RESOURCE PAPER

ASSOCIATION OF NEW JERSEY ENVIRONMENTAL COMMISSIONS

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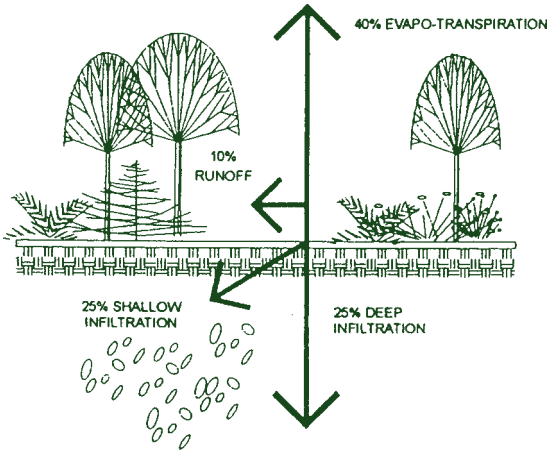
Municipal Options for Stormwater Management

From disastrous river flooding to powerful Nor'easters that pummel the coastline, New Jersey is no stranger to catastrophic storm events. In fact, scientists expect extreme storms to increase in frequency and severity over the coming years due to climate change. Floods are a threat to public safety and property.

But it doesn't take a disaster to illustrate how rainfall and stormwater runoff affect municipalities and jeopardize water quality. During almost any storm, street gutters can fill and overflow onto sidewalks. Oil-streaked runoff rushes from road surfaces into storm drains. Fertilizers and pesticides wash into the street, then into the storm sewer system, and finally into lakes and streams.

The US Environmental Protection Agency (EPA) has identified stormwater runoff as the primary cause of water pollution in the 21st Century. The federal Clean Water Act requires governments, including municipalities and schools as well as developers, to institute measures to address these problems.



Water Cycle with Natural Groundcover

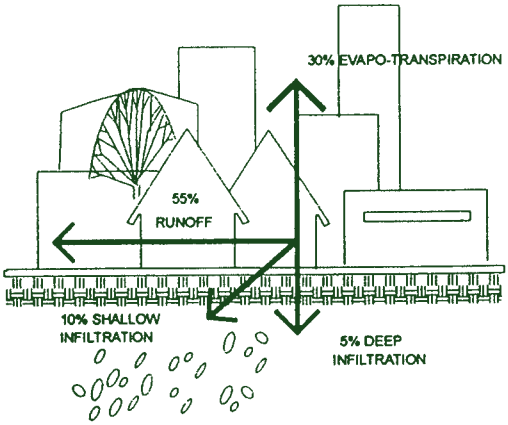
What Is Stormwater?

Stormwater is precipitation that falls as rain, snow, sleet or hail. Stormwater is best understood in terms of the water cycle. Under natural conditions, about 10 percent of precipitation runs over the land surface and about 50 percent infiltrates the soil to replenish groundwater flow and base flow to streams. Plant uptake and evapotranspiration account for about 40 percent.

Stormwater flows from higher points on the land to lower points within a watershed. A watershed is a natural region defined by the land area from which precipitation drains into a particular body of water — a river or lake. One watershed may be part of a larger one, or contain several smaller sub-watersheds. All watersheds, no matter what their size, function in the same manner. Precipitation falls on the land, then drains from the higher areas over and through the soil until it eventually reaches rivers, streams, lakes, or the ocean.

Impervious Cover — Super Highway for Stormwater Pollutants

When natural conditions change because of development or land use alterations, the water cycle changes dramatically. As land is covered with more impervious surface, larger quantities of runoff, traveling faster, carry more pollutants from the pavement to our waterways. With urban development, less than 15 percent of the runoff infiltrates the soil and over 55 percent runs off.



Water Cycle with 75-100% Impervious Surface

The amount of impervious surface in a watershed largely determines the quantity of pollutants in streams, lakes and rivers. Detailed studies of the amount of particular pollutants found in waters show that even when impervious cover is only 10 percent or less of a watershed, water quality can be negatively impacted.

When impervious cover is between 10 percent and 25 percent, the water quality is impacted and deteriorating. Over 25 percent impervious cover results in badly deteriorated surface water quality in the watershed streams and lakes. As development intensity increases, impacts on water quality and the need to carefully manage stormwater also increase.

Why Worry about Stormwater Runoff?

As stormwater runoff travels across the land surface, it picks up a number of pollutants that can pose serious health risks to humans and can disrupt and seriously damage water ecosystems. Under the Clean Water Act, regulations are in place requiring states to manage stormwater runoff.

Nonpoint source pollution is pollution that has no specific source, but is caused by a variety of pollutants that are present in stormwater runoff. The pollutants include the following:

- ***Nutrients***, including nitrogen and phosphorus, are needed for plant growth and are bound to the soil. However, high levels can cause a health hazard in drinking water. They also stimulate excessive aquatic plant growth and lower dissolved oxygen levels in the water, causing fish and other aquatic life to be smothered. Algae blooms are examples of how excess nutrients pollute. Sources of excess nutrients include soil erosion in uplands, stream banks and channels; animal waste; fertilizers and septic systems.
- ***Pathogens*** are disease-causing bacteria and viruses associated with the presence of fecal or animal waste matter. They affect human health directly through water contact or ingestion and through consumption of shellfish. Sources include failing sewer or septic systems or animal waste runoff.
- ***Sediment*** is made up of fine particles of eroded soil or sand. Sediment in excessive quantities smothers aquatic life, carries pollutants, like nutrients and heavy metals that are bound to soil particles, and makes water cloudy. Common origins are sites cleared of vegetation for construction, timber harvest and farming. Stream bank erosion and channel incision are also major sources of sedimentation.
- ***Toxic contaminants*** include such substances as heavy metals and pesticides. Because they resist breakdown and accumulate in organisms (bioaccumulation), they threaten the food chain. Sources include industrial (including certain power plants), commercial, household and agricultural chemicals and toxics from auto emissions.
- ***Debris*** consists of trash such as old tires, shopping carts and floatables, like plastics. It comes from illegal dumping and street litter. It threatens aquatic life and detracts from recreational and aesthetic values.
- ***Thermal stress***, or elevated water temperature, reduces survival rates and disease resistance of valued native species such as brook trout and allows the spread of non-native (exotic) species, thereby negatively impacting biologic diversity. Causes include increased pavement near streams and loss of vegetated stream buffers.

What Must Municipalities Do?

Plan to Protect and Manage Water Quality

Stormwater management is not optional. Under the requirements of the federal Clean Water Act, New Jersey adopted stormwater regulations in 2004 requiring municipalities and schools to manage stormwater runoff. But even if the state hadn't put regulations in place, your town would need to deal with stormwater to lessen flooding and contamination of water resources. Municipal officials can manage and prevent such problems by implementing a comprehensive stormwater management plan and a stormwater ordinance to establish strict standards for new development.

Decisions town officials make have a direct impact on the quality of the state's streams and lakes, many of which serve as our drinking water sources. Municipalities control land use. What is on the land is directly reflected in the quality of our rivers, streams and reservoirs. New buildings and roads change the surface of the land and change the way precipitation behaves after it falls on the land. Comprehensive stormwater management can prevent flash floods and significant water pollution from nonpoint sources.

Master Plan

Planning to prevent stormwater runoff problems — source control — is the first step municipalities can take. The municipal **master plan** provides an excellent opportunity to protect streams and lakes. The intent and purpose of the Municipal Land Use Law (MLUL) (N.J.S.A. 40:55D-2) clearly includes protection of natural resources. The law requires municipal master plans to provide a statement of the objectives and policies upon which other elements of the master plan are based.

For example, protection of a particular river or lake may be among the stated objectives of a master plan. This goal would provide the basis for a **greenway plan** along the stream or lake, or a stream or lake buffer zone. A more general objective could be protection of water resources.

A master plan should be based on a municipality's physical characteristics, usually described in a natural or environmental resources inventory (ERI). Typically, the inventory identifies the location of wetlands, steep slopes, forests, rivers, lakes, and aquifers. It describes the soils and the geology as well as the cultural resources. It identifies areas suitable for development as well as those needing protection.

The town's ERI and stormwater management plan should call upon one another and both should be consulted when it's time for reexamination of the master plan, as required every ten years.

A town's master plan should also include an assessment of and a plan for the infrastructure needed to serve anticipated development. In other words, the amount of growth projected by the master plan requires planning for adequate roads, stormwater facilities, water supply and wastewater treatment facilities.

New Jersey's 2004 NJ stormwater regulations require towns to adopt a stormwater management plan that then becomes part of the master plan. As an element of the master plan, a comprehensive stormwater management plan will help a municipality protect water resources as it develops and redevelops. A stormwater management plan needs to deal with runoff on a watershed, subwatershed or drainage area basis. Towns should insure that the stormwater plan reflects coordination with upstream and downstream neighbors. Lake communities need to work together to establish mutually beneficial stormwater strategies to protect the lake.

Contents of Stormwater Management Plan

By law, every municipality must have a stormwater plan, but newer land use officials may not be aware of the plan or familiar with its contents. A model stormwater management plan can be found as an appendix to the Stormwater Best Management Practices (BMP) manual from the New Jersey Department of Environmental Protection (NJDEP). Here are the basic elements:

- Natural stormwater management areas — certain land areas possess a more direct relationship to stormwater than others because they either absorb or hold stormwater, or because altering them greatly increases stormwater runoff (i.e. steep slopes). The stormwater management plan should take advantage of and protect these critical areas in order to avoid the costs of negative stormwater impacts. The plan should include protection of the natural stormwater management areas that a natural or environmental resource inventory has identified, including floodplains, wetlands and steep slopes (See box on page 4). Stormwater management plans should ensure maximum infiltration to reduce flooding and maximize groundwater recharge.* Particular water bodies also call for special protection from stormwater runoff to protect water quality. For example, the stormwater regulations require 300-foot buffers adjacent to Category One streams.**
- Identification of each waterway's watershed area and a description of land use, topography, and soils. Delineation of a waterway's watershed or drainage area is central to planning for stormwater management.

* See Spring 2006 *ANJEC Report* article by Abigail Fair, "Stormwater Best Management Practices in Site Plan and Subdivision Review."

** See Spring 2007 *ANJEC Report* article by John Thonet, "Municipal Regulatory Powers in Category One Stream Buffers."

Natural Stormwater Management Areas Identified by a Natural or Environmental Resource Inventory

Tying the stormwater ordinance to the ERI helps to identify natural areas in need of protection from stormwater runoff.

Floodplains

A stream consists of the stream channel and adjacent floodplain. Floodplains give space for water to spread out during flood events that occur whenever the amount of water in a stream channel exceeds the capacity of the channel to carry it. The effects of flooding are intensified when the floodplain becomes restricted. When sediment is deposited in the river channel, the capacity of the channel to carry floodwater is decreased. Increased runoff from upstream development in the watershed, while not addressed in the NJDEP stormwater regulations, increases erosion and pollutants carried in the stormwater runoff.*

Wetlands

Wetlands are areas that support distinctive types of vegetation that can grow and reproduce despite periodic inundation of water. Wetlands provide several important functions:

- filtration of stormwater;
- moderation of weather extremes;
- flood storage during heavy precipitation;
- replenishment of groundwater and stream base flows during dry weather because of their absorptive capacity;
- habitat for animals and plants.

Whether or not NJDEP issues a permit to fill an isolated wetland, that wetland likely provides stormwater management benefits that need to be strongly considered in the modification of a site.

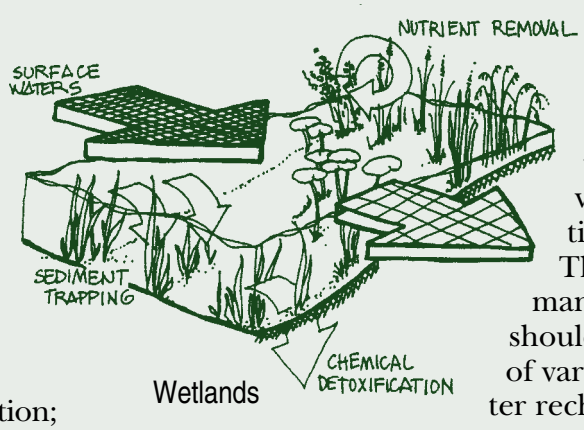
* See Winter 2008 *ANJEC Report* article "Streams and the New Flood Hazard Area Regulations" by Abigail Fair).

Steep Slopes

Steep slopes consist of slopes of over 15 percent. Their disturbance can cause rapid increase in the rate of runoff and serious erosion problems. To address this issue, Lambertville strengthened its steep slope ordinance to consider the stormwater impacts of development by requiring a reduction in allowed impervious surface as a penalty for building on steep slopes. The ordinance also contains measures to protect downstream properties from the disturbance.

Groundwater Recharge Areas

Areas of well-drained soil with extremely good infiltration capability allow stormwater to replenish groundwater supplies. Their disturbance must be carefully planned to maintain their recharge potential and to prevent contamination by pollutants. The stormwater management plan should identify areas of varying groundwater recharge rates.



Wetlands

Stream Headwater Areas

Land areas characterized by seeps, springs or intermittent surface water drain into ephemeral or intermittent waterways at the source of flowing streams. Ephemeral streams carry water during and immediately after rain. Intermittent streams carry rain irregularly depending on precipitation and groundwater conditions. Both types of waterways have little or no capacity to assimilate polluted runoff.

- Assessment of waterway hydrology and hydraulics. This assessment will determine the waterway's channel capacity and the physical characteristics of the stream's watershed that will affect flow. The assessment should also include monitoring to obtain baseline data against which future monitoring can be measured.
- Identification of stormwater problems, retrofit opportunities and a prioritized schedule to address them. Identifying stormwater problems sets the stage for corrective action. It also provides a list that can be acted on when funding becomes available. Prioritizing stormwater problem areas for improvement enables municipalities to budget adequately over time.

- A map of existing stormwater management infrastructure, including consideration of downstream infrastructure capacity.
- A maintenance schedule for municipally owned facilities. The schedule should include regular street sweeping, with more frequent sweeping in heavy traffic areas. It should also include regular cleanout of stormwater catch basins and facilities.
- A stormwater ordinance. (See NJDEP's model stormwater ordinance in the BMP manual at *http://www.state.nj.us/dep/stormwater/bmp_manual/NJ_SWBMP_D.pdf*)
- Education for residents to encourage prevention of nonpoint source pollution.

What Else Can Municipalities Do?

Zoning and Land Use Ordinances

Zoning to Protect Water Quality

Zoning ordinances based on a comprehensive master plan provide the next step municipalities can take to protect water resources (referred to as source controls) and complement stormwater management plans.

Impervious cover limitations in the zoning schedule of bulk requirements limit the amount of land that can be covered by buildings, parking lots, roads and other impervious surfaces in different zones. The scientific findings on the impact of impervious cover on water quality provide a legally defensible basis for lower limits.

Large-lot zoning for ten or more acres may be appropriate in some cases to lessen stormwater management needs by reducing the amount of land disturbance to a size where stormwater can be managed wholly within the confines of the lot.

Lot-size averaging in particular zones enables municipalities to provide design flexibility for subdivision layout to promote resource protection. Some lots in a subdivision may be less than the standard minimum lot size, provided that other lots are larger than the minimum to protect environmentally sensitive areas from disturbance. Ordinance requirements should include:

- minimum parcel size allowed;
- designating the zones where allowed;
- limiting the resulting number of lots to equal the total allowed under the conventional zoning;
- requiring deed restrictions to prohibit further subdivision of lots larger than that allowed under conventional zoning.

Open space/cluster ordinances in specified zones require that a certain percentage of a site be preserved as open space, preferably to protect sensitive natural resources as well as provide desirable aesthetics. In exchange for dedicated open space, development is allowed on smaller lots than required by conventional zoning. A deed restriction on the dedicated open space assures its preservation in perpetuity.

Planned Unit Development (PUD) is a designed grouping of varied and compatible land uses, all within one contained development or subdivision, that permits a developer to meet overall community density and land use goals without being bound by existing zoning requirements.In certain zones a PUD can provide the same benefits as open space/cluster ordinances.

Noncontiguous cluster ordinance provisions have excellent potential to complement stormwater management efforts. The MLUL allows for residential clustering on non-contiguous areas to be developed according to a plan that concentrates residential housing units and preserves open space. The open space can be separate from the housing and should be deed-restricted to protect open space that provides natural conditions for recharge, for protection of vegetation or other features.

Overlay zoning enables municipalities to protect natural, cultural and other resources in more than one zone by establishing protection standards for specific resources that apply in any zone where the resource is located. For example, an overlay stream corridor protection ordinance establishes buffer requirements that include certain setbacks, no matter what zone the stream flows through.

Land Use Ordinances to Protect Water Quality

The ordinances establishing requirements for site plan and subdivision applications carry out the intent of the zoning and master plan. These ordinances are very important for protecting water resources. Techniques for managing precipitation where it falls at the source (called source management) accomplish important water quality and quantity functions.

Stormwater Management Ordinance

DEP's regulations (NJAC 7:8) require towns to adopt a stormwater management ordinance calling for "no net change" in volume and quality as well as use of non-structural BMPs. The stormwater ordinance will be effective only if it reflects these newer requirements, which many municipal and

civil engineers are just learning how to incorporate and apply in site plan review. Environmental commissions should question local land use board engineers and determine their experience with the stormwater regulations, and especially the "no net change" provisions and the use of nonstructural BMPs.

Stormwater management ordinances attempt to prevent increases in post-development volume, velocity (peak runoff rates) and negative water quality changes. To accomplish these goals, stormwater management requires calculation of peak rates of stormwater runoff before and after development so the increased runoff and reduced quality can be addressed. The state rules must address stormwater management for land disturbances of one acre or greater or one-quarter acre or more increase in impervious surface. N.J.A.C. 7:8-1.2. Municipalities may enact ordinances to address stormwater below NJ DEP thresholds, and some have done so.

PRINCIPLES

Stormwater management ordinances should be based on the following principles:

- mimic natural stormwater behavior;
- minimize disturbance of the site and retain natural features that perform stormwater functions;
- minimize impervious surfaces;
- disconnect impervious surfaces to provide opportunities for infiltration;
- use structural stormwater management facilities only after non-structural site opportunities are exhausted.*

STANDARDS

For residential development, regulations adopted by the Department of Community Affairs require municipalities to use the stormwater standards in the *Residential Site Improvement Standards (RSIS)* N.J.A.C. 5:21. These standards specify methods for calculating runoff and sizing stormwater collection and conveyance structures and the size storms to be used for quantity and quality control. The regulations do not require that the standards be applied to commercial development, so municipalities are free to adopt the same or other standards for stormwater management on commercial or industrial tracts.

* See Spring 2006 *ANJEC Report* article by Abigail Fair – "Stormwater Best Management Practices in Site Plan and Subdivision Review."

MAINTENANCE REQUIREMENTS

The ordinance should require submission of a stormwater maintenance plan with all development applications. At a minimum, the maintenance plan should include:

- specific maintenance tasks and schedules for each type of stormwater management facility used on the site (One benefit of nonstructural facilities is that they typically require less maintenance than structural types);
- consideration of the guidance in the *N.J. Stormwater Best Management Practices Manual* by NJDEP;
- a program of water quality monitoring and reporting to measure the effectiveness of the stormwater management plan;
- where monitoring demonstrates that implementation of the plan has not achieved the results anticipated, a provision for review of and revision to the plan;
- responsibility for maintenance should be clear to ensure long term compliance. If the municipality is not the responsible party, provision should be made for the municipality to perform needed maintenance and to charge the property owner. Some towns specify a date in the ordinance for yearly reporting by the applicant to alert the municipality that maintenance has been performed.
- recording, where appropriate, upon the deed of record for the property.

BEST MANAGEMENT PRACTICES (BMPs)

The ordinance should require use of BMPs where appropriate. BMPs are nonstructural and structural techniques for managing stormwater. NJDEP regulations require use of nonstructural techniques over structural ones wherever possible. (See box on pages 8 and 9.)

Other Land Use Ordinances

Other ordinances that control subdivisions and site plan development that are especially helpful for water resource protection:

Critical area ordinances regulate and provide design standards for environmentally sensitive areas. Such ordinances must state their purposes clearly and define the critical areas, e.g., steep slopes, floodplains, high water table soils, poorly drained soils, shallow depth to bedrock, streams, aquifer recharge areas. The ordinances set up specific techniques to protect these areas, including those described separately below.

Aquifer recharge protection ordinances identify recharge areas and prohibit uses that have potential negative impacts on groundwater. Such uses include gas stations, dry cleaning on site, onsite photographic development, or industrial yards. The ordinance also requires that development proposals maximize recharge of clean water.

***Lot* grading** requirements can insure that stormwater does not negatively impact off-site or off-tract properties. Some municipalities impose increasingly strict grading restrictions for varying degrees of steep slopes.

Pooper scooper ordinances require owners to pick up after their pets. Studies show that high levels of fecal coliform related to pet wastes are common in suburban and urban waterways.

Setback requirements can be reduced to shorten driveway lengths.

Shade tree protection ordinances protect trees from unnecessary cutting and may require tree replacement. Trees, with their evapotranspiration functions, are especially important to maintain the hydrologic or water cycle. The tree canopy breaks the force of the rain, while leaves intercept and hold precipitation and the tree litter and roots reduce the total volume of runoff by absorbing it in varying amounts, depending on the specific site and the season.

Soil movement ordinances regulate disturbance, removal or fill to minimize erosion and prevent soil compaction to lessen stormwater runoff.

Steep slope protection ordinances help to prevent and minimize erosion and sedimentation from stormwater runoff by regulating the amount of disturbance allowed on varying degrees of slope, usually starting with 15 percent slopes and higher.

Stream or riparian corridor ordinances establish vegetated buffers or setbacks from streams or lakes to provide overland flow through the vegetated buffer for filtration of stormwater runoff before it reaches the waterway.

Usable yard or lot area ordinances insure that residents on newly created lots have yard areas to use and enjoy. Ordinances define yards, lot areas and minimum area requirements and require that the usable contiguous yard area be outside of floodplains, wetlands, wetland buffer areas, stormwater detention basins, utility easements, water courses and steep slopes of certain percentages.

Wellhead protection ordinances establish zones of protection around wells to prevent pollutants from entering groundwater. NJDEP has established methodologies to determine the size of the zone by calculating the time of travel of polluted groundwater. For technical support, contact the DEP Bureau of Safe Drinking Water at (609) 292-5550.

What Else Can Municipalities Do?

Retrofit/Redevelopment

Stormwater management should also address existing development. Until recently, engineers and planners did everything possible to get stormwater runoff away from buildings, yards, parking lots and streets. The consequences of these practices are all too easy to document in higher peak flows and reduced low flows in our streams that translate to flash flooding when the same precipitation event under natural conditions would have resulted in no flood event and drought conditions when there is no regional causation. Only recently has any serious attempt been made to change the traditional treatment of stormwater runoff. Redevelopment offers good opportunities for introducing newer stormwater practices such as BMPs to protect water quality.

This section lists some retrofit and redevelopment possibilities. More specific information on retrofitting is available in the *NJDEP BMP Manual*. The *Manual* points out that many BMPs can be successfully integrated into existing development. For example, many older dry detention basins have excessive sediment build-up, litter and debris, and obstructed or malfunctioning outlet structures. Use of BMPs can reduce or eliminate these problems.

Correcting older construction practices can be very challenging and expensive, but municipalities can gradually retrofit existing stormwater management structures to manage associated expenses to improve water quality. Retrofit and redevelopment projects include:

- retrofitting catch basins with filtering devices to catch particulates and litter. Such retrofits require frequent cleaning or replacement;
- installing manufactured treatment catch basins that can augment the existing stormwater management system. These structures use filtration chambers or materials, vegetative components, or special flow characteristics to remove pollutants from stormwater;
- installing sand filters adjacent to impervious areas where there is no stormwater treatment;

(Continued on page 10)

Best Management Practices (BMPs)

Nonstructural BMPs

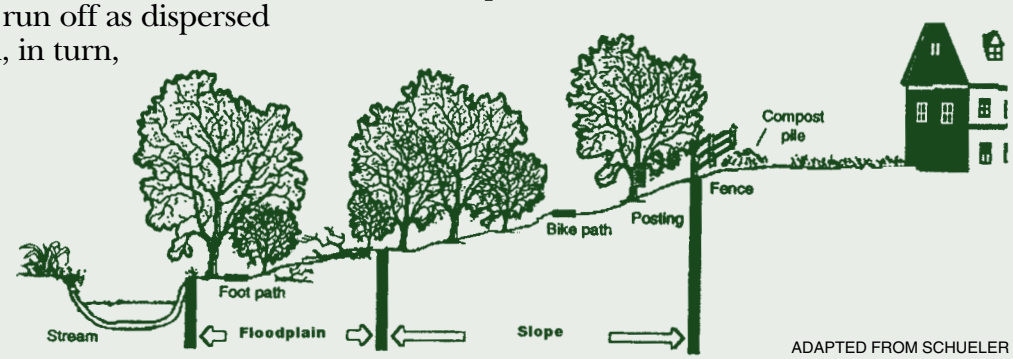
Nonstructural BMPs usually reduce the amount of work structural controls have to perform. For much more comprehensive information about BMPs, please refer to the *Stormwater Best Management Practices Manual* available on the NJDEP web site at *http://www.nj.gov/dep/stormwater/bmp_manual2.htm* or by calling 609-292-0407.

Dispersion rather than concentration of stormwater flows reduces velocity and allows for infiltration. Managing runoff at various smaller drainage areas on a site rather than collecting it into one area more closely mimics natural runoff conditions. Cuts in curbs can spread runoff from a parking lot over a large area. When combined with a swale (a broad lineal depression that conveys water) with enhanced infiltration, this technique is very effective. Flush curbing, where appropriate, allows stormwater to run off as dispersed sheet flow, which can, in turn, flow to vegetated swales.

Filtration through use of vegetation (grasses, reeds, rough groundcover), swales or strips allows particulates and sediment to settle out of stormwater. This is an effective way of pretreating runoff before it reaches detention or retention areas. It can reduce maintenance requirements for these structural stormwater elements.

Retention of natural vegetation promotes filtration and infiltration. It helps disperse runoff, can provide uptake of pollutants and can discourage wildlife such as geese that produce a high amount of fecal coliform in their waste. Many corporate headquarters are now reducing the amount of mown lawns and leaving a good portion of the site in meadow. The difference in texture also offers aesthetic variety in an otherwise homogenous landscape.

Stream buffers provide opportunities for infiltration and filtration of pollutants before stormwater can reach waterways. In creating a buffer, native plant material should be used and the site should be closely monitored for at least the first full season to insure the plants don't dry out and are protected from animals. NJDEP's Flood hazard Area Regulations require buffers for both flood hazard and riparian areas.



Stream Buffers

The book *Watershed Management Strategies for New Jersey*, Cook College, Rutgers University, Department of Environmental Resources, April 1989 recommends the following buffers:

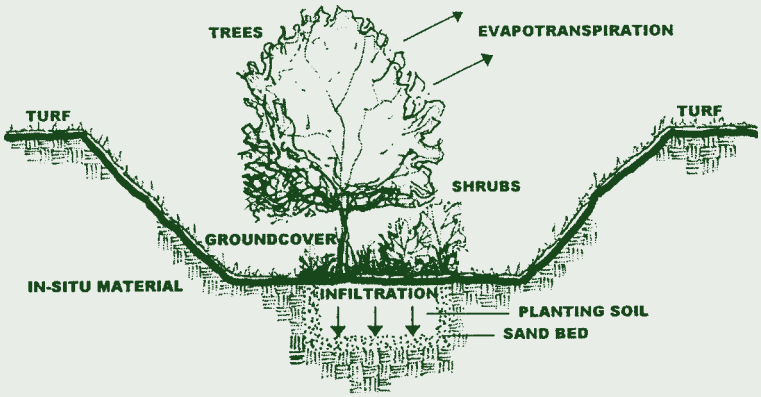
Function	Buffer Width from Water's Edge
Sediment control.	50 – 200'
Streambank and streambed erosion control	25 – 213'
Nutrient and pollutant removal	50 – 300'
Reservoir protection	75 – 300'
Stream temperature control	25 – 200'
Aquatic species protection	25 – 50'
Wildlife habitats protection	200 – 300'

(Continued on page 9)

Best Management Practices (BMPs) *(continued from page 8)*

Structural BMPs

Bioretention systems can remove pollutants, provide infiltration and help to moderate runoff volumes. They are more suitable for water quality treatment than quantity control. A bioretention facility should not be located in areas of high water table, where mature trees would have to be removed, or where slopes are greater than 10 percent.



Bioretention Basin

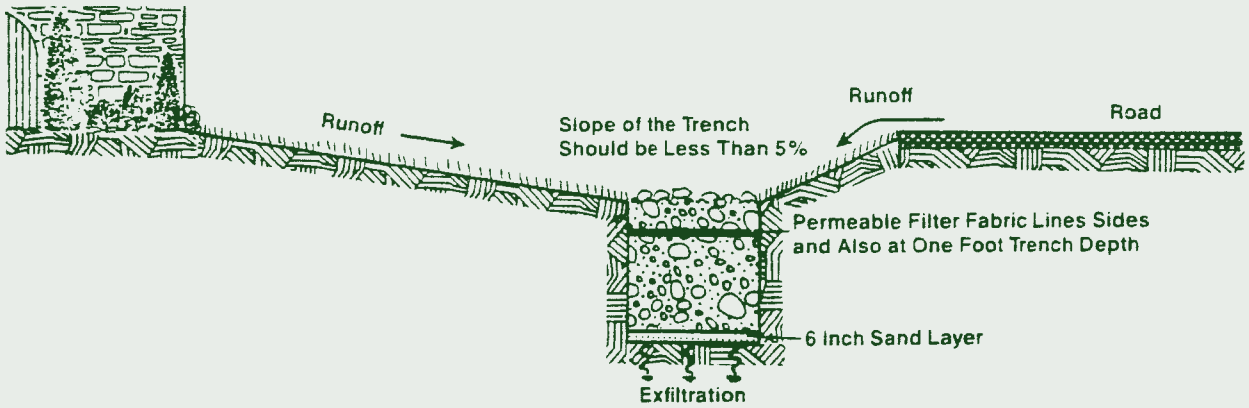
Infiltration techniques reduce surface runoff and help maintain base flow to streams by recharging clean stormwater into the earth. Infiltration techniques include dry wells, infiltration trenches, and pervious pavers underlain with gravel to promote percolation. Prior water quality treatment will help prevent clogging and reduce the need for maintenance. Infiltrating roof runoff is an excellent way to recharge clean water and to reduce the volume of stormwater that will have to be managed on site.

Dry wells are pits at least three feet deep that are filled with gravel and used primarily to collect roof runoff. Dry wells are suitable for infiltration of clean runoff that is free of sediment. Soil should be permeable and without high water tables.

An *enhanced swale* is a swale that is lined with a gravel base to promote infiltration. To prevent erosion, the slopes should be vegetated and, when side slopes or velocities demand, reinforced.

Pervious pavement material such as paving blocks, concrete grid pavers, perforated brick pavers, and compacted gravel allow infiltration. They are designed to provide a strong, noncompactible surface for parking or little used parts of a road such as for emergency access. Pervious pavement is suitable where infiltrated runoff will move through three feet of unsaturated soil. Pervious asphalt material can provide infiltration but requires very high maintenance with vacuum equipment.

Sand filters are typically water quality treatment systems constructed to handle runoff volume from small, high-intensity storms. They are used to remove or reduce stormwater pollutants before the stormwater reaches the stormwater conveyance system. Sand filters are ideal for use where impervious areas are small and carry low amounts of sediment. They are not effective where there are extended freezing periods.



Enhanced Swale

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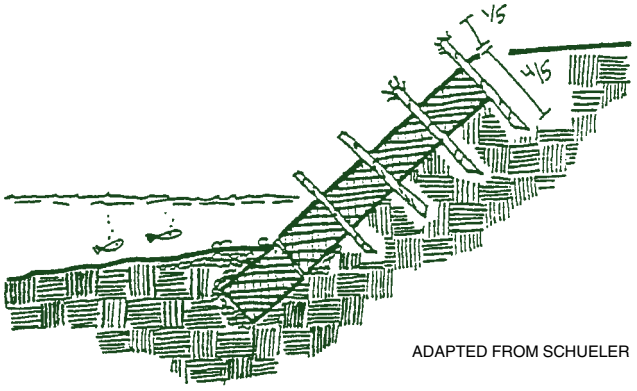
- installing wetland plants to retrofit detention/retention facilities for filtration and pollutant uptake;
- installing a riser pipe with a 3-inch orifice in a dry detention facility to prevent the first flush of pollutants from leaving a detention facility;
- removing concrete low flow channels to mitigate pollutant inflow being directed to the outlet structure and planting them to promote absorption and give pollutants time to settle;
- construction of basin internal berms (bumpers) to meander the flows to promote settling;
- installing trash racks to catch litter and debris before they enter detention or retention areas;
- converting impervious surfaces to pervious ones by requiring redevelopment projects to promote infiltration with alternatives like grassed pavers instead of pavement for excess parking areas;
- creating sunken rather than raised vegetated islands in cul de sacs or parking areas during redevelopment;
- requiring dry wells where appropriate for redevelopment projects or amended site plans;
- initiating a shade tree planting program for the significant evapotranspiration function trees provide;
- requiring tree planting in redevelopment projects.

Streambank Stabilization

Most suburban and urban, and some rural, streambanks have suffered substantial damage from old-time stormwater management practices. The primary damage is erosion caused by increased volumes and velocities of stormwater. The increased rate and volume of flow can gouge out vulnerable sections of the streambank, undercut vegetative growth, and deposit sediment downstream.



Streambank Stabilization

Actions to repair streambanks can range from simple revegetation to actual streambank reconstruction and can require consultation with experts in the field. Actions also can range from simple, practical protection measures to a combination of the practical with aesthetic improvements that provide real public enjoyment. Flood hazard area disturbance permits may be required.

EPA Phase II Stormwater Permits

The NJDEP adopted regulations in 2004 to implement federal EPA stormwater requirements for municipalities, large public complexes and highway agencies. EPA requires municipalities to address stormwater not only for new development, but also the results of uncontrolled runoff from existing developments.

The NJDEP regulations (*N.J.A.C.* 7:8) also include:

- Public education and outreach about nonpoint source pollution. Topics could include recycling (helps eliminate litter that flushes into storm sewers), water conservation, composting, use of rain barrels, reducing use of fertilizers and pesticides, shade tree protection and planting, and use of groundcover to replace lawns. Polls have shown that people want drinking water protected, and outreach efforts help communicate what your town is doing about it.
- Detection and elimination of illicit discharges to storm sewer systems. Public entities will have to map stormwater outfalls and establish a schedule for regular inspection of pipe outfalls to detect illicit discharges.
- Good housekeeping practices in public works yards and municipal streets. These include covering road salt and sanding materials, storage areas, regular street sweeping, periodic and regular cleanout of stormwater facilities and scheduled maintenance of stormwater catch basins and conveyance structures.
- Runoff control for new construction sites of an acre or larger to control soil erosion and sedimentation. Environmental commissions should monitor projects after approval by the planning board or zoning board of adjustment to ensure compliance with stormwater rules.
- Public involvement and participation in formulation of the stormwater plan.

Municipal Opportunities

An excellent educational resource for town boards and residents, available through ANJEC, is the nationally recognized Nonpoint Education for Municipal Officials (NEMO) program, developed by the Connecticut Extension Service. It provides useful illustrations and information about nonstructural stormwater management. ANJEC has adapted this presentation for New Jersey municipalities. Contact ANJEC at 973-539-7547 or *info@anjec.org* to schedule an ANJEC road show presentation.

Use of Integrated Pest Management (IPM) on public lands can substantially reduce runoff of pesticides into waterways. IPM is a system that encourages use of the minimal amount of the least toxic pesticide to control pests. A number of towns and school systems have adopted IPM to reduce use of pesticides on town-owned land.

Local school boards are independent of municipalities and are subject to the NJDEP regulations. To involve schools, towns should invite participation by staff or students in formulating a town's stormwater plan. This involvement will encourage "buy-in" by students and parents. School grounds and parking lots should be subject to the same good housekeeping practices that the municipality will use in public works yards and municipal streets. Towns should provide students and teachers with the nonpoint source pollution information because students can be very effective at encouraging their families to adopt actions for effective stormwater management. Towns can also encourage use of IPM on school grounds.

Conclusion — It's Not Just About Stormwater

Municipalities, as the political entities responsible for land use in New Jersey, have the duty to ensure clean drinking water supplies by providing meaningful protection for the state's waters. Cooperation with adjacent municipalities will enhance municipal efforts to clean up and protect rivers, streams and lakes as these water resources go beyond town boundaries. Such efforts fit into other municipal objectives — aesthetics improvement, open space preservation, shade tree protection, passive recreation opportunities, air quality and community livability. It's not just about stormwater.

Useful Internet and Telephone Links

ANJEC
973-539-7547 *www.anjec.org*

Center for Watershed Protection
410-461-8323 *www.cwp.org*

EPA Office of Water
202-566-1155 *www.epa.gov/owow/nps*

EPA Surf Your Watershed
202-566-1729 *www.epa.gov/surf/*

EPA National Pollutant Discharge Elimination System (NPDES)
202-564-6773 *www.epa.gov/npdes*

Landscape Change
732-932-1582 *http://crssa.rutgers.edu/projects/lc/*

International BMP Case Study Database
303-480-1700 *www.bmpdatabase.org*

NEMO (Nonpoint Education for Municipal Officials) Program
860-345-4511 *http://nemo.uconn.edu/index.htm*

N.J. DEP Stormwater
609-733-7021 *www.njstormwater.org*

N.J. DEP Watershed Management
609-984-0058 *www.state.nj.us/dep/watershedmgt*

Nonpoint Source News
202-566-1207 *www.epa.gov/owow/info/NewsNotes*

Stormwater Center
410-461-8323 *www.stormwatercenter.net*

USGS National Water-QualityAssessment
703-648-5716 *water.usgs.gov/nawqa*

Watershed Associations and Other Links

Bergen Save the Watershed Network
201-666-1877 *www.Bergenswan.org*

Delaware Riverkeeper
215-369-1188 *www.delawareriverkeeper.org*

Great Egg Harbor Watershed Association
856-697-6114 *http://www.gehwa.org/*

Great Swamp Watershed Association
973-966-1900 *www.greatswamp.org*

Hackensack Riverkeeper
201-692-8440 *www.hackensackriverkeeper.org*

New Jersey Watershed Institute
609-737-3735 *www.thewatershedinstitute.org*

New York/New Jersey Baykeeper
732-291-0176 *www.nynjbaykeeper.org*

Passaic River Coalition
908-766-7550 *www.passaicriver.org*

Skylands CLEAN
973-616-1006 *www.skyclean.org*

South Branch Watershed Association
908-782-0422 *http://www.sbwa.org/*

Stony Brook Millstone Watershed Association
609-737-3735 *www.thewatershed.org*

Upper Raritan Watershed Association
908-234-1852 *www.urwa.org*

Useful References

A Cleaner Whippany Watershed. Nonpoint Source Pollution Control Guidance for Municipal Officials, Engineers and Dept. of Public Works. NJDEP, Trenton, NJ, 2000.
http://mss3.libraries.rutgers.edu/dlr/showfed.php?pid=rutgers-lib:31679

Better Site Design: A Handbook for Changing Development Rules in your Community. Center for Watershed Protection, Ellicott City, MD, 1999.
www.stormwaterpa.org/assets/media/resources/ELC_BSDpart1.pdf

Methods for Measuring and Estimating Impervious Surface Coverage. NEMO Technical Paper. Nonpoint Education for Municipal Officials. University of Connecticut Cooperative Extension System, Haddam, CT.
http://nemo.uconn.edu/publications/tech_papers/tech_paper_3.pdf

Municipal separate storm sewer system [MS4], (EPA).
http://cfpub.epa.gov/npdes/stormwater/munic.cfm

Municipal Stormwater Regulation Program: 2010 Status Summary Report, NJ Department of Environmental Protection (DEP), Trenton, NJ.
http://www.state.nj.us/dep/dwq/pdf/2010_msrp_summary_report.pdf

N.J. Stormwater Best Management Practices Manual.
NJ Department of Environmental Protection (DEP), Maps and Publications, Trenton, NJ, 2000.
www.state.nj.us/dep/stormwater/bmp_manual2.htm

NJ Stormwater Management Rules, N.J.A.C. 7:8, last amended: April 19, 2010, NJ Department of Environmental Protection (DEP). *http://www.nj.gov/dep/rules/rules/njac7_8.pdf*

Residential Site Improvement Standards (RSIS)
N.J.A.C. 5:21. Department of Community Affairs, Trenton, NJ.
www.state.nj.us/dca/divisions/codes/offices/rsis.html

Reviewing Site Plans for Stormwater Management. NEMO Project Fact Sheets. Nonpoint Education for Municipal Officials. University of Connecticut Cooperative Extension System, Haddam, CT.
http://nemo.uconn.edu/publications/fact_sheets/nemo_fact_sheet_7_s.pdf

Site Planning for Urban Stream Protection, Tom Schueler, Metropolitan Washington Council of Governments. Center for Watershed Protection, Ellicot City, MD, *http://openlibrary.org/books/OL101992M/Site_planning_for_urban_stream_protection*

Stormwater Runoff, Lost Resource or Community Asset? A Guide to Preventing, Capturing and Recovering Stormwater Runoff. Delaware Riverkeeper Network, Washington Crossing, PA, 2001.
http://www3.villanova.edu/VUSP/Outreach/pasym01/pdffiles/A14.pdf

Watershed Protection Techniques. A Quarterly Bulletin on Urban Watershed Restoration and Protection Tools. USEPA, Summer 1994; not published since 1994.

This publication was made possible by grants from the William Penn Foundation and the Environmental Endowment for New Jersey

Founded in 1969 at the beginning of the environmental movement, the Association of New Jersey Environmental Commissions is a statewide, nonprofit organization with a unique mission. We provide leadership, training, information, tools and support to our State's local environmental commissions, green teams and elected officials who are working to safeguard natural resources and promote sustainable land use in their communities.

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MIMI UPMEYER RESOURCE PAPER COLLECTION

ANJEC dedicates its collection of Resource Papers to Mimi Upmeyer, who worked for ANJEC for 10 years and later served as a board trustee. As our State Plan project director, she worked with environmental commissioners and local officials in towns across New Jersey and provided them with information and contacts to help implement good land use planning and zoning. To help local officials deal with these issues, she conceived the idea for ANJEC's Resources Papers – and wrote the first three. Packed with concise, practical information on specific topics for local environmental protection, ANJEC's ever expanding stock of Resource Papers, has become a standard element of our educational program. For a list of all our Resource Papers, contact ANJEC at 973-539-7547 or visit the Publications page on *www.anjec.org*.