Banking on Natural Fibers

Products made from coir and jute play a key role in stabilizing a restored stream for a commercial stream mitigation bank.

By Greg Northcutt

When White Creek Mitigation, LLC, embarked on a large scale stream restoration project, their environmental consulting firm, Register-Nelson, Inc., based in McDonough, Ga., designed an approach involving natural restoration techniques. The design to restore and stabilize the degraded rural stream featured a reference reach dimension, pattern, and profile template overlaid with natural fiber stabilization materials.

The project combined stream stabilization principles developed by noted hydrologist Dave Rosgen with erosion control products made from environmentally-friendly coir and jute fibers. The jute fiber product used on portions of this project is designed for short-term applications on moderate slopes with lower stormwater runoff velocities. Versatile coir fibers, derived from coconut husks, are one of the strongest natural fibers. Providing the strength and durability for long-term application, they were used to control erosion on steeper slopes and higher flow velocity areas.

Both types of biodegradable fibers can be left in place to decompose, eliminating any waste disposal costs and their natural color blends in with the environment. Also, since the fiber products used in this project contain no synthetic netting, they minimize the potential for wildlife entrapment. Synthetic fibers, on the other hand, can interfere with site maintenance activities, such as mowing.

The banking process

The site and proposed treatments were approved by the U.S. Army Corps of Engineers as a commercial stream mitigation bank before the restoration work began in May, 2006. One purpose of this project is to generate stream mitigation bank credits, which are available for sale. These stream mitigation credits can be used as compensatory mitigation to satisfy mitigation needs under the requirements of Section 404 of the Clean Water Act.

The three-month long restoration project was completed in August, 2006. This coming winter, when planting conditions are more favorable, native trees and shrubs will be installed. They will be planted along the streambanks and in the riparian corridors paralleling the restored streams to establish a native bottomland hardwood community and stream habitat typical of streams found in undeveloped portions of this Piedmont region.

Completion of the stream restoration work marked the beginning of a required lengthy monitoring term to earn final acceptance of the restored stream by the U.S. Army Corps of Engineers. Register-Nelson will monitor the stability and ecological benefits of the site and will report to the Corps annually over the next seven years.

Rebuilding the stream

The restored stream, located on a former dairy farm, drains a 1.8 square mile watershed in a rural area southwest of Atlanta. “Livestock activity in and near the stream

over the years had left it highly degraded," says Mark Nelson, a partner in the consulting firm. "Given that the streams and riparian corridors were highly degraded, and that the site was in close proximity to the fast-growing and developing Atlanta region, the bank site is in a prime place to establish a stream mitigation bank."

The project involved the restoration of about one-half mile of White Creek and more than 1,000 ft. of three other smaller tributaries. The original meandering stream was channelized and straightened as part of previous farming operations. Over time, the channel became even more degraded and unstable. Nelson's crew built a new, re-located meandering channel for the stream. Heavy machinery, including excavators and front-end loaders, were used to produce the shape and form of a "C"-type stream based on the Rosgen stream classification system. Characteristics of a "C"-type stream include a meandering channel, with a slope of two percent or less and a series of riffles and pools.

After creating the new, stable channel for White Creek, Nelson and his crew installed riffles, log vanes, and other habitat and stabilization structures at various locations along the stream and the tributaries. These habitat and stabilization structures, made of cedar logs and boulders, are designed, in part, to reduce scour energies on the outside bends of the meandering stream. Along with strategically placed boulders they provide habitat for native warm-water fishes.

Reinforcing the slope toes

To further protect the newly-formed stream channels and banks from erosive base and flood flows, the company installed woven coir erosion control blankets, coir logs and coir wattles made by RoLanka International, Inc. These durable, natural and biodegradable products can be used in a variety of bio-engineered stream bank restoration projects. When installed properly they provide the initial soil protection needed to control erosion until mature vegetation becomes established to hold soil in place. These environmentally-friendly natural fibers minimize threats to wildlife and decompose in place, to eliminate any disposal costs at the end of their useful life.

Log-like rolls of coir were anchored along the outer bends of the stream banks to assist in protecting the structural stability of the earthen stream banks from the expected erosive stream flow velocities. This product, BioD-Roll, is made from coir fiber that is densely packed into a tubular outer netting, with 2-in. x 2-in. openings, made of coir twine.

The 12-in diameter, 10-ft. long coir rolls used on this project have a density of 9 lb./cu. ft. They are designed to resist erosion and support establishment of vegetation for about five years or longer. "The coir rolls help absorb and deflect the flow energies, especially on the outside meander bends, and assist in protecting the stream banks from eroding," Nelson says.

In time, sediment will be deposited around these rolls, to support growth of riparian vegetation.

Protecting the channel and side slopes

Two types of semi-permanent erosion control blankets were used to control erosion of the restored stream bed and banks. These blankets are woven from machine-twisted bristle coir twine and have a functional life of about four to six years. The open-weave construction allows vegetation to grow up through the openings in the blankets. It

also allows trees and shrubs to be planted through the mat without cutting it and reducing its strength.

The BioD-Mat 70 blanket was installed in the stream channel, where erosive forces typically are higher than on the streambanks. This blanket is recommended for slopes as steep as 1:1 and for flow velocities as high as 12 ft./sec. “This mat also collects sand, silt and pebbles that the stream carries naturally,” Nelson said. “These sediments cling to or are trapped in the voids in the mat and assist in creating habitat for macro-invertebrates.”

The lighter weight, less-densely woven BioD-Mat 40 product was used to protect the area of the streambanks and flood prone areas above the active channel. This product is recommended for slopes of 2:1 or less and flow velocities up to 8 ft./sec. “Because of the expected lower flow velocities in these higher areas compared to the active channel, these higher areas can be stabilized with a lighter-weave mat,” Nelson says.

The disturbed areas above the active channel and flood prone areas were covered with Jute Mat, another RoLanka product. Woven from biodegradable spun jute yarns, it is designed to provide protection for about six months.

Earthwork activities

The earthwork included construction of the new active channel where the higher velocities would generally be contained and creation of flood prone areas, which were tapered upgradient to natural ground. Earthwork was done in this taper area between flood prone and natural ground. “The jute fabric was used to protect the disturbed “non-flow” areas from rainfall and surficial runoff erosion and to assist in establishing herbaceous ground cover,” Nelson says.

The project also involved the installation of 12-in diameter, 10-ft. long BioD-Watl coir wattles. They were laid horizontally on the longer stream bank slopes to slow surfical runoff velocities and to collect suspended sediment before it washes into the stream. The wattles are made from cleaned mattress coir fiber that is uniformly and lightly packed into a high-strength bristle coir fiber netting which has 2-in. x 2-in. openings. These wattles allow runoff to pass through while trapping any sediment.

After protecting all disturbed areas with the blankets, they were seeded with millet to help control erosion temporarily. “The millet germinated well and produced a nice, uniform stand,” Nelson notes. This winter, bare root native mast trees, including oak and hickory, and fruiting shrubs, like elderberry and dogwood, will be installed through the coir and jute blankets, to assist in providing permanent stabilization, erosion control, and shading.

Monitoring-Maintenance Process

Initial performance of the White Creek project has met expectations, Nelson reports.

In the month directly after completion of the restoration and installation of the jute and coir products, the local watershed experienced a series of significant storm events, including some with up to about 2.5-in. of rainfall. “The stream remains stable and there has been no erosion,” he says.

Register-Nelson will continue to monitor the project over the next seven years following Corps of Engineers’ procedures. This will include comparing the longitudinal

and cross sectional profiles of the streams at selected points with the original measurements to detect any change in stability. “This information will be compared to a nearby reference stream to determine how other factors, such as drought or unusually heavy storms, might be affecting the stream’s stability. The monitoring will also include annual checks of growth and establishment of vegetation and the fish and macro invertebrate populations and habitats.

“We anticipate that we will need some follow-up maintenance through at least the first year after construction and applying flowing water to the newly restored channel,” Nelson says. “If there are any problems, we’ll fix them right away.”

Assuming all goes as planned, this reach of White Creek will improve in ecological function and value and provide suitable habitat for a diversity of species not only for the next seven years but for many more years to come. More information about mitigation banking, stream restoration, and use of the coir and jute products is available at www.RegisterNelson.com and www.WhiteCreekMitBank.com .