NONPOINT SOURCE SUCCESS STORY

West Virginia

Installing Limestone Dosers Improved Three Fork Creek

Waterbody Improved

Approximately 9,100 acres of untreated mine pools discharging acid, iron and aluminum into headwater tributaries left Three Fork Creek discolored and lifeless. As a result, the stream was added to West Virginia's 1996 Clean Water Act section 303(d) list of impaired waters list for not meeting the state's water quality standards for pH and metals. In-stream dosing of lime was implemented in the watershed, which reduced metals, increased pH and improved biological conditions. As a result, Three Fork Creek was removed from the state's impaired waters list for aluminum in 2014.

Problem

Most of the 103-square-mile Three Fork Creek watershed is in West Virginia's Preston and Taylor counties (Figure 1). The creek discharges into the Tygart Valley River, which in turn empties into the Monongahela River.

Extensive underground coal mining within the headwater tributaries (Birds, Raccoon and Squires creeks) of Three Fork Creek occurred before the enactment of the Surface Mining Control and Reclamation Act (SMCRA). This left behind approximately 9,100 acres of mine pools that continued to discharge acid mine drainage (AMD) into surface waters. In the Three Fork Creek watershed, the majority of pre-SMCRA mining was conducted in the headwaters section in the Upper Freeport coal seam.

Three Fork Creek (assessment unit WVMT-12-00) was placed on the state's list of impaired waters in 1996 for not meeting the water quality standards for metals and pH. The applicable water quality standards require that dissolved aluminum must be less than 0.75 milligrams per liter (mg/L) and pH must not be less than 6.0 nor greater than 9.0. A total maximum daily load was approved in 2001 to address the metals and pH impairments in the watershed. In 2004 the West Virginia Division of Natural Resources (WVDNR) determined that Three Fork Creek was the second highest contributor of AMD in the Monongahela River basin.

Project Highlights

The Three Fork Creek Watershed Restoration Project was initiated through a combined effort of the West Virginia Department of Environmental Protection's (WVDEP's) Office of Abandoned Mine Lands and Reclamation, West Virginia University (WVU), and the Save the Tygart Watershed Association. A new cost-effective approach to treating multiple discharges was necessary to achieve the desired watershed improvement. Ultimately, it was determined that in-stream, active treatment using lime dosers was the most viable option for treating the creek. Construction of the dosers was initiated in July 2010. Each system was completed and actively treating water by April 2011 (Figure 2).

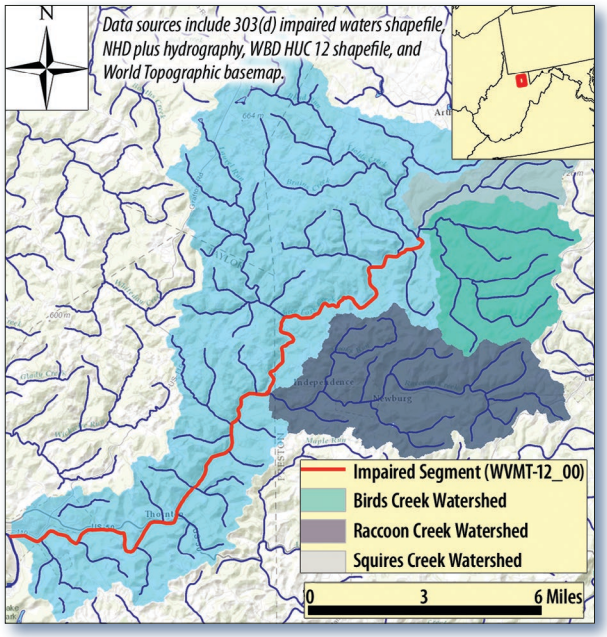

Figure 1. The Three Fork Creek watershed is in northern West Virginia.

Figure 2. This lime doser was installed as part of the Three Fork Creek restoration.

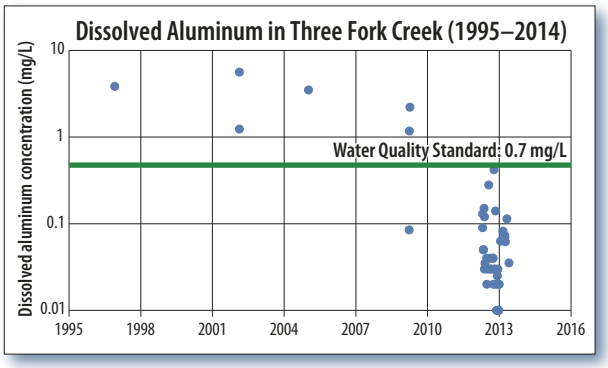

Figure 3. Dissolved aluminum levels in the Three Fork Creek watershed met state standards beginning in 2012.

Figure 4. Raccoon Creek before (inset photo) and after (main photo) lime dosing was implemented upstream.

In-stream treatment devices require constant maintenance and adjustments because of the dynamic conditions of the individual tributaries. WVDEP conducts sampling and adjustments of the doser systems twice per week. Volunteers from Save the Tygart sample the stream once per week.

Results

A post-construction water quality survey showed improvements in waters quality as seen in decreases in acidity and increases in pH and alkalinity (Table 1). With increases in pH, dissolved aluminum concentrations in Three Fork Creek also decreased (an almost 98 percent decrease in average concentrations in samples collected throughout the segment), meeting state standards (Figure 3). Because of these improvements, the 19-mile-long segment of Three Fork Creek (WVMT-12-00) was delisted for its dissolved aluminum impairment in 2014.

Table 1. Water quality (values are means) improved after lime doser installation

Stream	Dosing	pH	Acidity (mg/L)	Alkalinity (mg/L)
Birds Creek	before	3.9	85.1	0.8
Birds Creek	after	6.7	10.5	18.8
Squires Creek	before	3.4	101.6	0.8
Squires Creek	after	6.5	16.9	25.7
Raccoon Creek	before	4.1	96.2	1.7
Raccoon Creek	after	6.0	9.8	7.8
Three Fork Creek	before	5.1	21.9	2.3
Three Fork Creek	after	7.1	5.4	19.6

Restoration has led to improved biological conditions, as shown by increased populations of fish and benthic macroinvertebrates (including pollution-intolerant mayflies, stoneflies and caddisflies, collectively referred to as EPT—short for the order names Ephemeroptera, Plecoptera and Trichoptera). Pre-construction biosurveys in the watershed found a limited number of benthics (eight total taxa and three EPTs) and a single fish. Post-construction biosurveys in 2012 found positive benthic diversity (15 total taxa and eight EPTs) and a dramatic fish response. A total of 1,605 fish were collected, representing 21 species. Physical conditions have also improved (Figure 4). The local residents have noticed; many are taking advantage of the recreational opportunities now available in the watershed.

Partners and Funding

The restoration of Three Fork Creek was supported by the collaboration between WVDEP's Abandoned Mine Lands (AML) program and the Save the Tygart Watershed Association. WVDEP's AML Set-Aside account is used to fund the costs of operation and maintenance (O&M) and support monitoring. Capital construction cost for the dosers was $750,491. Since completion, O&M costs have totaled $274,440; the average cost per month is $18,296. The average cost per year for the past four years from October 2010 thru October 2014 for all nine dosers is $176,673. The total thus far is $1,060,036.

Save the Tygart volunteers perform monitoring at all doser sites. In FY 2014 they collected 1,144 samples (7,237 parameters) at an estimated cost of $41,503. The dosing effort continues and the typical cost seems to be decreasing slightly.

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Three Fork Creek Restoration Website