Chapter 1 Introduction to the Stormwater Management Guidebook

1.1 Introduction

The District of Columbia (District), like most ultra-urban areas, experiences increased stormwater runoff that results from development. This runoff places a burden on sewer systems and degrades aquatic resources when it is not managed adequately. Unmanaged stormwater runoff overloads the capacity of streams and storm sewers and 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 issue, the District first adopted stormwater management regulations in 1988. These regulations (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 was mandated through detention requirements based on the 2-year, 24-hour storm event for stream bank protection (widely accepted as the channel shaping flow) and the 15-year, 24-hour storm event for flood protection (the typical design capacity of the District's sewer conveyance system).

This Stormwater Management Guidebook (SWMG) provides technical guidance on the 2013 revisions to the 1988 regulations. The detention requirements have not changed significantly, but the focus on water-quality treatment has shifted to a standard for 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, retention practices effectively provide both treatment and additional volume control, significantly improving protection for District waterbodies. This Stormwater Retention Volume (SWRv) can be managed through runoff prevention (e.g., conservation of pervious cover or reforestation), runoff reduction (e.g., infiltration or water reuse), and runoff treatment (e.g., plant/soil filter systems or permeable pavement).

1.2 Purpose and Scope

The purpose of the SWMG is to provide the technical guidance required to comply with the District's stormwater management regulations, including the criteria and specifications engineers and planners use to plan, design, and construct regulated 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 a specific project and submit to DDOE, as required, all reports, design computations, worksheets, geotechnical studies, surveys, rights-of-way determinations, etc. Each such required submittal will bear the seal and signature of the professional engineer licensed to practice in the District who is responsible for that portion of the project.

1.3 Impacts of Urban Runoff

Historically, the collective impacts of rooftops, sidewalks, roadways, and other impervious surfaces on District streams and rivers have been divided into two categories, those attributed to changes in hydrologic response or resulting from human activities. The hydrologic response of an urban area changes when drainage areas become increasingly impervious, causing stormwater runoff volumes, flows, and velocities to increase while base groundwater flows decrease. Small annual storm events that would ideally be captured by the plants and soils of an undeveloped landscape are instead delivered quickly and efficiently through the receiving pipe network to city streams. Human activities in the city, ranging from heavy automobile traffic to use of various chemicals, generate increased pollutant loads. During dry weather, these pollutants combine with deposits of atmospheric pollution from outside of the city to build up on impervious surfaces where rain and snow events later wash them into the District's sewer pipes, streams, and rivers.

1.3.1 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 shift delivers large amounts of runoff to receiving pipes and streams during 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 impervious surfaces and the addition of 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 stormwater conveyance systems (meant to avoid flooding) deliver these larger volumes more quickly, which leads to an increase in runoff volumes and velocities. The time runoff takes to travel downstream becomes shorter, and infiltration into underlying soils and groundwater aquifers decreases or is eliminated (see Figure 1.2).

The District's 1988 stormwater management regulations responded to these volume impacts with a focus on "peak matching," where volume releases were delayed and released at a 2-year flow rate. Recent research has found that this approach has, in many cases, led to an increase in stream erosion because the full runoff volume is still forced through the receiving channel. Even at this low flow rate, the channel is subjected to an elevated flow for prolonged durations.

In addition, a 2-year flow control structure allows the large number of smaller-sized storms to wash off a site at the discharge rate allowed for the 2-year storm, when they should have a lower discharge rate. The District's new stormwater retention requirements complement and improve peak flow matching by retaining stormwater from these smaller storms on site and reducing the overall runoff volumes that leave the site. Retention is a better approximation of the natural drainage cycle.

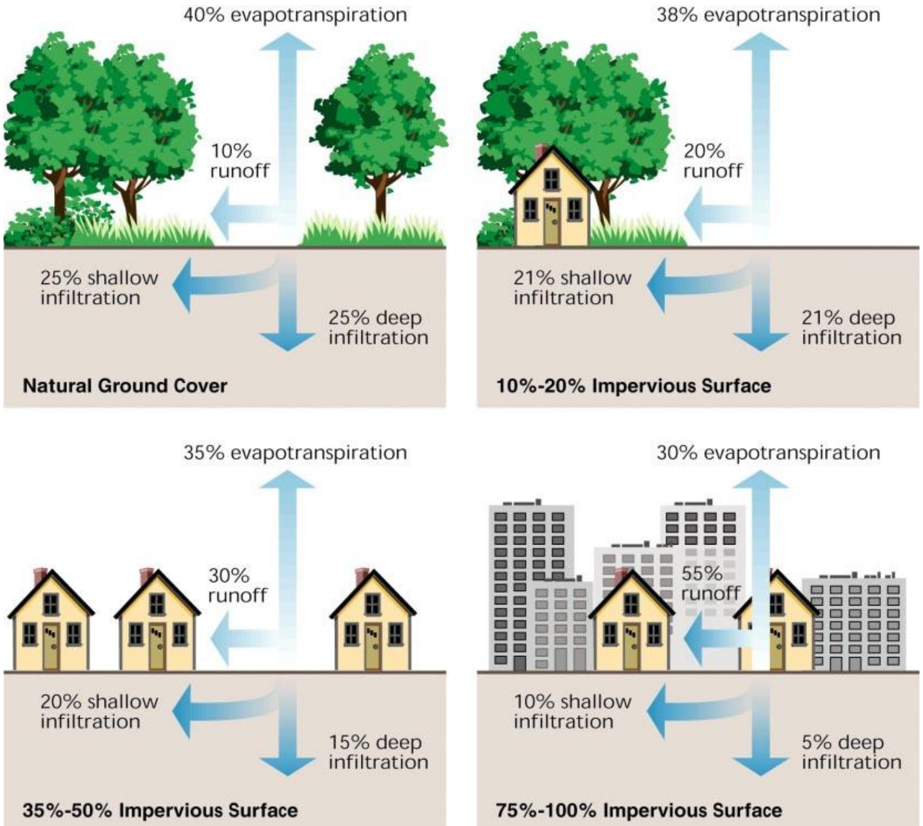

Figure 1.1 Changes in the water balance resulting from urbanization (FISRWG, 1998).

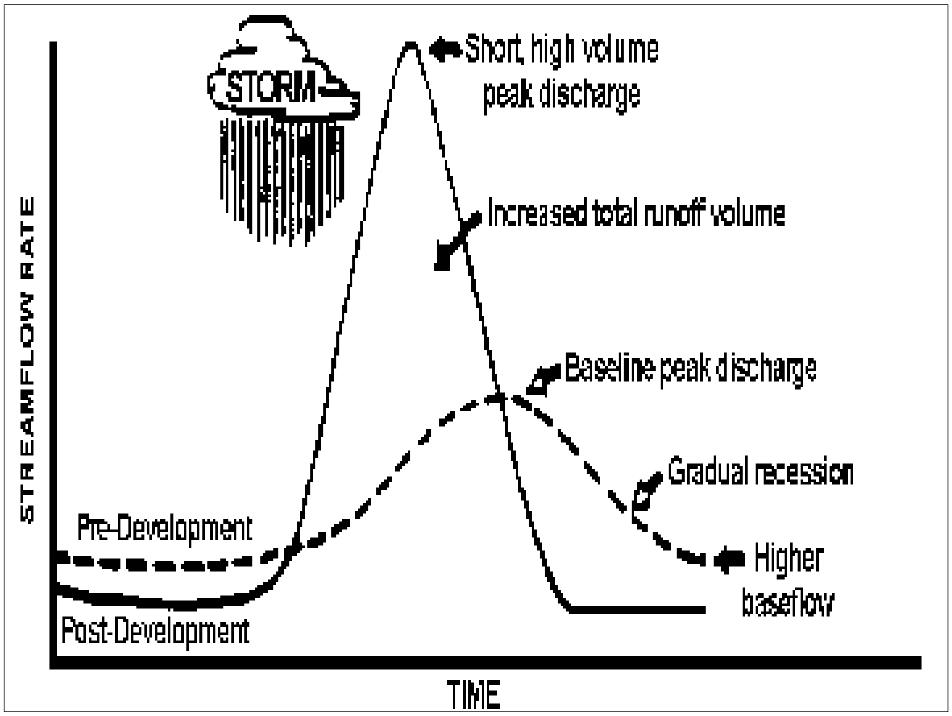

Figure 1.2 Changes in streamflow resulting from urbanization (Schueler, 1987).

1.3.2 Water Quality Impacts

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

Table 1.1 Common Pollutants in Urban Stormwater Runoff and Their Sources (SWQTF, 1993)

Pollutant	Automobile/ Atmospheric Deposition	Urban Housekeeping / Landscaping Practices	Industrial Activities	Construction Activities	Connections other than Stormwater	Accidental Spills and 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		

1.4 References

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