Permeable Pavement and Bioretention Swale Demonstration Project

Seneca College, King City, Ontario

Urban development alters the natural hydrologic cycle by replacing pervious vegetated areas with impervious roofs and pavements. These changes in surface cover reduce infiltration, and dramatically increase surface runoff, resulting in erosion of stream channels and increased potential for downstream flooding. As these higher runoff volumes enter receiving waters, they carry with them a variety of pollutants that ultimately degrade river ecosystems and contaminate swimming areas.

The use of permeable pavement and bioretention swales for treatment of runoff from parking lots, driveways and roads allows rainwater to slowly infiltrate into the ground, as it did prior to urbanization. As more water infiltrates, less runs off, providing for improved protection of downstream aquatic habitat, property and swimming areas.

Study Objectives

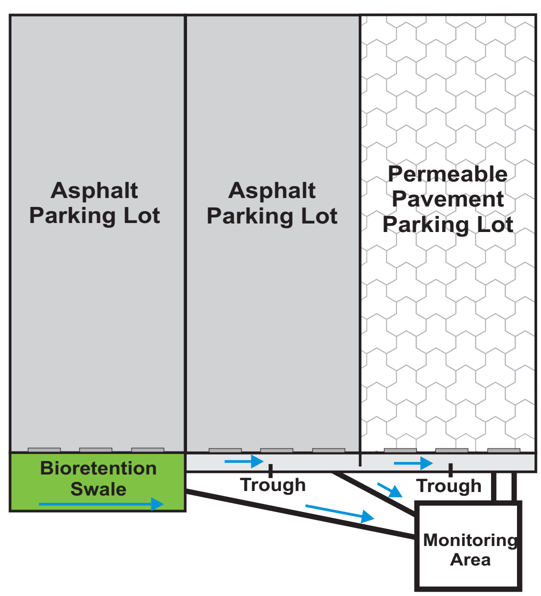
This study evaluates the long-term performance and effectiveness of permeable pavement and bioretention swales for stormwater management under climate and soil conditions representative of the Greater Toronto Area. While there has been a considerable amount of research conducted on the flow control aspects of permeable pavement and bioretention swales, few studies have examined the fate and transport of pollutants in soils underlying these installations, and data on the performance of such measures under winter conditions in a Southern Ontario climate are very scarce.

Site Description

In August 2004, a parking lot on Seneca College's campus in King City, Ontario was reconstructed with modular interlocking permeable pavement, a bioretention swale, and specialized surface and subsurface flow collection systems.

For monitoring purposes, the parking lot was divided into three equal areas. One third was resurfaced with a gravel sub-base and permeable pavement. The other two sections were left as asphalt surfaces. A bioswale was constructed at the end of one of these sections, in order to store and infiltrate all surface runoff from that section. The final third serves as a control for the study.

The surface runoff and infiltrated water is piped to an underground monitoring vault where automated flow meters and water samplers measure continuous flows and collect water samples during rain and snowmelt events year round.



Six older permeable pavement sites ranging in age from 3 to 16 years were surveyed in 2006. The surveys included investigations of surface infiltration rates, soil quality and the physical condition of pavements.

Results to Date

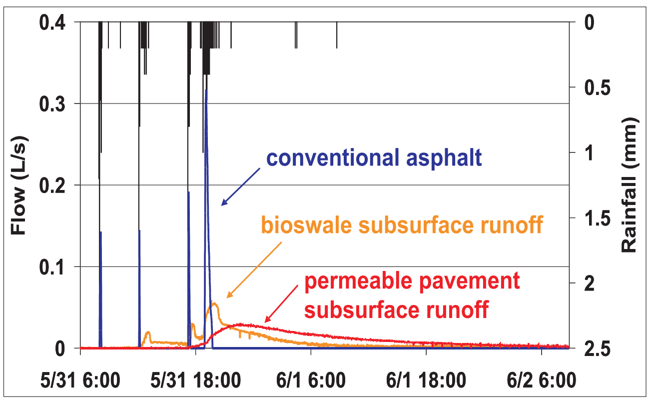
Water Quantity:

Over 99% of rainfall on the permeable pavement infiltrated.

Rainwater remained in the base layer for roughly 4 days following large rain events as water gradually infiltrated through the underlying clay loam soils.

The bioswale infiltrated all runoff for events up to approximately 20mm and subsequently overflowed.

Both technologies reduced peak flows by over 90%.



Flow from the permeable pavement, bioswale, and control during a 21 mm event on May 31, 2006 No surface runoff was measured from the permeable pavement. Bioswale overflows were not monitored.

At most older sites surveyed, surface infiltration was limited due to poor maintenance and/or design shortcomings, but the pavements were in good physical condition.

Water Quality:

- Results from 40 events monitored show that stormwater infiltrated through the permeable pavement and bioswale tends to have lower levels of typical parking lot contaminants such as zinc, lead and hydrocarbons, relative to conventional asphalt runoff.
- Depth profiles of soil chemistry from older permeable pavement sites surveyed suggest that most contaminants are captured in the base course layer and are not accumulating in soils beneath these installations.

Applying de-icing salts to permeable pavements may pose a risk to groundwater quality as the concentrations of these chemicals were not reduced by infiltration through the soil or granular media.

Future Work

Continue storm water and soil quality monitoring

Test structural durability and stability

Assess maintenance requirements

Develop guidelines for the Greater Toronto Area

Compare costs of permeable pavement, bioswales and conventional asphalt

For more information on this project or the Sustainable Technologies Evaluation Program, contact Glenn MacMillan at (416) 661-6600 x5212 or Tim Van Seters at x5337
The third interim report for this study is available for download from the STEP website at www.sustainabletechnologies.ca.

Project Funding Partners

Great Lakes Sustainability Fund
Toronto & Region Remedial Action Plan
Ontario Ministry of the Environment
City of Toronto
Region of Peel
Region of York
Town of Markham
Toronto and Region Conservation
Oak Ridges Moraine Foundation
The John and Pat McCutcheon Charitable Foundation
Seneca College
The Interlocking Concrete Pavement Institute
Fisheries and Oceans Canada
Wal-Mart Canada Corp.
Unilock
Hanson Pipe & Precast, Inc.
Layfield
Emco Corporation