# GUY COVE STREAM RESTORATION (CREATION) PROJECT

**Drs. Carmen Agouridis, P.E., Christopher Barton, & Richard Warner**

## Overview

Headwater stream systems provide ecosystem services such as water storage, carbon sequestration, nutrient cycling, habitat creation, and temperature modification. Surface mining often results in the loss of these ecosystem services. **The development of practical stream restoration and creation techniques for post-mined lands is needed to regain lost headwater stream system value.** In response, the University of Kentucky in cooperation with a number of agencies such as the Kentucky Department of Fish and Wildlife Resources, U.S. Army Corps of Engineers, Kentucky Division of Water, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and the Kentucky Department for Natural Resources has designed and constructed a headwater stream system at Guy Cove. The design was largely built on the Forestry Reclamation Approach (FRA), which encourages a non-compacted spoil medium to promote tree growth, in an effort to address concerns related to water quantity and quality as well as habitat development. This watershed-based restoration approach includes a headwater stream system comprised of ephemeral, intermittent and perennial channels, vernal ponds, a wetland-bioreactor treatment system, and a forest. The project was constructed in the fall and winter of 2008 with tree planting occurring in the late winter/early spring of 2009. Intensive monitoring was conducted five years post construction.

## Objectives

- Recreate headwater stream functions by utilizing natural channel design techniques and implementing the FRA.
- Attenuate runoff events to reduce peak discharges and increase base flows.
- Promote surface expression of water and enhance wetland treatment efficiency to improve water quality.
- Improve habitat through the development of a headwater stream system, vernal ponds and a hardwood forest.
- Establish a research facility and outdoor classroom for demonstrating design principles, construction techniques, and measurement of system performance.
- Educate a myriad of stakeholders including consulting and mining engineers, land reclamation design professionals, the regulatory community, environmental advocacy groups, and students.

## Major Design Components

- Modifications to the crown geometry.
- Compaction of the crown to control infiltration.
- Utilization of natural channel design techniques.
- Use of the FRA to promote tree growth.
- Development and/or enhancement of a variety of ephemeral channels utilizing different materials such as rock, logs, and woody debris.
- Creation of vernal ponds for and habitat enhancement.
- Implementation of a novel bioreactor-wetland treatment system to improve water quality.

## Habitat Creation

- Approximately **1 mile** of streams
  - About **3,335 ft** intermittent/perennial stream
  - About **1,555 ft** ephemeral channel
- Approximately **0.6 acres** of vernal ponds and wetlands
- Hardwood forest (**~30,000 trees planted on 40 acres**)

UNIVERSITY OF KENTUCKY
College of Agriculture, Food and Environment

## Key Results

Geomorphology

- Laterally and vertically stable over 5-year monitoring period (assessed 50 cross-sections annually).
- Bed material $D_{50}$ decreased over 5-year period as spoil weathered ($D_{50}$=64 mm to $D_{50}$=35 mm)

Hydrology

- GC01 and GC02 similar hydrograph (stormflow) patterns as reference watershed Falling Rock.
- Baseflow reduction between GC01 and GC02; new design ideas for reconstructing hyporheic zone.

Water Quality

- WQ parameters on crown are better than those observed during pre-restoration sampling period.
- At GC02, EC decreased from mean concentration of 827 µS $cm^{-1}$ in 2011 to 598 µS $cm^{-1}$ in 2012 and 471 µS $cm^{-1}$ in 2013.

Habitat

- RBP values increased over 5-year monitoring period. In 2014, crown sections ranged from 152-162; ephemeral channels 77-114; face of fill 157; toe of fill 117-133.
- Generated estimated 2,119 EIUs.

## Funding

Funding of **$1,586,600** was received from the Kentucky Wetland and Stream Mitigation Fund in cooperation with the Kentucky Department of Fish and Wildlife Resources; portions of the research were funded by U.S. Forest Service, U.S. Department of Energy with in-kind support provided by Appalachian Fuels at the Bent Mt. Surface Mine.








## Contact Information

Carmen Agouridis, Ph.D., P.E.
University of Kentucky
Biosystems and Agricultural Engineering
859-218-4344
carmen.agouridis@uky.edu