Managing Stormwater

Land use in the United States has dramatically changed in the past 25 years. As natural areas are developed and turned into parking lots, driveways, and houses, more impervious surfaces are created, generating increased amounts of polluted runoff. This increased volume of runoff enters streams at a much faster rate than previously. In a natural setting, rain falls on vegetation and is either captured by plants or infiltrated into the soil. In a developed community, stormwater runoff can cause flooding that is known to scour streambanks and cause erosion. The water that runs over lawns, ball fields, roofs, parking lots, and golf courses collects and deposits pollutants such as oil, sediment, fertilizers, trash, debris, and chemicals into nearby waterways. Managing stormwater to prevent pollution and flooding is a key aspect of most development projects.*

Stormwater runoff contains pollutants

Polluted runoff harms wildlife

Excess runoff causes flooding

The Importance of Stormwater Management

Stormwater management is the science of managing stormwater runoff to prevent adverse impacts on the environment. The main goal is to manage water quantity in addition to protecting water quality. For development in the last 20 to 30 years, the construction of stormwater management ponds (or basins) on the site has been the preferred stormwater management practice. Initially, the focus was on managing the rate of runoff from a development to prevent flooding and erosion. More recently, ponds were modified to address water quality issues in addition to quantity concerns. The concept is simple: convey stormwater runoff to a containment area where nonpoint source pollutants, such as sediment, can settle out. Clean water can then be slowly released into the nearest waterway. These facilities were typically one of three types: wet ponds, infiltration basins, and dry ponds. Recently, another category of stormwater management facilities has become widely used. They are collectively referred to as “green technology” and address water quality through more natural means such as infiltration.

*The Delaware Sediment and Stormwater Regulations require that all land-disturbing activities greater than 5,000 square feet in area are carried out according to an approved plan.

Stormwater Management Practices

Wet Ponds

Wet ponds, also called stormwater ponds or retention ponds, typically look just like an ordinary pond, with the exception that they are specifically designed to manage stormwater and have a fairly standardized design. Wet ponds contain a permanent pool of water that is a minimum of three feet deep. The outlet structure of a wet pond is above the surface of the water, ensuring that the pond stays full. Stormwater discharges from the pond only when the water level rises over the outlet as a result of runoff from a rainstorm. In addition to managing water quantity issues, wet ponds also improve water quality. Prolonged storage of stormwater allows sediment to settle out, improving the quality of the discharged runoff. Eventually, the water level in the pond goes back to where it was before the storm.

Infiltration Basins

Infiltration basins are designed so that stormwater eventually soaks into the ground, imitating natural conditions and recharging groundwater supplies. In addition to recharging groundwater, infiltration basins also trap pollutants, making them a highly valued stormwater management tool. Site conditions must be right in order for infiltration basins to work properly. For example, a high water table or soils with high clay content will prevent runoff from sufficiently infiltrating through the soil. It is a requirement that infiltration basins be dry within 48 hours after a storm.

Dry Ponds

Dry ponds, or dry detention ponds, are containment areas for stormwater runoff that remain dry except after rainstorms, when runoff is conveyed to them. An outlet structure is built into dry ponds to allow stormwater runoff from a recent storm to drain slowly into a nearby stream or waterway. It operates similarly to a bathtub with a partially blocked drain. When water is flowing into it, the tub continues to fill up, even though some water is getting out through the drain. Dry ponds are designed so that all of the water has drained after about 48 hours. During dry periods, the facility usually looks like a depressed area with grass growing on the bottom and side slopes. Dry ponds are designed to manage water quantity only, and their water quality benefits are minimal. Dry ponds are not a preferred best management practice in the state of Delaware because of this reason.

Green Technology and Low-Impact Development

Scientists and engineers are currently designing and promoting new stormwater management techniques called “green technology” best management practices. They are proven to mimic natural processes, require less maintenance, and enhance local property values. Green technology BMPs are typically incorporated into the landscaping, so most people don’t even realize when they see them. Green technology BMPs are designed to address water quality. In many instances they must be used in combination with more traditional practices, such as ponds, to prevent flooding and erosion. The term “low-impact development” is a type of development that incorporates several components of green technology BMPs.

Bioretention Cells

First developed by the Prince George's County, Maryland, Department of Environmental Resources, bioretention is a BMP that uses plants and soils to remove pollutants and allow recharge of groundwater by water infiltration. Although it has the appearance of a landscaped island, it is designed to temporarily store and treat stormwater runoff.

Rain Gardens

Rain gardens are a type of bioretention cell that is commonly used by homeowners to promote the absorption of rooftop rainwater into the ground. Rain barrels can also be used to collect rainwater from rooftops. This water can then later be used to water plants during a dry period.

Filter Strips and Riparian Buffers

Filter strips are vegetated areas set aside to absorb water. Similarly, riparian buffers are strips of vegetation planted along a stream or waterway. This vegetation filters pollutants from the water before it enters into the water body. Both are effective at absorbing stormwater and filtering pollutants.

Bioswales/Biofiltration

These shallow impoundments are designed to infiltrate runoff into the soil and recharge groundwater. They also remove pollutants from the stormwater as it is conveyed downstream.

Porous Pavement and Pavers

Using either porous pavement or paving stones is one alternative to using concrete where large quantities of water runs off instead of infiltrating into the ground. This type of infiltration practice can be used in parking lots, roads, sidewalks, and other paved areas. Note that porous pavement systems are not suitable for all applications. Since porous pavement only works in low-traffic areas, it is a useful tool for residential driveways and streets and commercial parking areas.

Manufactured BMP Devices

With ongoing research, new BMPs are constantly emerging. In addition to the BMPs described above, a number of different types of manufactured treatment devices are available for postconstruction stormwater management. Manufactured or proprietary technologies can be classified into several broad categories:

- Hydrodynamic separator systems (such as Vortechs, Stormceptor, Baysaver)
- Filtration systems, including in-line filtration systems (such as sand filters and StormFilter) and a large variety of catch basin inserts
- Sediment containment devices such as baffle boxes
- Stormwater underground storage tanks
- Fabricated underground piping systems
- Porous pavement materials

With a growing number of manufactured products emerging for stormwater quality management, selecting devices that are appropriate for particular development situations can be challenging. Although some of the newer devices have been relatively untested, some information about these devices, their costs and maintenance requirements, and how best to use them can be found on manufacturers' web sites and in BMP manuals such as those listed in the reference section of this chapter.

Good Practices for Local Governments

Plan

- Require the identification of critical natural resources on a site prior to laying out the proposed development. This will aid in designing a stormwater management system that takes advantage of the natural features of the site and minimizes stormwater management facility construction.

- Strongly encourage the protection of riparian buffers and wetlands.

- Look at total watershed drainage patterns, not just those at the project site. Encourage the development of hydrologic and hydraulic (referred to as H & H) models for individual watersheds. These models help to identify what discharges could be tolerated from a specific area within a watershed without causing downstream flooding.

- Encourage designers to perform a downstream analysis to ensure that the receiving waterway can accept drainage from a development site without causing flooding or stream bank erosion.

- Inform owners of proposed development parcels that a sediment and stormwater plan must be approved prior to construction for all land-disturbing activities greater than 5,000 square feet in area. The approval process can take time, so it needs to be built into any development schedule.

- Provide stormwater easements or drainage right-of-ways when the proposed subdivision is crossed by a watercourse or drainage way.

Minimize

- ∑ Promote designs that disconnect impervious surfaces and channel runoff to vegetated and other porous areas.
- ∑ Encourage on-site infiltration of water rather than diversion by impervious roads, parking areas, and drainage structures. Diverted stormwater alters the natural hydrologic cycle, discourages groundwater recharge, and generates increased runoff and flooding.
- ∑ Development should retain the natural landscape by minimizing grading and disturbance of existing vegetation. Encourage stormwater management systems that utilize existing vegetation and natural drainage patterns.
- ∑ Promote the use of green technology stormwater management BMPs.
- ∑ Permit shared and porous paved driveways and sidewalks.
- ∑ Drainage from roads, parking lots, and roofs should be carried on the surface in shallow, gently sloping swales. Swales regulate velocity, minimize erosion, filter runoff, and maximize percolation. Also, stormwater should be carried as sheet drainage, diffused over large surfaces as opposed to concentrated drainage directed to curbs, storm sewers, or ditches.

Mitigate

- ∑ Where pipes are used, encourage perforated over closed pipes to allow leaching or filtration.
- ∑ Educate citizens regarding environmentally friendly landscaping and lawn care.
- ∑ Educate residents concerning pollution prevention practices such as not dumping oil, trash, debris, or grass clippings into storm drains, swales, and ponds.

Maintain

- ∑ Encourage long-term maintenance of stormwater management BMPs.

Tradeoffs

Stormwater management is essential in order to prevent flooding, minimize erosion, and meet water quality standards required by law. Although not designed to address problems associated with catastrophic storms, the BMPs discussed above have proven to be effective for the more common rainfall events. These practices have drastically reduced the pollutants entering our streams and ponds from developing areas. Stormwater management techniques for new construction must continue to evolve in an effort to improve performance. Neglecting water quality and quantity problems in areas of the state that were developed prior to any stormwater management regulations will also result in a failure to meet national standards.

The long-term benefit of addressing stormwater from new and existing development greatly outweighs the initial cost. There will be a decrease in overall dredging and disposal costs due to reduced sedimentation, less frequent stream channel repairs, reduced flood damage and repair costs; decreased drinking water treatment costs, improved waterway aesthetics, increased tourism and tourist dollars, and potentially positive impacts to the commercial fishing and shellfishing industries.

Questions to Ask During the Development Process

- Does this proposed development minimize disturbance of the identified natural resources?
  Overall disturbance should be minimized in order to lessen the impact on the environment.

- Has there been an attempt to incorporate green technology BMPs into the stormwater management plan?
  Green technology BMPs should also be used whenever possible to lessen the impact on the environment.

- What are the impacts upstream and downstream of the site?
  It is crucial to consider this question when developing a site. For example, drainage patterns may change which can negatively impact an adjacent landowner.

- Is there an approved sediment and stormwater plan for every soil-disturbing activity greater than 5,000 square feet (not including agricultural land management)?
  Every land-disturbing activity over 5,000 square feet must have an approved sediment and stormwater plan. These plans must be submitted to the DNREC-approved delegated agency, specified by location:
    - *Kent County – Kent Conservation District*
    - *Sussex County – Sussex Conservation District*
    - *New Castle County (varies by location)*
        - *City of Newark – within city limits*
        - *City of Wilmington – within city limits*
        - *Town of Middletown – within town limits*
        - *New Castle Department of Land Use – all unincorporated areas of New Castle County*
        - *New Castle Conservation District – all incorporated areas of New Castle County (except city of Newark, city of Wilmington, and town of Middletown).*

  These plans are then reviewed by engineers who ensure that they are built to the proper capacity and built safely.

- Is there an entity (e.g., a homeowners' association) in place to deal with stormwater management issues and future facility maintenance?
  Because it is the property owner's responsibility to maintain stormwater management facilities on that land, a homeowners' association would be responsible for any publicly

owned land within a development, including stormwater ponds. The collection of dues is crucial, not only to maintain open space, but also to maintain stormwater management facilities.

- ∑ Have you considered the differing maintenance needs/costs for different types of stormwater facilities?
  Different types of facilities require varying degrees of funding and maintenance. For further information on maintenance costs, please contact the DNREC Sediment and Stormwater Program at (302) 739-9921 to obtain your free guide, Five Simple Steps to Maintaining and Enhancing Community Open Space and Stormwater Management Areas.

For Further Information

Center for Watershed Protection, Stormwater Manager's Resource Center
www.stormwatercenter.net/

Delaware Department of Natural Resources and Environmental Control

Five Simple Steps to Maintaining and Enhancing Community Open Space and Stormwater Management Areas. September 2004. Sediment and Stormwater Program. Dover, Delaware. 39 pp.

Green Technology: The Delaware Urban Runoff Management Approach.

Nonpoint Education for Municipal Officials

Factsheet 4: Strategies for Coping with Polluted Runoff
nemo.uconn.edu/publications/index.htm#factsheets

Technical Paper 1: Addressing Imperviousness in Plans, Site Design and Land Use Regulations *nemo.uconn.edu/publications/index.htm#factsheets*

Twin Cities Metropolitan Council

Urban Small Sites Best Management Practice (BMP) Manual. 2001. (Includes detailed information on 40 BMPs that are aimed at managing stormwater pollution for small urban sites. The goal of the manual is to support the principles of accommodating growth while preserving the environment.)
www.metrocouncil.org/environment/Watershed/BMP/manual.htm

New Castle County Department of Land Use

Water Management Code Background White Papers. 2004.

U. S. Environmental Protection Agency Web Site

Post-construction Stormwater Management in New Development and Redevelopment.
cfpub1.epa.gov/npdes/stormwater/menuofbmps/post.cfm