



# NONPOINT SOURCE SUCCESS STORY

## North Carolina

### Projects Reduce Impacts of Agriculture and Stormwater on Lower Mud Creek

#### Waterbody Improved

Agricultural operations and stormwater runoff degraded fish and benthic macroinvertebrate communities in a 2.23-mile segment of Lower Mud Creek, prompting the state to include it on the Clean Water Act (CWA) section 303(d) list starting in 1997. Extensive local, state and CWA section 319 grant-funded efforts to restore the headwaters of Mud Creek and its tributary Clear Creek included streambank stabilization, wetland restoration, and installation of agricultural BMPs including agrichemical mixing facilities, pasture watering systems and heavy-use road stabilization. Partners also installed urban stormwater control measures in the city of Hendersonville. The cumulative effect of section 319 funding and partners' restoration efforts contributed to the recovery of Lower Mud Creek and its removal from the CWA section 303(d) list in 2014.

#### Problem

The Mud Creek watershed is in Henderson County in western North Carolina (Figure 1). Mud Creek flows through the city of Hendersonville before emptying into the French Broad River. Mud Creek and its tributaries have been on the CWA section 303(d) list of impaired waters since 1997 because of poor benthic macroinvertebrate diversity and elevated fecal coliform pollution. Impacts of agriculture, streambank erosion and stormwater runoff from the Mud Creek watershed (including Clear Creek, Cox Creek and other tributaries) have contributed to Mud Creek's degradation.

#### Story Highlights

Watershed groups have been actively involved in monitoring and restoring Mud Creek since the late 1990s. The Volunteer Water Information Network (VWIN) began monitoring five sites in the watershed in 1992. In 2000, the North Carolina Ecosystem Enhancement Program (now Division of Mitigation Services) conducted a 2-year field study. Data from these and other sources led to the development of the Mud Creek Watershed Plan in 2003, which laid the groundwork for two decades of subsequent restoration efforts.

Approximately 6 miles upstream from Mud Creek's confluence with the French Broad River, 30 acres of agricultural land were removed from production as

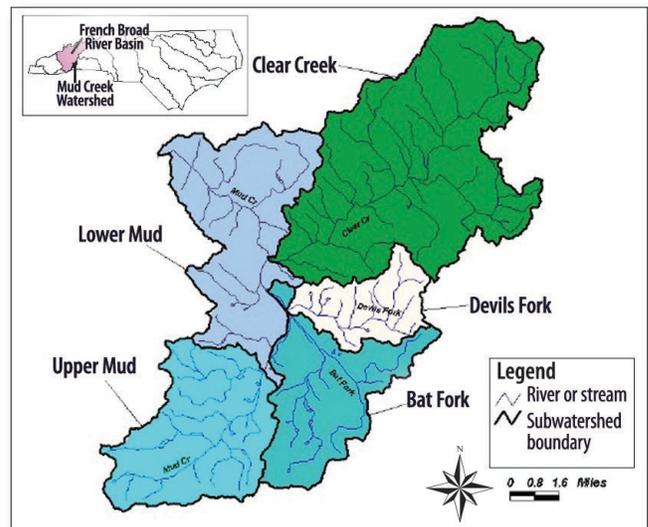


Figure 1. Mud Creek is in western North Carolina.

part of the section 319-funded Ochlawaha Bog (also known as the King Creek Bog) restoration project completed in June 2011. The project included restoring approximately 1,045 linear feet of stream, 16.65 acres of riparian buffers, and approximately 4.95 acres of wetlands within the Ochlawaha Bog (Figure 2). Restoring wetland hydrology and vegetation was important to protect the headwaters of Mud Creek.

As part of a 319-funded project completed in June 2013, partners installed three agricultural chemical mixing facilities on farm properties in the Lewis Creek



Figure 2. This restored portion of Ochlawaha Bog had been a farm field.

subwatershed, a tributary of Clear Creek. These facilities were installed to prevent potential spills during mixing and filling of sprayers (a source identified in the *Mud Creek Watershed Plan*.) The new facilities will capture spills and prevent pollutants from flowing into adjacent surface waters or seeping into groundwater of Mud Creek’s headwaters. Other restoration efforts included stabilizing 930 linear feet of eroding dirt road bed, which prevented an estimated 25 tons of sediment from entering Cox Creek, another headwaters tributary. Finally, project partners stabilized 1,275 linear feet of eroding stream bank and planted native riparian vegetation, preventing 17 tons of future annual soil loss. Post-implementation monitoring showed that Bank Erosion Hazard Index (BEHI) scores improved slightly and pebble counts indicated improvement in the quality of substrate.

Despite improvements in the Mud Creek watershed, three segments of Mud Creek and several of its headwater tributaries remain listed as impaired because they received *fair* scores for benthos or fish community assessments. Many partners in the watershed continue to install restoration projects that will help alleviate the impairment of these segments. For instance, North Carolina State University (NCSU) completed a demonstration project in 2017 using section 319 funds to install bioretention basins, multiple 2,200-gallon cisterns, and a level spreader-filter strip to reduce stormwater runoff to Lower Mud Creek in the city of Hendersonville. NCSU will monitor the project over time. Additional section 319 grant projects are underway, including a floodplain restoration project on Lower Mud Creek and further urban stormwater management projects in Hendersonville.

## Results

The North Carolina Division of Water Resources has conducted benthos sampling using the Ephemeroptera, Plecoptera, Tricoptera (EPT) index to measure the presence of pollution-sensitive aquatic insects. The index assumes that a waterbody showing high EPT richness is less likely to be polluted than another waterbody with relatively low EPT richness in the same geographic region. In addition, the state measured biotic integrity (BI) in the river segment. A lower BI value indicates better water quality. Monitoring results from both indices showed that the bioclassification of the segment has varied over time and has improved incrementally in 2012 (Table 1). As a result, North Carolina removed a 2.23-mile segment of Lower Mud Creek from the CWA section 303(d) list of impaired waters in 2014. Ongoing restoration in the watershed should contribute to benthos improvement beyond the *good-fair* category.

## Partners and Funding

Numerous groups have worked together to restore Lower Mud Creek. The CWA section 319 grant program has funded three projects totaling \$672,021 in the greater Mud Creek watershed. The Clean Water Management Trust Fund, Tennessee Valley Authority, and others have also contributed substantial grant funds. Other partners contributing services and funds include VWIN; Henderson County; North Carolina and Henderson County Cooperative Extension Service; Henderson County Soil and Water Conservation District; city of Hendersonville Water and Sewer; Carolina Mountain Land Conservancy; Environmental and Conservation Organization; North Carolina Division of Water Resources, Water Resources Development Grant; North Carolina Division of Mitigation Services; Americorps Project Conserve; and Land of Sky Regional Council of Governments.

Table 1. Bioclassification scores in Lower Mud Creek (1997–2012)

Year	EPT	BI	Bioclassification
2012	21	5.39	Good–Fair
2007	16	6.21	Fair
2000	10	7.13	Poor
1997	12	6.8	Fair



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