# Stormwater Management

Stormwater runoff occurs when precipitation from rain or snowmelt flows over the land surface. The addition of roads, driveways, parking lots, rooftops and other surfaces that prevent water from soaking into the ground to our landscape greatly increases the runoff volume created during storms. This runoff is swiftly carried to our local streams, lakes, wetlands and rivers and can cause flooding and erosion, and wash away important habitat for critters that live in the stream. Stormwater runoff also picks up and carries with it many different pollutants that are found on paved surfaces such as sediment, nitrogen, phosphorus, bacteria, oil and grease, trash, pesticides and metals. It comes as no surprise then that stormwater runoff is the number one cause of stream impairment in urban areas.

To reduce the impacts of runoff on urban streams, EPA expanded the Clean Water Act in 1987 to require municipalities to obtain permits for discharges of stormwater runoff. As a result, many communities have adopted regulations requiring developers to install stormwater management practices that reduce the rate and/or volume and remove pollutants from runoff generated on their development sites. This site provides links to a number of resources to help communities develop or improve their stormwater management programs. It also introduces some terminology related to the various approaches to stormwater management, keeping in mind that these are not mutually exclusive categories.

**Approaches to Stormwater Management - Terminology**

**Low-Impact Development (LID)** is a stormwater management approach that seeks to manage runoff using distributed and decentralized micro-scale controls. LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Instead of conveying and treating stormwater solely in large end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small-scale landscape practices and design approaches that preserve natural drainage features and patterns. Several elements of LID—such as preserving natural drainage and landscape features—fit right into the Green Infrastructure approach described below. Additional information on LID is available from the Low Impact Development Center.

**Green Infrastructure** refers to natural systems that capture, cleanse and reduce stormwater runoff using plants, soils and microbes. On the regional scale, green infrastructure consists of the interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while providing recreational opportunities, wildlife habitat, air quality and urban heat island benefits, and other community benefits. At the site scale, green infrastructure consists of site-specific management practices (such as interconnected natural areas) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls. Additional information on green infrastructure is available on EPA's Managing Wet Weather with Green Infrastructure website.

**Environmental Site Design (ESD)**, also referred to as **Better Site Design (BSD)**, is an effort to mimic natural systems along the whole stormwater flow path through combined application of a series of design principles throughout the development site. The objective is to replicate forest or natural hydrology and water quality. ESD practices are considered at the earliest stages of design, implemented during construction and sustained in the future as a low maintenance natural system. Each ESD practice incrementally reduces the volume of stormwater on its way to the stream, thereby reducing the amount of conventional stormwater infrastructure required. Example practices include preserving natural areas, minimizing and disconnecting impervious cover, minimizing land disturbance, conservation (or cluster) design, using vegetated channels and areas to treat
stormwater, and incorporating transit, shared parking, and bicycle facilities to allow lower parking ratios.

**Stormwater Management Resources**

To access FREE downloads of Center resources on stormwater management, go to our Free Downloads page.

- EPA's National Pollution Discharge Elimination System (NPDES) Stormwater Program webpage provides a wealth of technical and regulatory information about the NPDES stormwater program.
- The Local Government Environmental Assistance Network provides a list of resources, databases and tools to help local governments comply with stormwater management regulations.
- EPA's Economic Benefits of Runoff Controls reports how that certain urban runoff management controls can be incorporated into a development in a way that provides aesthetic and economic benefits.
- The International Stormwater Best Management Practices (BMP) Database project website features a database of over 300 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other study-related publications.
- Virginia Stormwater BMP Clearinghouse provides detailed specifications for design and construction of various stormwater BMPs.
- University of New Hampshire's Stormwater Center is dedicated to the protection of water resources through effective stormwater management.
- Bioretention Performance, Design, Construction, and Maintenance. A concise treatment of monitoring results on bioretention practices from NC State University's Biological and Agricultural Engineering Stormwater Engineering Group, this publication discusses some design considerations, and how filter media can be changed to address various nutrients.
- North Carolina State University's Biological and Agricultural Engineering (BAE) Stormwater Engineering Group's mission is to "learn and teach" stormwater management. Research areas of interest include the function and impacts of stormwater management such as bioretention areas, green roofs, stormwater

wetlands, permeable pavements, water harvesting systems, and other innovative treatment practices.

- Permeable Pavement: Research Update and Design Implications. A comprehensive fact sheet on permeable pavements from NC State University.
- Stormwater Treatment: Assessment and Maintenance is an online manual for assessment and maintenance of stormwater treatment practices developed by the University of Minnesota and the Minnesota Pollution Control Agency.
- Villanova Urban Stormwater Partnership. The mission of the Villanova Urban Stormwater Partnership is to advance the evolving field of sustainable stormwater management and to foster the development of public and private partnerships through research on innovative stormwater Best Management Practices, directed studies, technology transfer and education.
- The Precipitation Frequency Data Server is an easy-to-use compilation of precipitation data for different regions of the country, by NOAA's National Weather Service Hydrometeorological Design Studies Center.
- GreenWorks.tv 's Managing Stormwater: Best Management Practices contains short videos for educating municipalities and the public about stormwater runoff impacts and various best management practices.
- The Chesapeake Stormwater Network seeks to improve on the ground implementation of more sustainable stormwater management and environmental site design practices in each of 1300 communities and seven states in the Chesapeake Bay Watershed.
- The Chesapeake Bay Stormwater Training Partnership delivers targeted training on new tools and practices to improve the quality of stormwater runoff. The Partnership works with stormwater design professionals from local government and the private sector to understand and apply the latest stormwater management design and implementation strategies.