chemical usage and cost. Fort Collins uses an early warning system to keep turbid water out of its facility.

"We have a water quality instrument above our intake facility that gives us adequate warning time to respond by closing our intake facility," says Oropeza. "During that time we rely on water from Horsetooth until the Poudre River clears up again." Fort Collins can fall back on Horsetooth Reservoir when they need it, but water rights or limited sources may restrict other water providers from that level of flexibility.

RESTORE OR IGNORE?

"One of the questions that's being studied is: under what conditions is it appropriate to do nothing, to do no post-fire stabilization?" says Deborah Martin, a research hydrologist and lead scientist for wildfire research with the U.S. Geological Survey. "In a populated area, the answer probably is not very often. You have to do what you can to stabilize watersheds so you don't get peak runoff that affects life, property and water supplies."

Sometimes post-fire storms threaten all of those things. Two months after the 1996 Buffalo Creek fire southwest of Denver, a thunderstorm dumped over two inches of rain. Catastrophic flooding ensued, washing out a county highway, depositing 10-years-worth of sediment into Strontia Springs Reservoir and killing two people. Denver Water, which provides water to 1.3 million people on the Front Range, has since spent \$26 million to restore areas that have been affected by wildfire, including dredging 225,000 cubic yards of sediment out of the reservoir.

Restoration efforts begin within weeks of a fire, since the first rains pose the largest threat. Burned Area Emergency Response teams identify which areas are of highest priority and the appropriate restoration treatments to apply. One of those treatments is aerial mulching, which uses helicopters to drop agricultural straw or wood-shred mulch onto steep, hard-to-access slopes. It is a widely-used and effective tool for reducing erosion, says Pete Robichaud, Ph.D., a



COURTESY DENVER WATER

LET IT FLOW? CRITICS OF POST-FIRE RESTORATION WORK SAY THE BEST THING TO DO AFTER FIRE MAY BE TO LET THE SYSTEM RECOVER ON ITS OWN.

research engineer with the U.S. Forest Service who studies the effectiveness of treatment techniques, and has been used on both the High Park and Waldo Canyon fires from last summer.

In addition to hillslope treatments like aerial mulching, there are a variety of tools for treating river channels, though very little research has been done on the effectiveness of these techniques. Channel treatments range from straw bale check dams and settlement basins that filter or trap sediment to large-scale projects that reroute the channel itself. The Hayman Restoration Project, a 3-year, \$4 million effort to restore a tributary to the South Platte River, has utilized a variety of these treatment approaches.

Large-scale channel alterations are time- and resource-intensive and their benefits have not

been well-documented. "I am something of a critic of any kind of major stream restoration project," says Rebecca Lave, an associate professor of geography at Indiana University and author of *Fields and Streams: Stream Restoration, Neoliberalism and the Future of Environmental Science*. "There are things that we can do that I think clearly remove barriers to streams healing themselves, like removing dams and culverts. Anything we can do to get out of the stream's way makes all kinds of sense to me. But when we're doing these very elaborate, very expensive projects, I am not really sure whether they're worth doing."

U.S. Geological Survey hydrologist Moody agrees. "I focus on natural systems and I think the system will take care of itself," he says.

MEET THE Watershed Wildfire Protection Group

Fire burns across management boundaries and affects a large swath of users, but federal agencies, water providers and local governments have not historically communicated about these issues. The Watershed Wildfire Protection Group formed in 2008 to end that trend and determine a better way to approach wildfire/watershed interactions and management. Out of its work, a standardized assessment process was established to identify "zones of concern" for focused treatment before and after wildfire. Additionally, Denver Water partnered with the U.S. Forest Service in 2010 as part of their Forests to Faucets program to improve forest and watershed conditions through preemptive efforts like forest thinning. Learn more at denverwater.org/supplyplanning/watersupply/partnershipUSFS.

"Some of these methods are effective for your small- or medium- rainstorm floods. But they will not stop the big one. They'll fill up, they'll overflow, they'll burst. You might stop some small ones, but the question is: is that worth it for the money?" •

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