Section 319
NONPOINT SOURCE PROGRAM SUCCESS STORY
Maryland

Restoring Stream Reduces Nitrogen in an Urbanized Watershed

Waterbody Improved

Uncontrolled stormwater runoff caused stream erosion and degraded riparian habitat in Maryland's Minebank Run and Lower Gunpowder Falls watersheds. Maryland Department of the Environment (MDE) added Lower Gunpowder Falls (including Minebank Run) to the state's Clean Water Act (CWA) section 303(d) list of impaired waters for nutrients (phosphorus) in 1996. On the basis of benthic and fish assessments, MDE also classified the waterbody as impaired for biological integrity in 2006. Project partners implemented numerous stream restoration activities that led to visible and measurable water quality improvements. Until additional improvements are documented, however, the segment will remain on the impaired waters list.

Problem

Minebank Run and Lower Gunpowder Falls are in the scenic Cromwell Valley in eastern Maryland's Baltimore County. Minebank Run is an urban headwater stream that joins the Gunpowder River just south of Loch Raven Reservoir, at which point the watershed is called Lower Gunpowder Falls. Minebank Run drains 2,135 acres and makes up approximately 7 percent of Lower Gunpowder Falls' 29,470-acre watershed. The watershed was once primarily used for agriculture but is now densely developed in specific areas.

Minebank Run receives a high volume of runoff from impervious surfaces in suburban residential areas, office parks, highways and other areas surrounding Towson, Maryland. MDE first added the Lower Gunpowder Falls watershed, including Minebank Run, to the state's CWA section 303(d) list for phosphorus impairments in 1996. In 2006 MDE also listed it as impaired because it did not meet its designated use of aquatic life and wildlife support.

Before the restoration, Minebank Run exhibited severe bank incision, a disconnected floodplain, degraded fish and invertebrate habitat, loss of the riparian zone, and high sediment and nutrient loads from stormwater runoff. Stormwater conveyance channels, built to remove stormwater from roads quickly and not to protect hydrologic morphology, caused flashy, high-volume flows that eroded streambanks (Figure 1), exposed sewage trunk lines and damaged park roads and access bridges. Maryland Biological Stream Survey data confirmed that the number and diversity of macrovertabrates and fish were lower than they should be, indicating that Minebank Run was in an unhealthy, degraded condition.

Figure 1. High-volume stormwater flows damaged this stretch of Minebank Run.

Project Highlights

Baltimore County Department of Environmental Protection and Resource Management (DEPRM) conducted two phases of restoration activities—the first in 1999 and the second in 2005—on Minebank Run, a subwatershed within the Lower Gunpowder Falls watershed. In 1999 DEPRM worked to stabilize highly erodible banks, construct point bars, and add riffles and meander features with step-pool habitats along 8,000 linear feet in a headwaters portion of Minebank Run (Figure 2).

The project reduced the stream gradient to allow the stream to overflow its banks and reconnect to the floodplain. Reconnecting the floodplain allows phosphorus and sediment to be deposited on the floodplain rather than be carried downstream. It also provides a greater residence time for nitrogen to be removed by native vegetation uptake and

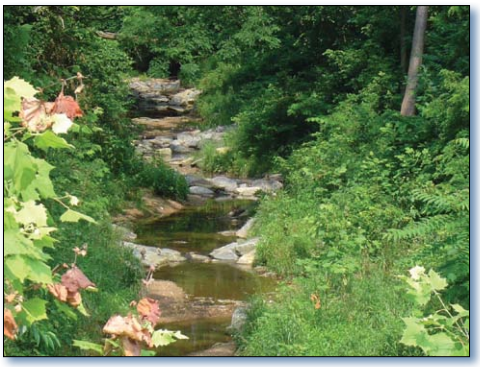

Figure 2. DEPRM added riffles, meanders and step-pool habitats during phase one of the project.

Figure 3. Minebank Run at Loch Raven High School, before restoration.

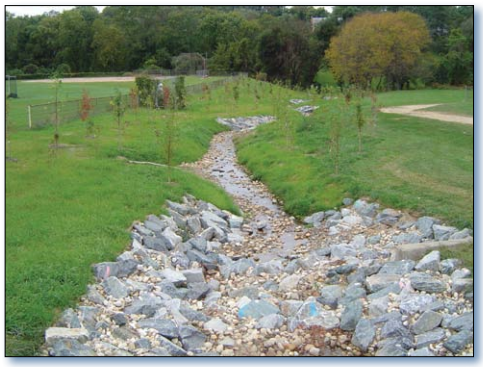

Figure 4. Minebank Run at Loch Raven High School, after phase two of the restoration project.

denitrification. The restoration involved planting 3,000 trees and 6,000 shrubs, which created a buffer and encouraged the uptake of available nitrogen.

DEPRM began the second phase of restoration in 2005 on a downstream reach of approximately 9,500 linear feet of Minebank Run. This phase had similar objectives as the first but was more extensive, involving removing a 500-foot concrete channel that coveys stormwater from Cromwell Road to Minebank Run (Figures 3 and 4). The restoration, on the grounds of Loch Raven High School, included adding step-pools, increasing the stream's sinuosity and planting riparian vegetation—all of which help dissipate flow energy, reduce erosion, moderate water temperatures and create stream channel and riparian habitat. Once the projects were complete, monitoring and geomorphologic evaluations were conducted over several years by a variety of project partners.

DEPRM armored stream banks at key locations to protect existing infrastructure such as sewer lines, bridges and roads. That has the beneficial effect of making the stream more hospitable to benthic macroinvertebrates and fish by decreasing flow speed, preventing scour and minimizing damage to aquatic habitat.

Results

The second phase of the Minebank Run project included reconnecting the stream to the floodplain and evaluating the results. A number of study partners collaborated to assess the projects between late 2003 and mid-2004. Results indicate that the project measurably reduced the bioreactive nitrogen (nitrate and nitrite) concentration in the surface water and groundwater. Nitrogen concentrations declined by 25 to 50 percent [1.5 milligrams per liter (mg/L) to 0.8 mg/L], while denitrification rates increased nearly twofold in test wells.

The project efforts removed an estimated 50,000 pounds (25 tons) of sediment typically discharged from the stream annually. Associated phosphorus reductions could range from 100 to 200 pounds annually. The projects have had many beneficial effects by reducing flow and increasing dissolved oxygen levels. The stream's physical and hydrological conditions appear to have improved substantially; however, measurable water quality and biological improvements will likely not occur a several years. In the meantime, DEPRM will continue to monitor biological conditions in both waterbodies.

Partners and Funding

DEPRM led the restoration and mitigation efforts. Partners in the nationally recognized floodplain denitrification study include the U.S. Geological Survey, Institute of Ecosystem Studies, DEPRM, and the University of Maryland's Center for Environmental Science.

Some state and federal funding partners participated at different stages to assist with and document the work. In 2003 Maryland's CWA section 319 program provided $150,000 to support DEPRM's efforts; that was complemented by another $100,000 in local match funding. Overall, Baltimore County estimates that the costs for Phases I and II were $2.2 million and $4.4 million, respectively.

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