RESEARCH HIGHLIGHT

Technical Series 01-117

Stormwater Management Alternatives

INTRODUCTION

Stormwater management focuses on preventing or managing the numerous adverse economic, social and environmental impacts of stormwater runoff. In the past, grants and subsidies from the federal and provincial governments played a role in funding municipal stormwater management programs. Today, developers, builders and others working with the housing industry need to be aware of innovative solutions that can be employed at lot- and cluster-levels. These innovations are referred to as stormwater best management practices (BMPs).

In urban areas, stormwater can adversely affect the environment, municipal infrastructure and water treatment facilities in terms of the quantity and quality of the runoff:

- *Stormwater quantity impacts* - Under natural conditions, only about 10% of rainwater exists as runoff, with the remainder infiltrating soils or evaporating. In urban settings with more impervious area, about 55% of rainwater becomes stormwater runoff. The amount of runoff depends partially on the amount of impervious surface area. The greater the impervious area, the more it gives rise to a variety of concerns, including higher volume of runoff, greater stream and runoff velocity during storm events, increased peak discharges and reduced groundwater recharge. Porous pavement, illustrated in Figure 1, is a BMP example of quantity control as it allows more water infiltration.

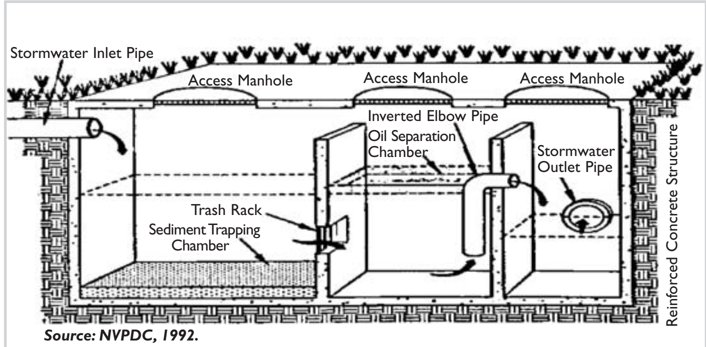

Figure 1 Oil and Grit Separator

- *Stormwater quality impacts* - Stormwater also presents adverse quality impacts through contaminants collected during runoff. In rural areas, pesticides and fertilizers are of particular concern. In urban areas, contaminants depend largely on surrounding land uses. Primary urban activities contributing to increased discharge include:
  - construction operations
  - pest management
  - littering
  - vehicle use
  - sewer cross-connections
  - outdoor material storage
  - landscaping activities
  - operation of landfills
  - pet and animal waste
  - transportation de-icing
  - poor septic systems
  - releases from industrial activity

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Oil and grit separators, illustrated in Figure 2, contribute to quality control by capturing particulates and hydrocarbons.

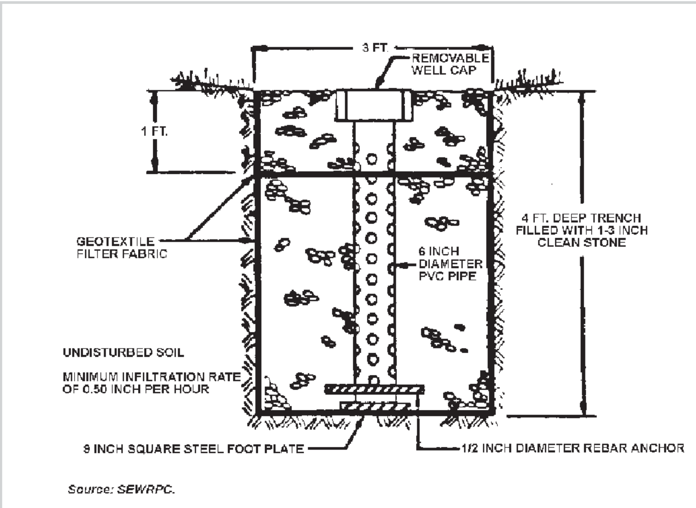

Figure 2 Infiltration trench

The degradation caused by urban stormwater runoff can result in the following economic, environmental and health problems:

- flooding and personal property damage
- infrastructure damage
- erosion
- siltation and sedimentation
- increased water temperature
- harm to aquatic life due to changes in water chemistry and habitat loss
- polluted, disease-bearing waters which harm sport fisheries, threaten human health and increase water treatment costs
- water-borne trash (e.g. cigarette butts, polystyrene cups, etc.) and increased sediment loads adversely affecting water clarity

TYPES OF BMP SOLUTIONS

Stormwater BMPs can be sub-divided into two categories, structural and non-structural, as listed in Table 1. This highlight and related CMHC case studies focus on structural BMPs, given that they are more relevant for developers and builders. Structural BMPs involve physical plants and modification of the environment. They may be above ground, at-level, or below ground, can range from small devices to larger facilities, and can often be installed in either greenfield or brownfield developments. Non-structural stormwater BMPs rely primarily on the actions of residents.

Different BMPs address water quantity or quality control or a combination of the two. There are limitations for each practice however. For this reason, several BMPs are often used together or in conjunction with downstream end-of-pipe controls.

Table 1 Types of BMPs

Structural	Non-Structural
Bioretention Filters	Animal Waste Collection
Constructed / Artificial Wetlands	Chemical Storage
Curb Elimination	Educational Programs
Detention Ponds / Dry Ponds	Exposure Reductions
Filter Strips / Vegetative Buffer Strips	Illicit Discharge Controls
Grassed Swales	Landscaping and Vegetative Practices
Infiltration Basins	Parking Lot / Driveway Cleaning
Infiltration Trenches	Pesticide and Fertilizer Management
Oil and Grit Separators / Water Quality Inlets	Street / Sidewalk Sweeping
Pervious Pipe System	
Porous Pavement	
Reduced Lot Grading	
Retention Ponds / Wet Ponds	
Roof Leader Disconnection	
Sand Filters	
Sump Pumping of Foundation Drains	
Urban Forestry	

Figure 3 Constructed Wetlands: Quantity and Quality Control

Constructed wetlands, shown in Figure 3, are an example of water quantity and quality control. They not only reduce runoff but also remove pollutants by various means.

CASE STUDY EXAMPLES OF BMPS

Ten case studies of on-site stormwater BMPs are presented on CMHC's Web site, www.cmhc-schl.gc.ca

The case studies provide descriptions of the initiatives; identify a BMP's efficiency in removing various pollutants; give installation and operational cost estimates; and identify implementation considerations for such aspects as design, site, soil, drainage, climate, thermal pollution, land uses, maintenance and safety. The following table provides an overview of the 10 case studies.

Table 2 Overview of Stormwater BMP Case Studies

Type and Function	Benefits
Constructed Wetlands – quantity and quality	■ minimize point source and non-point source pollution prior to stormwater entry into streams, natural wetlands and other receiving waters ■ remove pollutants through adsorption, wetland plant uptake, retention, gravitational settling, physical filtration and microbial decomposition
Detention Ponds – quantity and quality	■ reduce flooding by holding stormwater in a pool and delaying discharge ■ remove limited amount of pollutants through gravitational settling ■ low to moderate pollutant removal compared to other stormwater management facilities
Downspout Disconnection – quantity primarily	■ reduces volume and cost of stormwater requiring treatment ■ reduces loads to watercourses, basement flooding from sanitary sewer backups and leaking downspout connections ■ also some quality benefits: removes particulates and soluble pollutants, provides cleaner watercourses and groundwater recharge, recycles rainwater
Infiltration Trenches – quality	■ remove particulate and soluble pollutants through soil absorption and subsequent biological and chemical conversion in the soil ■ can also help provide groundwater recharge, particularly in areas with a high degree of impervious surface, control peak flows and protect against erosion
Oil and Grit Separators – quality	■ improve downstream quality as part of treatment train ■ well suited to capture particulates and hydrocarbons from small, highly impervious surface areas such as residential townhouse or apartment parking lots, loading and parking areas at commercial facilities and gas stations
Porous Pavement – quantity primarily	■ reduces impervious area, subsequently minimizing volume of surface runoff ■ new storm sewer systems can be designed for reduced flow capacity and at lower cost ■ less runoff enters combined storm and waste water system, thereby reducing treatment costs ■ reduces combined sewer overflows
Retention Ponds – quality	■ permanent pools of water allow for gravitational settling of suspended particulates, biological uptake of pollutants by plants, algae and bacteria, and decomposition of some pollutants
Sand Filters – quality	■ treat stormwater runoff from residential and commercial buildings, parking lots and roads by removing pollutants such as heavy metals, sediment, E. coli and phosphorus
Urban Forestry – quantity and quality	■ post-development planting or pre-development preservation of trees, shrubs and other ground covers in an urban context ■ reduce runoff by intercepting rain, retaining stormwater in mulch layer and facilitating infiltration ■ remove pollutants and prevent soil erosion
Vegetative Practices – quantity and quality	■ filter strips and grassed swales are typical examples ■ slow runoff and reduce peak flows ■ settle particulates before water enters another treatment device ■ properly constructed, treed strips can remove more than 60% of particulates and perhaps as much as 40% of plant nutrients from urban runoff ■ reduce pollutants such as sediment, organic matter and trace metals ■ often used as pre-treatment devices for other stormwater control practices, such as infiltration basins and trenches ■ increased groundwater recharge

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Full reports on this research project are available from the Canadian Housing Information Centre at the address below.

Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

To find more ***Research Highlights*** plus a wide variety of information products, visit our website at

www.cmhc.ca

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