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TECHNICAL SUMMARY

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PROJECT COST:
$195,955

Two bioslopes lead to a bioswale. Stormwater follows the bioswale and is filtered through a stone outlet into a detention pond.

# Using Regional Materials to Manage Stormwater Runoff

## What Was the Need?

Following the requirements of the Minnesota Pollution Control Agency, MnDOT designs and constructs roadways with means to contain and manage the first inch of stormwater runoff—the "first flush"—flowing from impervious pavements. The agency often accomplishes this with low-impact development (LID) practices such as bioslopes and bioswales (shallow ditches) along roadways that mimic the original landscape. Constructed of tested soil mixtures and vegetation, bioslopes and bioswales effectively absorb runoff and filter sediment, heavy metals, chemicals and other pollutants that wash from the roads, preventing entry into the watershed.

*Researchers determined that natural soil amended with locally sourced materials performed well in bioslopes and bioswales. This practice will allow MnDOT to avoid hauling in costly commercial materials for stormwater management installations.*

In previous MnDOT highway construction projects, soils that are unsuitable for supporting pavements, such as peat and muck from wetlands, are dug out and hauled away as waste. Commercial compost mixtures are transported to the site for bioslope and bioswale construction. These hauling operations are expensive. To reduce costs, MnDOT has been investigating the use of natural materials close to construction sites and previously discarded as waste as possible filtration media in LID stormwater management.

Phase I of this project examined the infiltration capabilities of compost mixtures and naturally abundant peat and muck in northeastern Minnesota as alternatives to commercial soil and sand in bioslopes and bioswales. Researchers conducted laboratory tests and constructed pilot plots, monitoring their performance. The current project continued the lab and field investigations, and developed a new peat-based biofilter based on research findings.

## What Was Our Goal?

The primary objective of this project was to apply the results of the first phase of study to the design and construction of bioswales and bioslopes using local alternative media. An essential corollary objective was to determine whether lab tests and procedures could accurately predict and monitor the performance of these media in the field. Further, researchers sought to determine the effects of aging on alternative media performance.

## What Did We Do?

The multidisciplinary research team addressed all aspects of alternative filter media suitability, from water retention and infiltration capacity, to contaminant-filtering effectiveness, to the ability to grow and support vegetation. First, researchers conducted a comprehensive literature review of bioslope and bioswale designs and methods of monitoring filtration media properties on-site. They examined best management practices, including state and federal regulations. Next, they collected treatment media from across Minnesota, including salvaged peat and muck, and commercial peat from an approved source. Researchers evaluated the media and determined potential filtration mixtures based on the results of the previous project and MnDOT standards.

*continued*

*"Lab and field investigations showed the salvage and reuse benefits of muck and other organic materials for slope and ditch topdressing to retain the first flush of rain from roadways."*

**—Dwayne Stenlund,**
Erosion Control Specialist, MnDOT Office of Erosion Control and Stormwater Management

*"This project's results allow MnDOT to use in situ soil to build bioslopes and bioswales to retain the first inch of roadway runoff and associated pollutants. Using in situ materials rather than transporting new materials to the site will save taxpayer dollars."*

**—David Saftner,**
Department Head, University of Minnesota Duluth Department of Civil Engineering

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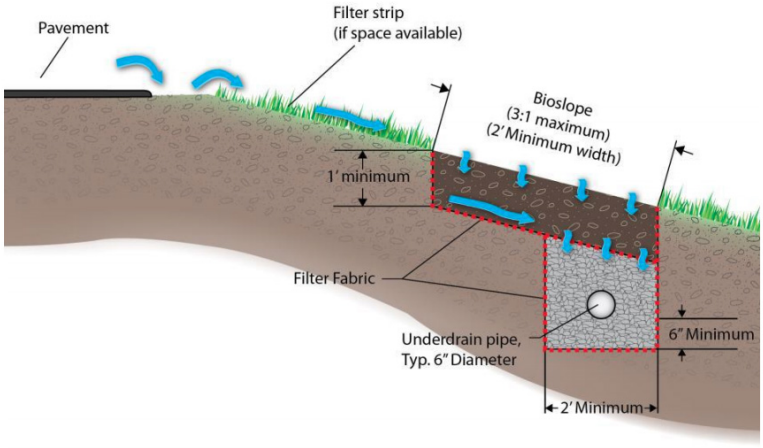


This cross section of a common engineered bioslope shows the position of a vegetation filter strip, a section of biofiltration material and an underdrain pipe beneath it. The blue arrows indicate the flow of water.

In situ and lab materials from nine established and newly constructed biofilter sites were tested. These sites were constructed between 1990 and 2014, and the main soil filtration medium was amended with compost, peat or muck. On-site materials were evaluated for compaction, conductivity and absorption while lab samples were analyzed for metal and other contaminant retention.

Researchers also monitored six pilot test sites from Phase I. Three plots were prepared with native soil mixed 50/50 with compost and three plots with native soil mixed 50/50 with peat. Plots were examined and data were retrieved from instruments previously installed to measure rainfall, soil absorption and ambient temperature.

The team also established and monitored a new peat-based biofilter stormwater system using selected filter materials and designs. The new biofilter was installed throughout 5.7 miles of new road construction at Eagles Nest, which included extensive bioslopes and a bioswale enhanced with an underdrain system to resist silt clogging.

## What Did We Learn?

Most sites showed deficiencies in nutrient and organic matter to support plant growth, and were dominated by weedy plants. Additional fertilizer and organic matter along with appropriate seeding could assure a good cover crop of grasses.

Compost and peat showed comparable effective water absorption and infiltration performance in amended biofilters. Lab tests can conservatively predict field performance. Researchers noted that early trends should be reinforced by further monitoring.

Peat's performance shows it is a good alternative to compost for removing metals and phosphates in biofilters. It removes metals as well as compost and leaches less phosphate. Capacities to retain pollutants diminish with age for both media.

## What's Next?

Alternative local filtration media show great promise in stormwater management bioinstallations. The next phase of this project will gather additional data from all plots to more fully assess the alternative media's capabilities over time.

*This Technical Summary pertains to Report 2019-31, "Development and Regionalization of In Situ Bioslopes and Bioswales," published July 2019. The full report can be accessed at* mndot.gov/research/reports/2019/201931.pdf.