Appendix C
Storm Water Management

Introduction

The most effective storm water management criteria would require that post-development runoff from new construction projects be controlled so that pre-development runoff characteristics (quantity and quality) are maintained for all rainfall events. Practically, this ideal condition may be difficult to achieve due to the complex changes which result from urban development.

The goal in storm water management should be to maintain adequate water quality standards and to ensure that, for a predetermined frequency storm, runoff will not damage adjacent properties or exceed the capacity of receiving streams.

Criteria

Properties and waterways downstream from new development sites should be protected from erosion due to increases in the volume, velocity, and peak flow rate of storm water runoff. In many cases, state and local regulations will apply to the allowable quality and quantity of storm water runoff. Each developer or land user should become familiar with the regulations which apply to their location and take steps to comply with the applicable regulations.

In the absence of state or local regulations which apply to the quantity of runoff from a development site, the following guidelines may be used.

A. Concentrated storm water runoff leaving a development site must be discharged directly into a well-defined, natural or man-made off site receiving channel or pipe. If there is no well-defined off site receiving channel or pipe, one must be constructed to convey storm water to the nearest **adequate channel**. Newly constructed channels shall be designed as **adequate channels**.

   An **adequate channel** is defined as a natural or man-made channel or pipe which is capable of conveying the runoff from a 2-year, 24-hour storm without overtopping its banks or eroding after development of the site in question. A receiving channel may also be considered **adequate** at any point where the total contributing drainage area is at least 100 times greater than the drainage area of the development site in question; or, if it can be shown that the peak rate of runoff from the site during a 2-year storm will not be increased after development.

B. If an existing off-site receiving channel is not an **adequate channel**, one of the following options may be used.

   1. Improve the receiving channel to an **adequate** condition. Such improvements shall extend downstream until an adequate channel section is reached.

2. Develop a site design that will not cause the pre-development peak runoff rate from a 2-year, 24-hour storm to increase. Such a design may be accomplished by enhancing the infiltration capability of the site or by providing on-site storm water detention measures. The pre-development and post-development peak runoff rates may be determined by methods contained in Appendix B.

3. Provide a combination of channel improvement, storm water detention, or other measures which will accomplish the desired result.

C. All channel improvements or modifications must comply with all applicable laws and regulations. Modifications to streams should be done in accordance with the standards contained in this handbook.

D. If an option which includes storm water detention is chosen, a plan for maintenance of the detention facilities should be prepared. The plan should set forth the maintenance requirements of the facility and the party responsible for performing the maintenance.

E. Increased volumes of unconcentrated sheet flows which will cause erosion or sedimentation of adjacent property should be diverted to a stable outlet or detention facility.

Storm Water Management Practices

There are a number of practices and techniques which may be employed to manage both the quantity and quality of urban storm water runoff. Following is a summary of some runoff control practices which may be used.

A. ***Urban Impoundments***: This practice involves the construction or modification of surface water impoundments in a manner which will protect downstream areas from potential water quality degradation, flooding, and stream channel degradation due to upstream urban development. The objective is to detain storm water and release it at a controlled rate. Downstream water quality is improved through sediment removal, plant uptake of nutrients, chemical transformations, spread-out pollutant loadings and other processes. If properly constructed and maintained, a sediment basin which was used to control sediment during construction can also serve as a storm water management device.

B. ***Parking Lot Storage***: This practice involves the use of impervious parking areas as temporary impoundments during rainstorms. Parking lot drainage systems can be designed to temporarily detain storm water in special designated areas, and release it at a controlled rate. The objective is to protect

downstream areas from increased flooding, stream channel degradation and/or combined sewer overflows caused by urban development. It is important that these facilities be designed to minimize potential safety hazards and inconvenience to motorists and pedestrians.

C. ***Rooftop Detention***: This practice allows storm water falling directly onto flat roof surfaces to be temporarily ponded and gradually released by incorporating controlled-flow roof drains into building designs. The purpose is to reduce adverse impacts of rooftop runoff on sewer systems and receiving streams. Rooftop detention can be incorporated into the design of most new buildings, and many existing structures also can be modified for this function.

D. ***Rooftop Runoff Disposal***: This practice encourages the disposal of rooftop runoff by systems and techniques that avoid or replace direct connections of roof drainage systems to sewer systems. The objective is to reduce the frequency of sewer overflows. Proposed alternatives to sewer connection include surface drainage, subsurface infiltrations, and runoff collection and storage.

E. ***Cistern Storage***: This practice involves the collection and storage of storm water runoff in a storage tank or chamber above or below the ground. A cistern can serve solely as a storm water detention device to protect downstream areas from flooding, stream channel degradation and/or sewer overflows, or it can be used to collect polluted runoff for later treatment. Water collected in a cistern may also be put to use for lawn watering, fire protection or other purposes.

F. ***Infiltration Pits and Trenches***: This practice involves the excavation of pits or trenches which are backfilled with sand and/or graded aggregates. Storm water runoff from impervious surfaces can be directed to these facilities for detention and infiltration. Permeable soils are a prerequisite. The potential for groundwater pollution must also be carefully evaluated.

G. ***Concrete Grid and Modular Pavement***: This practice involves the use of a special pervious paving material in low traffic areas. The pavement consists of concrete grids or other structural units placed on a pervious base such as gravel or sand. The resultant pavement provides an adequate bearing surface and yet allows a significant amount of infiltration thereby reducing runoff volume and discharge rate and improving the water quality.

H. ***Porous Asphalt Pavement***: This practice involves the use of a special asphaltic paving material which allows storm water to infiltrate at a high rate. Infiltration water is stored below the pavement in a high-void aggregate base. This practice provides for storm water detention and in some cases increases infiltration into the ground. Use of the practice can contribute to reduced sewer overflows, decreased flooding and stream channel degradation, and improved water quality.

l. ***Grassed Waterways, Filter Strips, and Seepage Areas***: This practice involves utilizing grassed surfaces to reduce runoff velocities, enhance infiltration and remove runoff contaminants, thus improving runoff quality and reducing the potential for downstream channel degradation and sediment pollution due to urban development. Concepts covered include using grass lined roadside swales instead of curb and gutter installations; using grass-lined open drainage channels instead of paved channels; using grass-covered surfaces to intercept runoff and filter out some of the contaminants; and using small shallow basins over permeable soils to capture and infiltrate runoff.

Design Aids

Many of the practices contained in this handbook can be used in a storm water management system. Methods of determining pre-development and post-development runoff are located in Appendix B. SCS Technical Release 55 contains a method of determining the amount of storage required to maintain a given peak rate of outflow.