Chapter 1

Introduction to the Stormwater Management Guidebook

1.0 Introduction

Inadequate management of increased stormwater runoff resulting from development places a burden on sewer systems and degrades the aquatic resources in waterbodies of the District of Columbia (District). By overloading the capacity of streams and storm sewers, unmanaged stormwater runoff is responsible for increased combined sewer overflow events and adverse downstream impacts such as flash flooding, channel erosion, surface and groundwater pollution, and habitat degradation.

Recognizing this, the District first adopted stormwater management regulations in 1988. These regulations (in chapter 5 of title 21 of the District of Columbia Municipal Regulations) established requirements to manage both stormwater quality and quantity. Quality control focused on the removal of pollutants from up to the first 0.5 inches of stormwater runoff, often referred to as the first flush. Quantity control came in the form of detention requirements based on the 2-year, 24-hour event for stream bank protection, as this is widely accepted as the channel shaping flow, and the 15-year, 24-hour event for flood protection, as this is the typical design capacity of the District of Columbia's sewer conveyance system.

The revisions to the 1988 regulations, on which this Stormwater Management Guidebook provides technical guidance, have not significantly changed the detention requirements, but the focus on water quality treatment has shifted to volume retention. Major land-disturbing activities must retain the volume from a 1.2 inch storm event, and major substantial improvement activities must retain the volume from a 0.8 inch storm event. By keeping stormwater on site, stormwater retention effectively provides both treatment and additional volume control, significantly improving protection for District waterbodies. This volume can be managed through runoff prevention (e.g. conservation of pervious cover or reforestation), runoff reduction (e.g. infiltration, water reuse), and runoff treatment (e.g. plant/soil filter systems, permeable pavement, etc.).

1.1 Purpose and Scope

The purpose of this Stormwater Management Guidebook (SWMG) is to provide the technical guidance required for compliance with the District's stormwater management regulations, including the criteria and specifications to be used by design engineers and planners for the planning, design, and construction of sites and Stormwater Best Management Practices (BMPs).

It is the responsibility of the design engineer to review, verify, and select the appropriate BMPs and materials for the specific project under design and to submit to DDOE, as required, all reports, design computations, worksheets, geotechnical studies, surveys, rights-of-way determinations, etc. All such required submittals will bear the seal and signature of the Professional Engineer licensed to practice in the District who is responsible for that portion of the submitted project.

1.2 Impacts of Urban Runoff

The collective impacts of the rooftops, sidewalks, roadways, and other impervious surfaces of an urban center, such as the District of Columbia, on streams and rivers have historically been divided into two categories. First, the hydrologic response of an urban area is changed. As drainage areas become increasingly impervious, stormwater runoff volumes, flows, and velocities increase, while base groundwater flows decrease. Small annual storm events that would be captured by the plants and soils of an undeveloped landscape are delivered quickly and efficiently to the receiving pipe network and streams in a city. Second, human activities in the city generate increased pollutant loads, ranging from heavy automobile traffic to use of various chemicals. These pollutants, as well as the deposition of atmospheric pollution from outside of the city, build up on impervious surfaces during dry weather, and rain and snow events wash these pollutants into the District's sewer pipes, streams, and rivers.

1.2.1 Hydrologic Impacts

Urban development causes significant changes in the rainfall-runoff relationship within a watershed. Rainfall volumes shift from evapotranspiration and infiltration to surface and piped runoff. This delivers large amounts of runoff to receiving pipes and streams for even the smallest rainfall event within an urban development (see Figure 1.1). A city represents a transformation from a natural catchment to a sewershed, through an increase in surface imperviousness and an underground piped conveyance system. Natural drainage patterns are modified and stormwater runoff is channeled through roof drains, pavement, road gutters, and storm drains. Direct connections between impervious surfaces and conveyance systems for stormwater meant to avoid flooding deliver these larger volumes more quickly. This leads to an increase in runoff volumes and velocities. The time taken for the runoff to travel downstream is shorter and infiltration into underlying soils and groundwater aquifers is decreased or eliminated (see Figure 1.2).

The stormwater management regulations established in 1988 responded to these volume impacts with a focus on "peak matching." Recent research finds the approach to delaying volume releases and releasing at a two-year flow rate has, in many cases, led to an increase in stream erosion. Under this approach, the full runoff volume is still forced through the receiving channel. Even at the lower flow rate, the channel is subjected to an elevated flow (the 2-year flow rate in the District) for prolonged durations. In addition, the many storms that are smaller than the 2-year storm are allowed to wash off the site through the 2-year flow control structure at the same higher rate of discharge that would be allowed for the 2-year storm. Retention requirements complement peak flow matching by retaining stormwater from these smaller storms on site and reducing the overall volumes that leave the site. This is a better approximation of the natural drainage cycle.

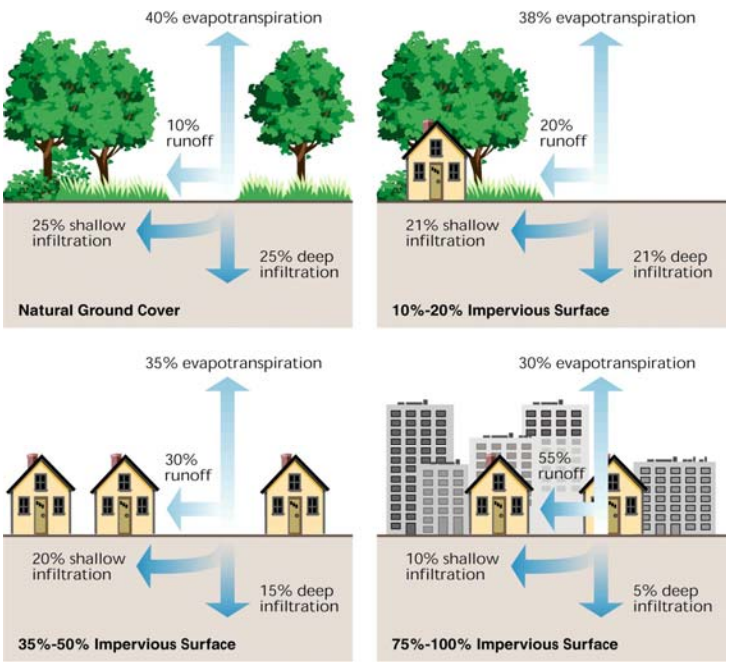

Figure 1.1. Changes in the Water Balance Resulting from Urbanization (FISRWG, 1998).

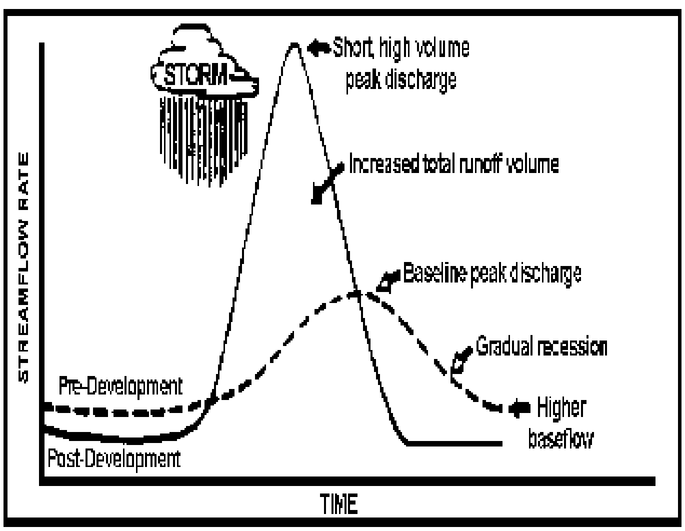

Figure 1.2. Changes in Streamflow Resulting from Urbanization (Schueler, 1987).

1.2.2 Water Quality Impacts

As land is developed, naturally vegetated areas that once allowed water to infiltrate and purify itself in the soil are replaced with impervious surfaces. Approximately 43% of the District's natural groundcover has been replaced with impervious surface. These impervious surfaces accumulate pollutants deposited from the atmosphere, leaked from vehicles, or windblown from adjacent areas. During storm events, these pollutants quickly wash off and are rapidly delivered to downstream waters. Some common pollutants found in urban stormwater runoff and their sources are profiled in Table 1.1.

Table 1.1. Common pollutants found in urban stormwater runoff and their sources. (Municipal Handbook, State of California, 1993)

Pollutant	Automobile/ Atmospheric Deposition	Urban Housekeeping / Landscaping Practices	Industrial Activities	Construction Activities	Non-Stormwater Connections	Accidental Spills & Illegal Dumping
Sediments	X	X	X	X		
Nutrients	X	X	X	X	X	X
Bacteria and Viruses	X	X		X	X	X
Oxygen Demanding Substances		X	X	X	X	X
Oil and Grease	X	X	X	X	X	X
Anti-Freeze	X	X		X	X	X
Hydraulic Fluid	X	X	X	X	X	X
Paint		X		X	X	X
Cleaners and Solvents	X	X	X	X	X	X
Wood Preservatives		X		X	X	X
Heavy Metals	X	X	X	X	X	X
Chromium	X	X	X			
Copper	X	X	X			
Lead	X	X	X			
Zinc	X	X	X			
Iron	X		X			
Cadmium	X		X			
Nickel	X		X			
Magnesium	X		X			
Toxic Materials						
Fuels	X		X	X	X	X
PCBs	X				X	X
Pesticides	X	X	X	X	X	X
Herbicides	X		X	X	X	X
Floatables		X	X	X		