



NONPOINT SOURCE SUCCESS STORY

Pennsylvania

Treating Mine Drainage Improves Bennett Branch

Waterbody Improved

Acid mine drainage (AMD) discharges from abandoned mine lands (AML) led to severely degraded water quality in much of the Bennett Branch of Sinnemahoning Creek (Bennett Branch) and tributaries, which created toxic conditions for fish and macroinvertebrates. The Pennsylvania Department of Environmental Protection (PADEP) added the main stem of Bennett Branch to its Clean Water Act (CWA) section 303(d) list of impaired waters in 1996 for metals and in 2002 for pH for not meeting aquatic life designated use for warm water fishes. A total maximum daily load (TMDL), or pollution diet, was developed to abate the pollutants. In 2022, PADEP delisted 32 miles of the Bennett Branch—the largest acid mine drainage stream restoration in recorded history (see a project [story map](#) and [video](#)).

Problem

Historically, many surface and underground mines were simply abandoned after mine operators extracted all available coal. Over 15 billion tons of coal were removed from Pennsylvania, and 250,000 acres of mine lands were abandoned—leaving behind safety hazards and pollutants. Since the 1960s, Pennsylvania has been a national leader in establishing mining laws and regulations to ensure that reclamation occurs after active mining is completed.

The 387-square-mile Bennett Branch watershed in central Pennsylvania is largely forested and mountainous (Figure 1). Roughly 19 square miles contain abandoned underground mine workings. Another 15 square miles have been surface (strip) mined or used for coal refuse disposal. Approximately 70% of the watershed is state-owned land. Historical data show that mining began in the mid to the late nineteenth century, and most mines had been closed by the late 1960s. Surface (strip) mining began in the 1940s and continues to a lesser extent today.

The lower 33 miles of the 38-mile-long Bennett Branch were severely impacted by AMD. In 1996, the main stem of Bennett Branch (from the village of Hollywood downstream to the confluence with Driftwood Branch in Driftwood Borough) was listed in Pennsylvania's draft Integrated Water Quality Report (Integrated Report) as impaired for one or more uses by a pollutant. The source of the impairment was historical AMD and the cause was heavy metals. In 2001, the PADEP aquatic biologists examined six stations and found depressed benthic macroinvertebrate diversity (i.e.,

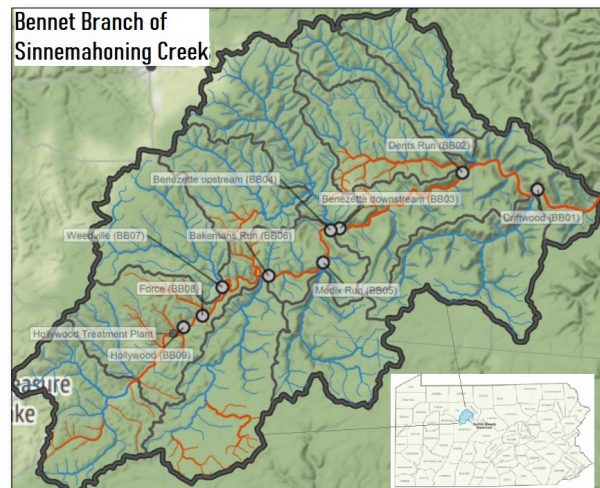


Figure 1. Bennett Branch is in central Pennsylvania.

only five taxonomic groups were collected) and abundance. In 2006, PADEP aquatic biologists examined five stations and found only 17 taxonomic groups, with no station having more than seven taxa. In 2009, a TMDL was completed that consisted of load allocations for iron, magnesium, aluminum and acidity. The TMDL required that the iron and aluminum concentrations be below 0.75 and 1.5 milligrams per liter, respectively, and the pH be 6–9 standard units.

All inventoried AML sites within the watershed were cataloged, and a detailed restoration plan was developed for the Bennett Branch watershed that identified 37 projects intending to restore water quality in the main stem of the Bennett Branch, improve water quality in the AMD-impacted tributaries, and maximize the AML reclamation throughout the watershed.

Story Highlights

Since 2004, PADEP's Bureau of Abandoned Mine Reclamation (BAMR) has spearheaded numerous projects to restore water quality and reclaim abandoned mines. To date, 25 remediation projects have been completed, including the largest remediation project in the watershed, the Hollywood Treatment Plant, which captures and treats an estimated 2.7 million gallons per day from 21 AMD discharges. The headwaters area near Hollywood included a mix of projects such as reclamation, remining, and the construction of a large, centralized treatment plant. The Caledonia Run Subbasin projects included a mix of reclamation with alkaline addition, remining, and several lime dosers. The Dents Run Subbasin projects included a mix of reclamation with alkaline addition, remining, passive treatment and the installation of two lime dosers. Extensive water sampling and monitoring of mine drainage discharges and sampling stations along the Bennett Branch and its tributaries have been conducted. Approximately 150 sample stations were established for sampling and monitoring since 2004.

Results

PADEP assessed an approximately 32-mile section of Bennett Branch over four sampling events at nine stations in 2019–2021 and examined the aquatic life (e.g., benthic macroinvertebrates), general water chemistry, and habitat conditions. These surveys generated Index of Biotic Integrity (IBI) scores for 26 samples at nine stations between Hollywood and Driftwood, a distance covering 32.25 miles of Bennett Branch. The 26 samples collected were above (with most samples significantly above) the aquatic life use IBI attainment

threshold of 50 for a large stream designated and protected for warm water fishes (Table 1). As a result of the dramatic improvements, PADEP removed 32 miles of Bennett Branch Sinnemahoning Creek from the impaired waters list in 2022.

Partners and Funding

Since 2004, restoration efforts were led by PADEP BAMR, the U.S. Army Corps of Engineers (Baltimore District), and the Bennett Branch Watershed Association at the grassroots level. BAMR also partnered with other state and federal agencies and the mining industry to maximize the restoration work and to reduce the overall project cost. Since 2013, volunteers and the Potter County Anglers have been stocking trout. Other partners included Elk County Commissioners, Elk County Conservation District, Energy Resources, Kojancic Family Limited Partnership, Original Fuels Coal Company, P & N Coal Company, PADEP Knox and Moshannon District Mining Offices, Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, Rocky Mountain Elk Foundation, Rosebud Mining Company, Susquehanna River Basin Commission, Trout Unlimited, U.S. Department of the Interior's Office of Surface Mining, Waroquier Coal Company, and Western Pennsylvania Conservancy.

Funding sources have included \$14,609,000 in BAMR AMD Set-Aside funding for construction of the Hollywood Treatment Plant. Other restoration projects in the watershed were supported by \$45 million from BAMR Title IV AML funding, Pennsylvania's Growing Greener Grants Program, and U.S. Army Corps of Engineers funding.

Table 1. Bennett Branch of Sinnemahoning Creek: IBI scores (2019–2021).

Sampling Timeframe	Sampling Locations								
	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09
Spring 2019	-	93.7	96.9	-	-	72.3	-	-	-
Spring 2020	97.1	92.5	88	89.3	90.4	62	52.9	-	-
Fall 2020	92.7	81.8	85.9	77.2	80.6	85.2	61.5	-	-
Spring 2021	98.7	99.7	95.2	92.2	97.2	74	56.5	57.5	95.8

Notes: BB01: Driftwood; BB02: Dents Run; BB03: Trout Run Downstream; BB04: Trout Run Upstream; BB05: Medix Run; BB06: Bakemans Run; BB07: Weedville; BB08: Force; BB09: Hollywood



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