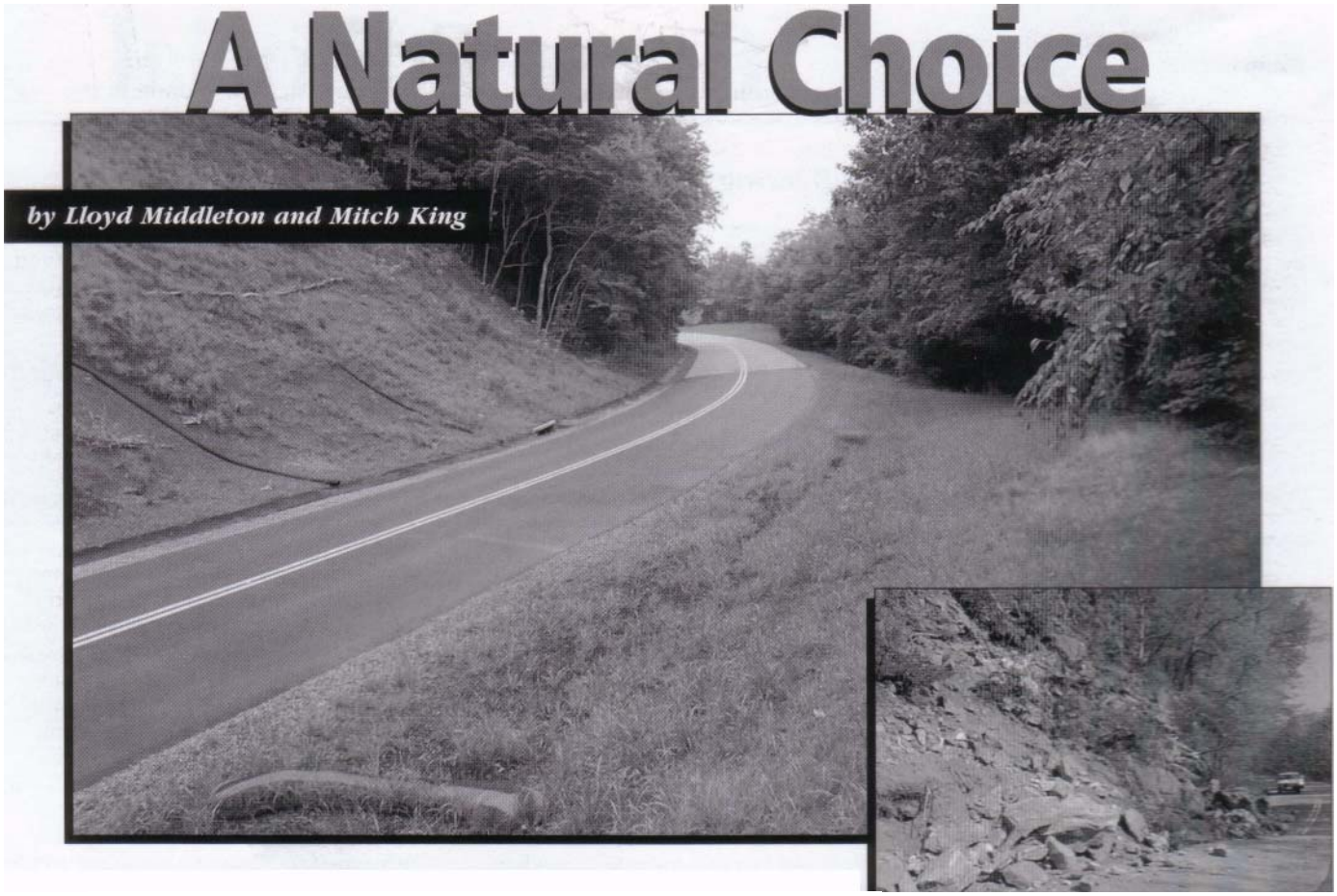
A Natural Choice

by Lloyd Middleton and Mitch King



Using compost for environmentally sound roadside slopes is one time when waste pays off.

Controlling erosion and re-establishing vegetation are key components in most road and highway construction or rehabilitation projects. Roadside embankments, shoulders, medians, and other nonpaved surfaces can be vulnerable to the elements, leading to excessive runoff, rutting, and damaged aesthetics. Conventional methods to prevent these conditions include hydroseeding and root reinforcement systems. In recent years, an alternative erosion control mechanism—compost—has been gaining in popularity.

Several State departments of transportation have begun to experiment with compost mixtures for roadside revegetation. Recently, the Federal Highway Administration's Eastern Federal Lands Highway Division (EFLHD) had an opportunity to test the composting method. A small landslide along the Blue Ridge Parkway near Asheville, NC, took out a section of the roadside cut area, and EFLHD was charged with repairing the section and ensuring the affected area's environmental sustainability. The project was unprecedented in that not only was it the first time EFLHD had used compost in this capacity, but also never before, to EFLHD's knowledge, had compost been applied to roadside terrain this steep.

The results indicate that compost shows so much potential that it should be seriously considered as a best management practice. Not only is compost as good as or better than conventional erosion control methods, but also it benefits the environment by reducing the biodegradable wastes that go to landfills.

This rockslide (shown in the inset above) on the Blue Ridge Parkway in North Carolina occurred in May 2002, **but by August** 30 the use of compost blanket and FilterSoxx to control erosion had begun to restore vegitation (shown in the main photo) despite a 2-month drought.

Enhancing the Ecosystem

Composted mixtures of peat moss, bark, processed wood chips, lawn grass chippings, manure, and other materials interact to produce a healthy growing ecosystem. Research and field trials show that compost works effectively in stabilizing steep slopes and preventing erosion. Composted organic material stimulates the chemical, physical. and biological characteristics of soil. It improves root growth, adds reinforcement to the slope, and enhances the germination of grass or other vegetation.

Thanks to its absorbency. compost helps control runoff. This benefit is important on steep slopes where the soil is too poor and non-absorbent for vegetation to become established. Compost can absorb as much as the first 12." millimeters (0.5 inches) of a rainfall.

Although hydroseeding helps control runoff as well, in some settings it may not be as resistant to erosion as the compost method. Hydroseeding is a grass-planting process that consists of spraying a mixture of hay, straw, fiber mulch, water, fertilizer, agricultural lime, grass seed, and tackifier (basically a glue).

Laying silt fences or straw bales are other conventional erosion control methods, which often are used in conjunction with hydroseeding. A silt fence is basically a temporary barrier deployed along the lower perimeter of a slope, made of woven wire and fabric filter cloth that is used to catch sediment-laden runoff.

Compost berms are as good as or superior to silt fences or straw bales in filtering soil particles from storm water and can allow more water to pass through, according to composting advocates. The compost mixture also stimulates the seeds to germinate more quickly and grow deep roots.

Steep Challenges

EFLHD is responsible for engineering safe and environmentally sensitive roadways and bridges on Federal lands from the States bordering both sides of the Mississippi River on east to the Atlantic Coast, plus the territories of Puerto Rico and Virgin Islands. The chief agency that owns and operates the Blue Ridge Parkway, where the composting project took place, is the National Park Service.

The project site is about 13 kilometers (8 miles) south of Asheville, NC, and about 145 kilometers (90 miles) from the EFLHD field office in Sevierville, TN. In late May 2002, a roadside cut area on the Blue Ridge Parkway gave way, producing a large slide of rock and soil onto the roadway, which prompted closing of the parkway. EFLHD's goal was to reopen the scenic road by the Fourth of July weekend, in time for the big tourist rush.

EFLHD was operating under a number of other constraints in addition to the tight timeframe. The slide area is steep: parts of the slope are a 45-degree angle, and some parts are even more dramatic. In fact, the steepness of the slope is one reason why EFLHD chose to apply a new technique for this project. Conventional equipment would have been unworkable in that venue.

In addition to the steepness of the area and the need to repair the road and slope under an extremely tight deadline because of the coming tourists, another problem was that late May-early June is not the optimal season for establishing vegetation; September or April is better suited for that.

The natural spring water in the area is among the purest in the world—so pure that some companies requiring large amounts of clear •water have located their production facilities in Asheville. EFLHD is mandated to protect the environment, particularly the water quality. The Division therefore wanted to establish a green, vegetated slope on the repaired section to prevent excessive runoff. Another environmental goal was to prevent the introduction of noxious weeds, meaning that EFLHD had to avoid the use of top-soil, straw, or hay.

The section of the road in question, -which was built in the 1960s, has steep banks above and below it. The slide occurred when the road hillside cut area gave way to pressure that had been building up for years. The affected area measured 122 meters (400 feet) in length along the roadway and 40 meters (130 feet) sloping up from the roadway. The total site "was 0.6 hectares (1.5 acres). EFLHD had only 6 weeks to remove 15,300 cubic meters (20,000 cubic yards) of rock and soil from the slope—about 2,500 tandem dump truck loads at 5 to 6 cubic meters (7 to 8 cubic yards) per load, prepare the seedbed as the slope was excavated, pave the road, place lockdown netting, and apply compost blended with seed, 25 to 75 millimeters (1 to 3 inches) in depth.

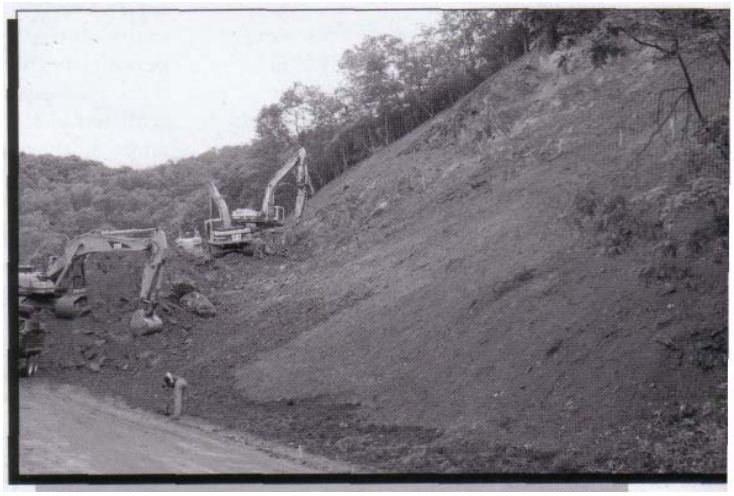
Other challenges included the need for contractors with rock-climbing and rappelling expertise to apply the compost. Another challenge was administrative—coordinating participation by the National Park Service, U.S. Department of the Interior, Federal Highway Administration, and several contracting companies.

The bulk of the time spent on the project consisted of clearing and grubbing the area and removing the slide material. Most of the excavated material "was rock. No blasting was permitted, since the vibrations produced by the blast could have expanded the slope failure zone.

How the slide area was prepared was important. Roughing of the substrate with the backhoe teeth parallel with the contours of the slope was required. This was performed during excavation operations. When doing the grading, the contractor made a point of avoiding "slicking off" (i.e., smoothing down to a hard surface) and avoiding making vertical claw marks that would have channeled water. Instead, the machinery was used to create indentations or imprints every few feet to prepare the substrate for a seedbed.

Blanketing the Embankment

After the excavation, EFLHD was ready to revegetate the slope. An extensive review of the trade journals on composting gave no indication that this technique has been used on slopes steeper than 2:1. The parkway therefore would be a test



The excavation of the slope prior to the placement of compost had proceeded well by June 4, as shown in this photo of clearing the slide material.

Trackhoes work together to excavate the slope down to established grades._

By June 17, the contractor's rock climbers were rappelling down the slope to place lockdown netting to help hold the compost in place until a mature root mat is established.

Looking down the slope across the lockdown netting to the Blue Ridge Parkway below.

case to see if compost would simulate the natural forest floor on such steep terrain.

EFLHD's overall objectives were to test the effectiveness of using compost blankets and berms for erosion and sediment control, establishing vegetation on a slope steeper than a 2:1 ratio, and mixing compost with crushed stone as a stabilization mixture for the road shoulder.

The Division decided to apply a combination of compost blankets and netting to the slope. To do the job, EFLHD worked with a mulch company. The owners of the company were taken aback by the steepness of the slope but quickly realized it was doable, thanks in part to the fact that two of the employees are rock-climbing enthusiasts. They never thought they would have to use that skill on the job.

For these types of projects, the mulch company often uses manure-based compost but this time chose a biosolids-based compost. The particles are coarser than manure-based compost, making the mixture more resistant to rain and erosion. The biosolids-based compost •was mixed with nutrient-enhanced leaf compost and wood fibrous-composted mulch.

Prior to applying the compost, the rock climbers rappelled down the slope to place lockdown netting to increase the strength of the root system and reduce the risk of a blanket root system failure. As the grass roots penetrate the compost netting, they bind and tie the compost blanket and berms to the ground surface.

To break up the flow of water and prevent it from concentrating, mesh tubes filled with compost and grass seed were laid across the entire slope. These patent-pending Filtrexx™ FilterSoxx™ were anchored to the slope with wood stakes, acting as an erosion control device. The contractor placed the FilterSoxx every 9 vertical meters (30 vertical feet) across the slope, as well as around the perimeter. The FilterSoxx and compost berms cause whatever water accumulates on the slope to spread out uniformly. After the grass is established, they biodegrade and act as a biofilter. Once the netting and berms -*were* applied, the next step was the compost blanket, which was 51 millimeters (2 inches) thick on average.

Approximately 207 cubic meters (270 cubic yards) of compost, or 20 dump truck loads, were required for the job. Using a patented airlock system, the seed and compost were blown through a pneumatic hose using a computer-controlled process that calibrates the quantity of seed and compost. As the seed and compost were pushed through the hose, the tumbling mixed them so that they can be applied in the 51-millimeter (2-inch) layer. Rather than a surface application of seed, this process is a three-dimensional application of seed and compost that combines erosion control and seeding technologies into one step.

For the application, the contractor used a pneumatic blower truck and about 122 meters (400 feet) of hose, handled by the rock climbers. For the lower and widest portion of the slope, the contractor rented a 20-meter (65-foot)-high lift. A high lift machine could have reached the upper parts of the slope, and rock climbing is not necessarily required, but was used in this case because the contractor had expertise in rock climbing.

The National Park Service requires all shoulders on the Blue Ridge Parkway to be covered with grass. EFLHD therefore prepared the roadway shoulders with enriched compost mixed with an American Association of State Highway and Transportation Officials (AASHTO) No. 78 crushed stone and seed for shoulder stabilization. In this mixture, 100 percent of the particles

By June 26, the contractor had begun spreading the compost with the seed mixture on the completed slope. The berm, constructed of a sock containing compost, controls water runoff.

The contractor used a pneumatic blower to apply the compost.

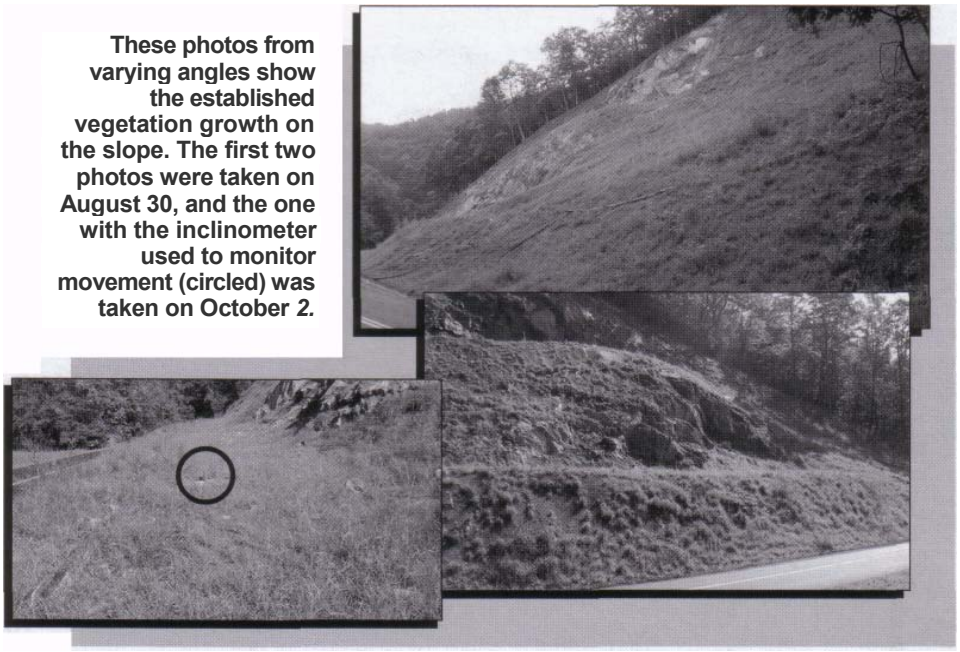
can pass through a sieve with 9.525-millimeter (0.375-inch) holes. This compost-gravel mixture enables the shoulder to be drivable, yet prevents rutting by tires.

Withstanding the Elements

On the second-to-last day of the compost installation, a storm brought rainfall of 76 millimeters (3 inches) per hour. Although a small breech and some rilling occurred, the breech self-healed, and the rilling stopped. The rainstorm was actually fortuitous, enabling EFLHD to observe the performance of this technology under a heavy rain.

EFLHD completed the work on June 28, 2002. The next major test was drought. Although the dry conditions caused the vegetation to grow less densely than was desirable, adequate vegetation was established. The compost with the seed prescription was designed to account for such seasonal climatic conditions. Although the grass germinated and then dried up, the seed in the compost mixture will enable the grass to regerminate when the growing conditions are right.

Staff members from EFLHD are conducting periodic site visits and photographing the area to evaluate the effectiveness of the erosion control and vegetation establishment project.



These photos from varying angles show the established vegetation growth on the slope. The first two photos were taken on August 30, and the one with the inclinometer used to monitor movement (circled) was taken on October 2.

A Building Block in The Biosphere

The cost of this technique ranged from 20-50 cents per 0.093 square meters (1 square foot), depending on the accessibility and steepness of the slope. The cost included seed, 25 to 76 millimeters (1 to 3 inches) of compost, turf reinforcement netting, compost filter berms around the perimeter, and the berms applied in increments on the contours across the slope. This system is economical when considering the benefits and costs compared with alternate systems. Although the cost of hydroseeding is typically about 7-10 cents per 0.093 square meters (1 square foot), the vulnerability to erosion on such a steep slope may be higher than with the compost technique. This area was more rock than soil, so a growing medium was needed for the vegetation, and the compost provides that medium. To use hydroseeding on steep slopes would require a root system reinforcement mat placed prior to seeding, along with at least some soil/ seed mixture with a temporary rolled mat on top to prevent erosion. The 7 to 10 cents includes only the hydroseed application. Compared with the hydroseeding method, including the two mats and soil/seed mixture, the compost method is more economical.

For any project of this type, procuring the right variety of compost is key. In this case, AASHTO's FP-96 Section 713.05 specifications for mature compost do not apply but were modified to fit the site conditions and meet appropriate compost tests in accordance with U.S. Environmental Protection Agency and U.S. Composting Council requirements. AASHTO specifications for the use of compost for erosion control currently are in draft form.

The compost product should have the U.S. Composting Council Seal of Testing Assurance, which ensures basic quality and consistency; verify with the compost company that the compost has this seal. In addition, different situations require different composts. For example, the angle of the slope has a bearing on the selection of particle size and application rate.

As the technology of using compost in highway construction evolves, FHWA could consider adopting this technology as a best management practice. As a tool, composting can be used for temporary erosion and sediment control during construction phases and permanent erosion and sediment control through establishing sustain-able vegetation. FHWA could consider developing technology transfer demonstration projects and incorporating this technology into its standard specifications and plans.

Compost is a building block for the life support of the birds, bees, and other animals in the biosphere. Composting may prove to be a superior way to stabilize roadside slopes or anywhere else engineers want to establish roadside vegetation. The bottom line is clean water and aesthetically pleasing roadside vegetation.

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