A Citizen's Guide to Maintaining Stormwater Best Management Practices

For Homeowners Associations and Property Owners

Pitt County Stormwater Program

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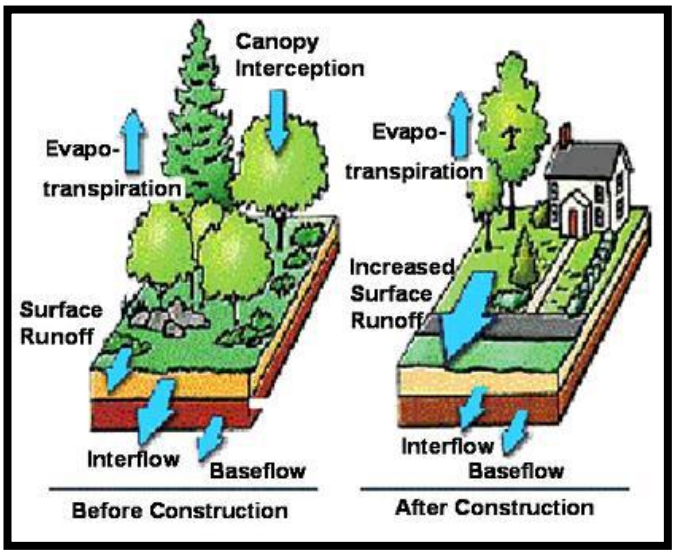
What is Stormwater Runoff?



Stormwater runoff is runoff water from rain that flows across the landscape. As runoff flows off of rooftops, paved areas, bare soil, and lawns, it gathers in increasingly large amounts (from ditches, to streams, and rivers) until it finally empties into the ocean. During this process stormwater picks up and transports many of the pollutants it encounters. These pollutants can include dirt, fertilizers, pet waste, pesticides, and automoblie fluids (e.g. oil, gasoline, and antifreeze). By carrying all these different kinds of pollution into our waterways, stormwater itself becomes a water pollutant. Development increases the amount of impervious areas present in our watersheds. By increasing the imperivous areas, we increase the runoff volume during a storm. As a result, the stormwater does not have an opportunity to soak into the ground where natural filtration of the runoff would otherwise occur (See Figure 1).

Water quality data in North Carolina clearly show that nitrogen and phosphorus loading is a major problem in Pitt County's watersheds. Phosphorus is a common ingredient of fertilizers, manure, and organic wastes in sewage and industrial effluent. While it is an essential element for plant life, too much of it in water can cause a reduction in dissolved oxygen. This process, known as eutrophication, can cause fish kills in our streams and rivers. Soil erosion is a major contributor of phosphorus to streams. Bank erosion occurring during peak flows can transport a lot of phosphorous from the river banks and adjacent land into a stream or river. Well-managed lawns and landscaped areas help protect water quality by reducing soil erosion and filtering pollutants. However, the fertilizers used to maintain these natural areas also contribute to the pollution of our waterways.

Nitrogen is another source of concern for Pitt County. Like phosphorous, nitrogen is a natural compound that is essential to life but becomes a threatening source of pollution when present in excessive quantities. The majority of nitrogen on the planet exists in the form of N_2 gas in the atmosphere and, in fact, composes 78% of the air we breathe. Nitrogen also naturally exists in the physical environment where it is found in a number of other forms called nitrates. The nitrates of most significance to Pitt County are those found in fertilizers and vehicle emissions. And, much like phosphorous, these nitrates are

collected by stormwater runoff and are eventually deposited into our streams and rivers. Research shows that nitrogen deposits from both urban and agricultural runoff account for the majority of nitrogen currently in our streams and rivers.

Therefore, it is necessary for Pitt County to address sources of nitrogen, phosphorus and other pollutants. The Board of County Commissioners adopted the Stormwater Ordinance in October 2004, making us responsible for improving and protecting the quality of water in our community. The goal of the Pitt County Stormwater Ordinance is to develop and implement stormwater pollution controls that will keep our waterways healthy. Healthy rivers and streams directly impact our property values and the quality of life that we enjoy. Our daily activities directly impact the quality of water around us. It is our responsibility to be a part of the pollution solution by controlling what we purposefully and inadvertently send to our rivers and streams.

Do You Have A Stormwater BMP?

BMP Terms

Best Management Practice (BMP) – A structural device or nonstructural practice designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution generated by nonpoint sources, and provide other amenities.

Buffer – A natural or vegetated area through which stormwater runoff flows in a diffuse manner so that the runoff does not become channelized and which provides for infiltration of the runoff and filtering of pollutants.

Drainage Easement – A legal right granted by a landowner to a grantee allowing the use of private land for stormwater management purposes.

Detention Pond – Temporary stores water before discharging; primarily used to reduce peak flow, but does not reduce runoff volume.

- **Dry Detention Pond** – Stores stormwater runoff, but dries following a rain shower. This devise is not effective at removing nutrients, but does reduce peak flow rates.
- **Wet Detention Pond** – Stores stormwater, but has a permanent pool of water, except for extended periods of no rainfall. This devise is more effective in removing nutrients than a dry detention pond.

Stormwater Wetland – Temporary store runoff in shallow pools that support conditions which are suitable for the growth of wetland plants. These plants uptake nutrients such as nitrogen and phosphorus.

Vegetated Swale – An open channel drainageway used to collect and convey stormwater and filter pollutants.

The term "Best Management Practices," or BMP, was introduced and defined by the U.S. Environmental Protection Agency as a practice or combination of practices that is an effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources.

What is non-point source pollution? Sources of non-point pollution include sediment, nutrients, motor oil, and lawn care products that run off hard surfaces and yards into drainage ditches and storm drains. These stormwater conveyance systems typically empty into nearby streams and rivers. A variety of local, state and federal laws, including the Pitt County Stormwater Ordinance for Nutrient Control and the federal Clean Water Act, encourage or require the control of non-point source pollutants using BMPs.

Do you have a BMP on your property or in your neighborhood? Ponds, ditches and depressions that you see every day may actually be engineered stormwater facilities designed to reduce flooding and improve water quality. As development occurs, land is covered by roads, driveways, rooftops and other hard surfaces that do not allow stormwater to infiltrate (or soak) into the ground. Without BMPs, the end result of development may be flooding and poor water quality in the adjacent streams and rivers.

The four most common BMPs in Pitt County are wet detention ponds, dry detention ponds, vegetated swales and stormwater wetlands. The long-term benefits of BMPs only obtained if the improvements are properly maintained.

Types Of Stormwater BMP's

Stormwater Wetland

Vegetation in stormwater wetland located adjacent to Pactolus Elementary School.

Stormwater wetlands are constructed systems similar to wet ponds that incorporate marsh plants in a shallow pool. As stormwater runoff flows through the wetland, pollutants are naturally removed by different chemical and biological processes as the water is filtered through the wetland soil. Wetlands are one of the most effective stormwater practices in terms of removing pollutants, and they also offer aesthetic value. While natural wetlands can sometimes be used to treat stormwater runoff that has been properly pretreated, stormwater wetlands are fundamentally different from natural wetland systems. Stormwater wetlands are designed specifically for the purpose of treating stormwater runoff, and typically have less biodiversity than natural wetlands both in terms of plant and animal life. There are several design variations of the stormwater wetland, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland.

In addition to regular maintenance activities, several design features can be incorporated to ease the maintenance burden of stormwater wetlands. One potential maintenance concern in stormwater wetlands is clogging of the outlet. Wetlands should be designed with a non-clogging outlet or a weir outlet with a trash rack. Wetlands should incorporate design features that make sediment cleanouts of both the forebay and the shallow pool easier. Wetlands should have direct maintenance access to the forebay, to allow relatively routine (five to seven years) sediment cleanouts. In addition, the shallow pool should generally have a drain to draw down the wetland for the more infrequent dredging of the main cell of the wetland. Typical maintenance activities are included in Table 1.

Table 1. Maintenance Activities for Wetlands	
Activity	**Schedule**
**Official Inspection by a professional BMP Inspector, during which the date of the inspection; the condition of each BMP element; any maintenance work performed on the wetland; and any issues noted for future maintenance should be officially recorded and kept in a log.	Monthly and within 24 hours after every water quality storm (greater than 1.0 inches of rainfall).
Inspect for invasive vegetation (i.e. cattails) and remove.	Semi-Annual Inspection
• Inspect for damage to the embankment and inlet/outlet structures. Repair as necessary. If erosion persists, construct erosion control devices such as rip rap along the inlet embankment or reinforced turf matting. • Monitor for sediment accumulation in the facility and forebay. • Examine to ensure that inlet and outlet devices are free of debris and operational.	Annual Inspection
• Repair undercut or eroded areas.	As Needed Maintenance
• Clean and remove debris from inlet and outlet structures • Monitor side slopes for appearance of bare soil or erosive gullies. If necessary, re-grade the gully and plant new ground cover. Monitor plant growth until it is established. • Maintain the height of vegetation at approximately 6 inches.	Frequent (3-4 times/year) Maintenance
• Supplement wetland plants if a significant portion have not established (at least 50% of the surface area). • Harvest wetland plants that have been "choked out" by sediment build-up.	Annual Maintenance (if needed)
• Removal of sediment form the forebay.	5 to 7 year Maintenance
• Monitor sediment accumulations, and remove sediment when the pool volume has become reduced significantly.	20 to 50 year Maintenance

In addition, there are a few standard rules to consider in the maintenance of a stormwater wetland.

- Never apply fertilizer to the wetland unless you are planting new vegetation, which require an initial fertilization to establish.
- It is advisable to have a dam safety expert inspect the wetland inlet once annually.
- Never *spray* pesticide in the wetland. Any weeds should be removed by hand, but if a pesticide is deemed necessary, it should be applied to the plant(s) by hand.
- If any questionable circumstances relative to maintenance of a stormwater wetland arise, either the Pitt County Planning Department at (252) 902-3250, or the North Carolina Division of Water Quality 401 Oversight Unit at (919) 733-1786, should be contacted.

Landscaping of wetlands can make them an asset to a community, and can also enhance their pollutant removal. To ensure the establishment and survival of wetland plants, a landscaping plan should provide detailed information about the plants selected, when they will be planted, and a strategy for maintaining them. The plan should detail wetland plant species, as well as vegetation to be established adjacent to the wetland. A variety of techniques can be used to establish wetland plants. The most effective technique is the use of nursery stock as live potted plants, or bare root stock.

When developing a plan for wetland planting, care needs to be taken to ensure that plants are established in the proper depth and within the planting season. Planting season in Pitt County is generally during spring to early summer. Plant lists are available by contacting the Pitt County Planning Department at (252) 902-3250.

Dry Detention Pond

Dry detention ponds are basins whose outlets are designed to detain the stormwater runoff from a storm for a minimum duration (e.g., 24 hours) which allow sediment particles and associated pollutants to settle out. Unlike wet ponds, dry detention ponds do not have a permanent pool. However, dry detention ponds are often designed with small pools at the inlet and outlet of the pond.

In addition to regular maintenance activities needed to maintain the function of dry detention ponds. Several design features can ease the maintenance burden associated with a practice. In dry detention ponds, a "micropool" at the outlet can prevent re-suspension of sediment and outlet clogging. A good design also includes maintenance access to the forebay and micropool. Another design feature that can reduce maintenance needs is a non-clogging outlet pipe. Typical examples include a reverse-slope pipe, or a weir outlet with a trash rack. A reverse slope pipe draws from below the permanent pool extending in a reverse angle up to the riser and determines the water elevation of the micropool. Because these outlets draw water from below the level of the permanent pool, they are less likely to be clogged by floating debris. A vegetated buffer should be maintained around the pond, and plants within the detention zone (i.e., the portion of the pond up to the elevation where stormwater is detained) should be able to withstand both wet and dry periods. The side slopes of dry

Example of a dry detention basin.

ponds should be free of any erosion. Typical maintenance activities are included in Table 2.

Table 2. Maintenance Activities for Dry Ponds

Activity	Schedule
**Official Inspection by a professional BMP Inspector, during which the date of the inspection; the condition of each BMP element; any maintenance work performed on the detention pond; and any issues noted for future maintenance should be officially recorded and kept in a log.	Quarterly and within 24 hours after every water quality storm (greater than 1.0 inches of rainfall).
• Note erosion of pond banks or bottom.	Semi-Annual Inspection
• Inspect for damage to the embankment. • Monitor for sediment accumulation in the facility and forebay. • Examine to ensure that inlet and outlet devices are free of debris and operational.	Annual Inspection
• Repair undercut or eroded areas. • Mow side slopes. • Pesticide/ Nutrient management. • Perform Litter/ Debris Removal.	Standard Maintenance
• Seed or sod to restore dead or damaged ground cover.	Annual Maintenance (As needed)
• Removal of sediment form the forebay.	5 to 7 year Maintenance
• Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25%.	25 to 50 year Maintenance

Wet Detention Pond

Wet detention ponds are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). Ponds treat incoming stormwater runoff by settling and nutrient uptake. The primary removal mechanism is settling while stormwater runoff resides in the pool. Nutrient uptake also occurs through biological activity in the pond. Wet ponds are among the most cost-effective and widely used stormwater treatment practices.

One maintenance concern in wet ponds is potential clogging of the pond outlet. Ponds should be designed with a non-clogging outlet such as a reverse-slope pipe, or a weir outlet with a trash rack. A reverse slope pipe draws from below the permanent pool extending in a reverse angle up to the riser and establishes the water elevation of the permanent pool. Because these outlets draw water from below the level of the permanent pool, they are less likely to be clogged by floating debris. Another general rule is that no low flow orifice should be less than 2" in diameter (smaller orifices are more susceptible to clogging).

Direct access is needed to allow maintenance of both the forebay and the main pool of wet detention ponds. In addition, wet detention ponds should generally have a drain to draw down the pond or forebay to enable periodic sediment clean outs.

Landscaping of wet detention ponds can make them an asset to a community, and can also enhance the pollutant removal. A vegetated buffer should be created around the pond to protect the banks from erosion, and provide some pollutant removal before runoff enters the pond by overland flow. In addition, ponds should incorporate an aquatic bench (a shallow shelf with wetland plants) around the edge of the pond. This feature provides some pollutant uptake, and also helps to stabilize the soil at the edge of the pond and enhance habitat and aesthetic value. Typical maintenance activities are included in Table 3.

Table 3. Maintenance Activities for Wet Ponds

Activity	Schedule
**Official Inspection by a professional BMP Inspector, during which the date of the inspection; the condition of each BMP element; any maintenance work performed on the detention pond; and any issues noted for future maintenance should be officially recorded and kept in a log.	Monthly and within 24 hours after every water quality storm (greater than 1.0 inches of rainfall).
• Inspect for damage. • Monitor for sediment accumulation in the facility and forebay. • Examine to ensure that inlet and outlet devices are free of debris and operational.	Annual Inspection
• Repair undercut or eroded areas.	As Needed Maintenance
• Clean and remove debris form inlet and outlet structures. • Mow side slopes.	Monthly Maintenance
• Removal of sediment form the forebay. .	5 to 7 year Maintenance
• Monitor sediment accumulations, and remove sediment when the pool volume has become reduced significantly.	20 to 50 year Maintenance

Vegetated Swales

The term "swale" refers to a series of vegetated, open channel practices that are designed specifically to treat and attenuate stormwater runoff for a specified water quantity volume. As stormwater runoff flows through the channel, it is treated through filtering by the vegetation in the channel. Vegetated swales incorporate modified geometry and other design features to use the swale to treat and convey stormwater runoff. Vegetated swales are the most similar to a conventional drainage ditch, with the major differences being flatter side slopes and longitudinal slopes, and a slower design velocity for water quality treatment of small storm events. Vegetated swales are the least expensive option, but also provide the least reliable pollutant removal. The best application of a vegetated swale is as pretreatment to other structural stormwater treatment practices.

Maintenance of grassed channels mostly involves maintenance of the grass cover. Typical maintenance activities are included in Table 4.

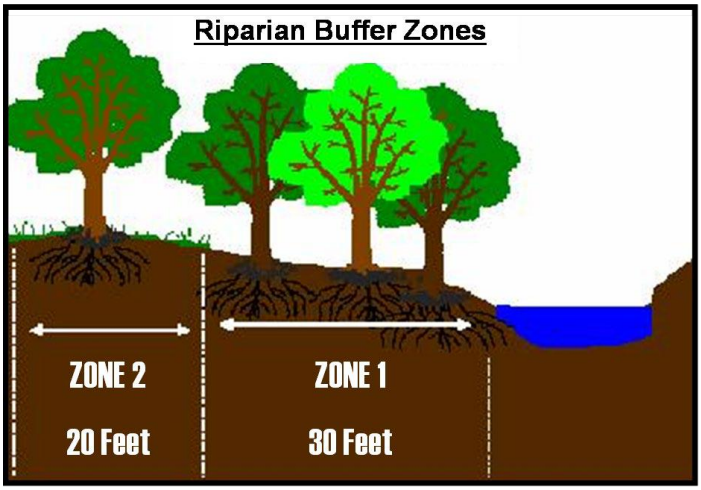
Table 4. Maintenance Activities for Vegetated Swales

Activity	Schedule
**Official Inspection by a professional BMP Inspector, during which the date of the inspection; the condition of each BMP element; any maintenance work performed on the detention pond; and any issues noted for future maintenance should be officially recorded and kept in a log.	Quarterly and within 24 hours after every water quality storm (greater than 1.0 inches of rainfall).
• Inspect grass along side slopes for erosion and formation of rills or gullies and correct. • Remove trash and debris accumulated. • Based on inspection, plant an alternative grass species if the original grass cover has not been successfully established.	Annual (Semi-annual the first year)
• Remove sediment build-up within the bottom of the swale once it has accumulated to 25% of the original design volume.	As needed (Infrequent)
• Mow grass to maintain a height of three to four inches	As needed (frequent seasonally)

Riparian Buffers

Riparian areas are green, vegetated areas found closest to streams, rivers, lakes, and ponds. They provide shaded places for us to enjoy while fishing, swimming, boating, and relaxing in a natural setting. These areas also help reduce the amount of nutrients in stormwater runoff. Riparian buffers slow the stormwater run-off, causing suspended sediments and nutrients they are carrying to collect in these areas rather than entering the stream. High levels of some nutrients and minerals can be damaging to aquatic life. The nutrients trapped by the plants act as a fertilizer, increasing the density of plant life and improving root systems. The trees and plants native to these areas need protection to allow them to continue absorbing nutrients. Riparian buffer zones also play a vital role in protecting water quality by reducing erosion and trapping sediment before it is able to enter our waterways.

The 50 foot area measured landward of the high water line is considered to be the riparian buffer. This area is divided into two zones;



Zone 1 consists of the first 30 feet extending landward of the high water level. It is the most sensitive and critical area and is designed to remain essentially undisturbed. Research has shown a filter strip 30 feet wide removes approximately 84% of sediment and soluble solids from surface runoff. Very few activities are allowed in this zone.

Zone 2, the area spanning 20 feet beyond the edge of Zone 1, plays an equally important part. It, too, is intended to be vegetated, but since it is farther away from the water's edge, this area is more versatile in terms of what activities can take place there. The riparian buffers are required to be shown on the recorded map for all subdivisions located in Pitt County. To find out if your property has a riparian buffer located on it, please refer to the recorded plat for your subdivision. To receive information on permitted activities within the riparian buffer, please contact the Pitt County Planning Department at (252) 902-3250.

The most important maintenance activities for a riparian buffer BMP include general upkeep (mowing, debris collection, and monitoring overgrowth), and quarterly inspections by a certified BMP inspector.

Developing a Plan for Maintaining Your BMP

The Pitt County Stormwater Ordinance for Nutrient Control was adopted on October 11, 2004. This ordinance requires stormwater maintenance agreements to be recorded with all subdivisions that have stormwater BMP's. This agreement can be obtained from the Pitt County Register of Deeds, located at the Pitt County Courthouse. This agreement requires the establishment of a maintenance plan to ensure that the BMP in your neighborhood continues to function properly.

Before a homeowner's association takes ownership of the stormwater facilities, you should obtain a copy of the site plan and as-built drawings that include all stormwater facility locations and types, easements, and deed restrictions. It is also suggested that you meet with the Pitt County Stormwater Administrator and the developer on-site to discuss the stormwater facilities, including the current conditions and maintenance of each stormwater facility.

If a maintenance plan does not already exist, you should consider developing a plan. There are many advantages to having this plan in place such as, keeping a historical record of each facility and creating a long-term maintenance budget.

Components of a Plan

The first step in developing a plan is taking an inventory of the stormwater facilities. These facilities can be found on the site plan for your development. This may require you to consult with the project engineer who designed the plan to locate underground components.

Next, you will need to identify maintenance needs and create inspection checklists. With your site plan in hand, walk the site and take note of the physical and design characteristics of each facility. By doing this, some basic maintenance needs will become obvious. These needs may include establishing vegetation, mowing, removing trash or sediment, etc. While identifying these needs begin thinking about your

inspection checklist. The checklist, at a minimum, should include the following the date of inspection, the condition of the BMP elements, any maintenance work that has been performed (as well as who performed the work), and any issues noted for future maintenance (sediment accumulating, vegetation needing pruning or replacement, etc.). Checklists are important because they provide a history of how the facility has functioned. The checklist should include everything from vegetation to structural design. Inspections can be completed by anyone interested in performing the task. The main goal is to monitor and identify needs on a regular basis. The inspector should be reliable, detailed and willing to communicate with the maintenance personnel.

Establishing record keeping procedures may also be beneficial. This allows a homeowner's association to keep up with scheduling inspections, data collected during past inspections and when routine maintenance is needed. Inspection checklists and record logs should be kept in a known, set location.

One of the major components of developing a maintenance plan is to identify both the long and short term costs associated with each BMP of your maintenance plan. The expenses associated with maintaining a BMP are highly dependent on the BMP type and how it was designed. A funding mechanism should be created and regularly funded with an amount that provides enough money to pay for the maintenance expenses over the lifetime of the BMP. One option is to establish an escrow account, which can be spent solely for sediment removal, structural, biological or vegetative replacement, major repair, or reconstruction of the BMPs. In the case of a residential subdivision, the escrow account could be funded by regular contributions by the homeowners' association. To get more information on how to legally structure such an account, the advice of an attorney may be needed.

Most of the short term maintenance can be performed by residents in your neighborhood or a landscaping company. Short term maintenance, in most cases, pertains to mowing grass, removing invasive plant species and repairing any erosion problems. If you do decide to have a landscaping company perform maintenance on your BMP, advise them that the facility is a water quality devise. Be sure to communicate the need to keep the facility free of grass clippings and leaf piles. You will also need to identify the "No mow zones". These are areas in which the vegetation is serving a purpose, such as nutrient uptake. Maintenance costs will vary based on the type and size of BMP you have. Costs for mowing and weed control are usually calculated per acre. Landscaping companies typically are willing to provide costs estimates. You should expect these costs to increase between three to five percent each year. Once you have a grasp on the costs that will be involved with the maintenance and upkeep of the stormwater facility you can establish the amount of monthly or yearly dues that are assessed to each homeowner.

Long term maintenance costs typically involve replacing structural components and removing sediment from the facility. Although a nonprofessional can undertake many maintenance tasks effectively, a professional should be consulted periodically to ensure that all needs of the BMP facility are met. Some elements that can need professional judgment include structures, outlets, and embankments/dams by a professional engineer,

as well as plant system health by an appropriate plant professional. Some developing problems may not be obvious to the untrained eye. In addition, it is advisable to have professionals do the more difficult or specialized work. If the work is not done properly the first time, not only will the effort have been wasted, but also the facility may have been damaged by excessive erosion. Grading and sediment removal are best left to professional contractors.

Maintenance after floods and other emergencies can require immediate mobilization. It can include replanting vegetation, removing debris and repairs to structures. This should be taken into account when budgeting for maintenance.

A written plan may also prove to be very beneficial. By having a written plan, all of the residents in the subdivision can be made aware of the responsibilities of the homeowner's association. The plan should include the name and location of the site, a copy of the site plan and as-built drawings, the maintenance agreement, and any other records associated with the creation of the homeowners association. It should identify the regulatory and legal requirements and address the funding, collection of funds, budget approval process and a method of evaluating the plan and services performed by contractors. On a yearly basis, review your inspection program, checklists and any contracts with landscapers or engineering companies. This may also be a good time to make sure your inspection checklists are detailed and is not missing any information, you are receiving good service from your landscaper, and your fees are covering the costs.

Last, but not least, is to educate the people that live in your neighborhood about the purpose of the stormwater facility and good house keeping methods. This can be accomplished in several ways. One example is to send out a monthly newsletter that lists ways they can help prevent pollution. Most of the time people do not know that they are contributing to water pollution. By sending a newsletter and increasing the knowledge about water quality they may become a stakeholder in protecting the environment. Another example is holding a BMP cleanup day. Even if the maintenance is being performed by a landscaping company, involving the community in maintenance activities can prove to be a cost effective way of prolonging the life of the BMP.

Pollution Prevention at Home

Many people think that most of the pollution in our waterways come from large industries, corporations, and sewage treatment plants. But if all of these sources of pollution were eliminated tomorrow, over half of the pollution would remain. So where does this pollution come from? All of us, in our daily activities, are polluters. Pollutants can be found in our detergents, pesticides, fertilizers, paints, litter, used motor oil and other household products. Over time, these materials accumulate on our driveways, roads and other surfaces such as parking lots. When it rains, these materials are collected by the rainwater and carried into the ditches and storm drains located across Pitt County. These stormwater conveyances eventually flow into our streams and rivers. These pollutants can cause serious problems, but with minimal effort from everyone in our community, our waterways can become cleaner.

Tips to Use at Home

- Properly use and store all toxic products, including cleaners, solvents, and paints. Please follow directions regarding container disposal.
- Dispose of paint properly. Wash paint brushes in proper manner.
- Use pesticides, herbicides, and fertilizers sparingly and follow the label instructions. Do not apply if rain is expected or near ditches, gutters, or storm drains.
- Do not over irrigate – this can cause sediment to wash into ditches and storm drains.
- Do not blow, sweep, or rake leaves or grass clippings into ditches or storm drains. Compost yard waste or bag and dispose of properly.
- Properly maintain your car to reduce leakage of oil and other fluids.
- Wash cars on lawns rather than paved surfaces to minimize runoff.
- Take used motor oil to participating oil recycling centers for disposal.

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