



A Citizen's Guide to Maintaining Stormwater Best Management Practices

For Homeowners Associations and Property Owners



Types of BMPs ♦ A Plan for Maintaining Your BMP ♦ Who Should Carry Out Maintenance

Inspecting Your BMP ♦ Maintenance Quick Guide ♦ Maintenance Costs

Annual Reports/City Inspections

**City of Greenville's Engineering Division
Stormwater Management Section**

July 2008

Do You Have a Stormwater BMP

The term "Best Management Practices" or BMP, was introduced and defined by the 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 non-point 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 storm drains. Storm drains typically empty into nearby water bodies and wetlands. A variety of local, state and federal laws 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 streams and lakes.

The five most common BMPs in Greenville are wet detention basins, dry detention basins, vegetated swales, bio-retention and stormwater wetlands. The long-term benefits of BMPs only work if they are maintained to sustain their effectiveness. Maintaining your BMP is an important part of Greenville's flood reduction and environmental protection efforts.



Meet on-site with members of your homeowner's association to find out where your BMPs are located.

BMP Lingo

Best Management Practice (BMP) - A practice or combination of practices that is an effective, practicable means of preventing or reducing the amount of pollution generated by non-point sources. Examples of BMPs include detention ponds, buffers, and vegetated swales.

Bio-Retention Cell/Rain Gardens - Bio-retention cells are shallow depressions in the landscaping that allow for temporary storage of the first one (1) inch of rainfall. A combination of vegetation and infiltration provide the required nutrient reductions.

Deed or Plat Restricted Areas - Easements, covenants, deed restricted open spaces, reserved plant areas, conservation easements, or public road right-of-ways that contain any part of the stormwater management system of a development.

Detention Basin - Temporarily stores water before discharging to river or lake; primarily used to reduce peak discharges, but does not reduce runoff volumes. Can be classified into two groups:

Dry Detention Basin - Stores stormwater runoff but dries up following a rainstorm or snow melt. Typically not effective at removing pollutants.

Wet Detention Basin - Also stores stormwater runoff, but contains a permanent pool of water that will more effectively remove nutrients in addition to other pollutants than other BMPs like a dry pond.

Filter Strip - A vegetated area designed to slow runoff velocities and filter out sediment and other non-point pollution.

Mitigated Wetland - Created or restored wetlands are intended to replace the beneficial functions of 404 wetlands lost due to development activities.

Native Vegetation - Native vegetation species that provide long root systems that can help stabilize stream banks, and can provide pollutant filtering capabilities.

Non-Native Vegetation - Plant species not native to an area that tend to out-compete and crowd out native species and dominate the area. Also called invasive species.

Non-Point Source Pollution - Also known as polluted runoff, comes from diffuse or scattered sources in the environment rather than from a defined outlet such as a pipe. As water moves across and through the land it picks up and carries away natural and human-made pollutants depositing them into lakes, rivers and even underground sources of drinking water.

Riparian/Vegetative Buffer - An area of vegetated land, preferably non-mowed native vegetation, left open adjacent to drainageways, streams, wetlands, lakes, ponds, and other surface waters for the purpose of minimizing the impacts of point and non-point source pollution.

Stormwater Wetland - A shallow constructed pool that captures stormwater and allows wetland vegetation to grow.

Vegetated Swales - An open channel drainageway used along residential streets and highways to convey stormwater and filter pollutants in lieu of conventional storm sewers.

Who Should Carry Out Maintenance

Cost, safety, and effectiveness are key factors in determining who will carry out your maintenance needs. Some of the more routine maintenance tasks can be done by a BMP facility owner. Those tasks may include landscaping, educating the neighborhood, and litter removal.

It is recommended that a professional landscaping company be hired for the more difficult routine work. Mowing, working around sloping embankments, stabilizing eroded areas, and replanting vegetation are tasks a professional landscaping company might best manage. Trained professionals can also identify problems early on saving expensive repairs later.

TIPS FOR WORKING WITH LAWN CARE COMPANIES

Your BMP is a water treatment system and requires special attention. Sit down with your landscaping company manager and discuss your BMP maintenance needs. Objectives might include:

- ◆ Communicate the facility is a water quality device.
- ◆ Communicate mowing practices; for instance, mowing at a higher level and perhaps not as frequently, or not at all especially in the buffer areas. You can also request that use of heavy equipment be avoided where possible, particularly in vegetated areas.
- ◆ Communicate the need to keep the BMP facility clear of grass clippings and leaf piles (convey this to residents as well).
- ◆ Ask whether the company follows an integrated pest management (IPM) plan and minimize the application of pesticides and fertilizers. An IPM plan can include:
 - Use of pesticides only as needed and only in trouble spots.
 - Use of alternatives to pest control or no control at all.
 - Policy of not applying chemicals when there is a heavy rainfall in the forecast.
 - Testing the soil before applying low-phosphorus fertilizer if needed.

INVOLVING THE WHOLE NEIGHBORHOOD IN MAINTENANCE RESPONSIBILITIES

Consider starting a public education program for your neighborhood. Even if day-to-day maintenance is left to a professional, involving the community in on-going BMP maintenance activities is a cost-effective way to prolong the life of the BMP and to prevent pollution.

Most of the time people are unaware that their activities contribute to pollution. Through education, people become aware of how their activities impact water quality and flooding, and they become a stakeholder in protecting their environment. Consider the following for your program:

- What are the pollution and flooding problems that need to be addressed?
- What activity or activities are responsible for the pollution or flooding? Encourage residents to change their habits to reduce pollution.
 - How will the message reach the targeted audience? Options could include public meetings, bulletin boards, local newspaper, and signage.
 - How can alternatives to pollution be encouraged? Recycling, proper yard waste disposal, and hazardous waste days are a good start.



Develop group projects like these listed below...

Adopt-A-Street

**ADOPT
A CITY
STREET**
YOUR BUSINESS NAME
HERE

**Cherry Oak
Subdivision**

Please consider adopting the street you live on to keep trash and debris out of our storm drains.

**Sat. July 12, 2003
9 a.m.-beginning at Howell St**

Even if you can't make it, pick up trash as you are taking your daily walk or jog through the neighborhood. For more information call 355-XXXX.

Storm Drain Stenciling

DON'T POLLUTE. FLOWS TO TAR-PAMLICO RIVER

Storm drain stenciling is a good community project to encourage clean water.

Contact 355-XXXX to participate

BMP Clean Up

Join Your Neighbors for a BMP Clean Up Day!

What's a BMP? A BMP, or Best Management Practice, is a facility designed to trap pollutants from our neighborhood before entering the Tar River.

**Sat., October 5, 2003
9 a.m. at the south pond**

Even if you can't make it, there are ways to protect our community's water quality. Following the suggestions on the attached brochure will help. For more information, call 355-XXXX.

A Plan for Maintaining Your BMPs

Since 2004, the City of Greenville Stormwater Management Program requires a stormwater facility maintenance plan to address water quality. If your subdivision was permitted in 2005 (those built in 2003-2004 were likely grandfathered) or after, a maintenance plan should be specified on the plan. The plan typically includes a description of inspection intervals and maintenance tasks required for each BMP.

Before a Homeowner's Association or property owner takes ownership of stormwater facilities:

- ◆ If you don't already have one, get a copy of the site plan that includes all stormwater facility locations and types, easements, deed restrictions, and stormwater facility maintenance plans.
- ◆ The approved site plan will show components of the stormwater system including basins, wetlands and swales. Consult with the site designer or permitting agency to identify below ground features like storm sewers or above ground features like wetland and native vegetation areas.
- ◆ Spend a day with your BMP! With site plan in hand, walk the site with the developer and a representative from the permitting agency. Take note of the physical and design characteristics of each drainage component and drainage easements. From there, some basic maintenance needs should become obvious. For example, vegetation may not have been sufficiently established around the perimeter of a basin or the outlet structure may contain sediment or debris.
- ◆ Inspection logs are essential to ensure all system components are functioning as originally constructed. They are important not only during inspection, but logs provide a historical status of facility functionality. Consider tailoring the logs to your site and facility types. This log is a requirement for your annual inspection performed by the City.
- ◆ Identify costs and allocate resources for maintenance. This task is typically the most difficult task for an association or facility manager. A good rule of thumb is to increase a routine maintenance budget by an average of 3-4 percent each year for inflation. For long term maintenance needs, consult your local government or work with a consulting engineer to estimate the cost of the needed work.



Get your homeowner's association involved. Educate members on the maintenance plan, and train volunteers to be inspectors.

- ◆ Before your annual city inspection, review your inspection programs, checklists, and contracts with landscaping companies and other contractors. Other items to check:
 - Is your tracking system working and does it need updating?
 - Does your inspection checklist or maintenance log need to be evaluated for more detailed inspection or other information?
 - Are you satisfied with professional services currently under contract, and are you getting what you paid for?
 - Is the association fee covering maintenance costs or is there a need to increase it?
- ◆ Last, but not least, it is imperative that those who live near a basin or another system component understand the purpose of the facility and the practices that keep the facility operating. For example, a native vegetative buffer is often viewed as a "mosquito haven" and aesthetically unpleasant. The preferred view is a manicured lawn mowed up to the banks of a wet basin with little or no vegetation on the perimeter. Use your newsletter or a neighborhood gathering to talk about and show the merits of native vegetated buffers or other BMPs. For more information on educating your community, see page 5.

SAMPLE INSPECTION LOG

ROUTINE MAINTENANCE

Wet and Dry Basins (with or without stormwater wetlands)

TASK: Remove accumulated debris and litter, especially around the inlet and outlet areas.

INLET LOCATION: Inspect wet basins inlets and outlets at Lincoln and Main Streets.

SCHEDULE: Monthly

LAST INSPECTION: 11/03/03

CURRENT INSPECTION: 5/2/04

OBSERVATIONS: Removed litter from inlet/outlets. Some erosion will need to be stabilized.

COMMENTS: Outlets need to be checked after snow melts during the winter. Vegetation around inlet area should be reviewed by landscaping company in the later summer to prevent/improve erosion problem.

INSPECTOR NAME: Ima Reed

It's not important how you set up your inspection log. What is important is that you follow the approved BMP Maintenance Plan.

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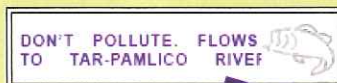
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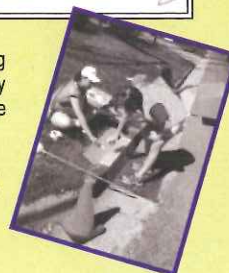
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Inspecting Your BMPs

Maintenance Program Components

- Regular Inspections
- Vegetation Management
- Embankment and Outlet Stabilization
- Debris and Litter Control
- Mechanical Components
- Inlet/Outlet Replacement or Repair
- Insect Control
- Maintenance of Access Route to BMP
- Overall Pond Maintenance
- Sediment/Pollutant Removal

REGULAR INSPECTIONS

This section outlines the maintenance needs for the most common types of BMPs found in the City of Greenville. It is important to remember that while general maintenance tasks can be outlined, actual maintenance needs will vary according to the specific site conditions. Many BMP inspections are conducted on an annual or semi-annual inspection schedule.

VEGETATION MANAGEMENT

Most BMPs rely heavily on vegetation to filter out nonpoint source pollution and to prevent erosion on embankments and slopes. The following is a quick reference (page 8 and 9) on how to keep your vegetation healthy.

- **Mowing.** Short grass (Kentucky blue grass, etc.) may look nice, but doesn't have a deep root system and is ineffective as a pollutant filter. Cut grass no shorter than 6-8 inches, particularly grass near basin embankments and slopes. Never mow down to the water's edge. In fact, replace the grass around wet basins with native vegetated buffers.
- **Weed and Pest Control.** More is not better when it comes to fertilizing and pesticide use, especially near basins, swales, lakes and streams. Excess fertilizer can flow off your lawn and into storm drains that eventually drain into nearby water bodies.
- **Non-Native Vegetation.** Non-native species can impact a BMPs effectiveness by blocking out the more effective long-rooted native vegetation. Short-rooted non-native species can actually destabilize a BMPs embankment or slope and reduce the BMPs pollutant filtering capabilities. Monitoring and mowing can help control unwanted, non-native species.

Factors Affecting Type and Frequency of Maintenance

Function of the BMP Facility. Inspections will vary depending on the type of BMP.

Visibility of the BMP Facility. The needs of the surrounding community will determine to a large extent the amount of maintenance for aesthetics and BMP facility effectiveness.

Landscaping. Maintenance needs will vary depending on the types of vegetation used in landscaping. Native vegetation needs less care and less mowing than turf grass.

Upstream Conditions. The conditions of the watershed upstream from your BMP can significantly impact the amount of sediment and other pollutants entering your BMP facility. Upstream commercial areas or roads may result in an increased need for litter and sediment removal, and other maintenance tasks.

Safety. Since BMPs can often involve the impoundment of water, the safety of nearby residents must be considered.

Need for Professional Judgment. BMPs are water treatment as well as storage facilities. While some routine maintenance can be undertaken by a non-professional, the judgment of a professional should be consulted regularly.

Financing. The costs associated with non-routine BMP maintenance tasks can be considerable. A fund should be established to provide for the costs of long-term needs such as sediment removal (see Non-Routine Maintenance).

- **No Mow Zone (Riparian Buffers).** In the City of Greenville, regulated surface waters are required to have native vegetated buffers of fifty (50) feet in accordance with the NC Division of Water Quality. It is recommended that any native vegetated buffer remain as "no mow" areas.

Inspecting Your BMPs CONT'D

EMBANKMENT AND OUTLET STABILIZATION

Finding the source of erosion and stabilizing it can improve the effectiveness of any BMP. Left unchecked, an erosion problem can necessitate dredging, replacement of an entire embankment or slope, or even an inlet structure.

A prime cause of erosion is a lack of deep-rooted vegetation that holds soil in place. There are several environmentally-favorable techniques to stabilize banks that combined structural products, like matting and deep-rooted plants.

In addition to erosion, problems like sinkholes, a rusty, broken or crushed pipe, odor, or algae blooms are all clear indications to call a consulting engineer.

Animal burrows will also deteriorate embankment integrity. Take steps to control animal burrowing by quickly filling existing holes.

DEBRIS AND LITTER CONTROL

Regularly check for litter, debris and floating debris. Floating debris can clog basin inlets, outlets and swales. If dumping is a problem, outreach to the neighborhood can help.

MECHANICAL COMPONENT, INLET/OUTLET REPLACEMENT

Erosion, corrosion, improper design, and lack of maintenance can all contribute to a component's loss of function. Valves, gates, pumps, locks and access hatches are some of the mechanical components of wet and dry basins that may eventually need replacing. Call a consulting engineer for an inspection and replacement cost estimates.

INSECT CONTROL

Mosquitoes and other insect breeding grounds can be created in shallow ponds of standing water. The development of a mosquito problem, particularly in dry ponds, is usually an early indication of a maintenance problem. It is likely the infiltration capacity of the BMP needs to be increased or sediment needs to be removed. It takes only 72 hours for larvae to hatch in standing water.

Other insect control options include larger wet basins that maintain a stock of fish to feed on mosquito larvae. In addition, natural vegetated buffers can provide shelter for mosquito predators.

MAINTENANCE OF ACCESS ROUTE TO BMP

Access to BMPs for routine and non-routine maintenance is critical.

SEDIMENT REMOVAL FREQUENCY

BMP	Sediment Removal Frequency
Wet Basin	5-15 years
Dry Basin	2-10 years
Vegetated Swale	2 years

OVERALL WET BASIN MAINTENANCE

A healthy aquatic ecosystem has many benefits that are often overlooked. A healthy wet basin should require little maintenance. However, a good indicator of an unhealthy ecosystem is excessive algae growth. This could be caused by nutrients from fertilization practices by a landscape company or surrounding neighbors, upstream activities or by excess sediment.

Steps should be taken to reduce nutrients at their source and to encourage the growth of more desirable aquatic and emergent vegetation in a wet basin.

SEDIMENT/POLLUTANT REMOVAL

Since the primary purpose of a BMP is to remove sediment and other pollutants from stormwater runoff, sediment will eventually accumulate in a BMP and needs to be removed. There are no specific rules governing the timing of sediment removal because facility maintenance varies. However, some general guidelines on sediment removal frequency are listed above.

Note that your wet basin may have been designed with stilling basins or forebays to collect settled sediment. Stilling basins are designed for sediment removal access, and sediment may need to be removed sooner than a BMP without a settling basin.

BMP COMPONENT REPLACEMENT

Eventually, like most infrastructure, some BMP components may need replacing and should be part of a BMP replacement fund. Components may include:

- inflow, outflow devices
- earthwork such as embankment and side slope stabilization
- trash racks
- mulches and vegetation
- valves, orifices
- pumps and switches

BMP MAINTENANCE QUICK GUIDE
(See approved plan for Operation & Maintenance Plan)

Wet/Dry Detention Basins

ROUTINE MAINTENANCE

- Remove accumulated debris and litter, especially around the inlet and outlet areas.
- Mow unless there is native vegetation. If native vegetation exists, consider periodic burns.
- Water clarity and algae growth should be monitored.
- Remove woody vegetation from all embankment areas.
- Stabilize/revegetate side and bottom areas.
- Stabilize/revegetate contributing areas to reduce incoming sediments.

INSPECTION SCHEDULE

- Monthly**
- Semi-Annually**
(Early Spring & Late Fall)
- Semi-Annually**
(Early Spring & Late Fall)
- As Needed**
- As Needed**
- As Needed**

NON-ROUTINE MAINTENANCE

- De-thatch grass to remove accumulated sediment and debris.
- Aerate compacted areas to promote infiltration.
- Monitor sediment accumulations, and remove sediment when the pool volume has become reduced significantly (roughly 15-20% of the basin), or when the basin becomes stagnant.
- Replace BMP mechanical components, reconstruct embankments and spillways.

- Every 2-3 Yrs**
- Every 2-3 Yrs**
- Every 2-3 Yrs**
- > 20 Yrs**

Tips for When Non-Routine Maintenance is Required

(Inspections should occur 24 hours after all storm events causing one inch of precipitation or more.)

- Visible signs of sediment accumulation.
- Insects and/or odor become problems.
- Visible damage to the embankment or mechanical components.
- Emergence of non-native wetland vegetation.
- Algae blooms occur in the summer months or ponded areas become dominated by a single aquatic plant species. (Wet Basins)
- Standing water is visible in inappropriate areas after 48 hours. (Dry Basins)

Vegetated Swales

ROUTINE MAINTENANCE

- Repair erosion and regrade.
- Mow routinely, unless there is a "No Mow Area."
- Remove accumulated debris, litter and sediment.
- Replace non-native vegetation with native vegetation.
- Remove woody vegetation and stabilize and revegetate side and bottom areas native vegetation.

INSPECTION SCHEDULE

- Annually**
- Semi-Annually**
(Early Spring & Late Fall)
- As Needed**
- As Needed**
- As Needed**

Tips for When Non-Routine Maintenance is Required

(Inspections should occur 24 hours after all storm events causing one inch of precipitation or more.)

- Standing water is visible after 48 hours.
- Insects and/or odor become problems.
- Wetland vegetation emerges where not intended.
- Visible erosion or undercutting of swale banks is apparent.

BMP MAINTENANCE QUICK GUIDE CONT'D
(See approved plan for Operation & Maintenance Plan)

Stormwater Wetland
(see also Wet Basins)

ROUTINE MAINTENANCE

- Remove accumulated debris and litter.
- Inspect for invasive species and remove where possible.
- Supplement wetland plants if not well established, 90 - 95% coverage is desirable.

INSPECTION SCHEDULE

Monthly
Monthly
Annually

NON-ROUTINE MAINTENANCE

- Remove accumulated sediment/pollutants, especially around inlet and outlet areas.
- Stabilize/replace inlet/outlet structures.

Semi-Annual

Annually

SPRING

- Non-native vegetation removal/control
- Vegetation planting
- Rain garden installation
- Debris removal
- Post-winter inspection of structures, embankments, and outlets
- Embankment stabilization
- Structural component replacement
- Clear storm grates of leaves, debris

SUMMER

- Non-native vegetation removal/control
- Vegetation planting
- Rain garden installation
- Debris removal
- Embankment stabilization
- Monitor/remove sediment
- Check for odors, standing water
- Structural component replacement
- Clear storm grates of leaves, debris

FALL

- Non-native vegetation removal/control
- Debris removal
- Embankment stabilization
- Check for odors, standing water
- Structural component replacement
- Clear storm grates of leaves, debris

WINTER

- Debris removal
- Clear storm grates of leaves, debris
- Monitor structures and outlets

Signs of Deteriorating BMPs...



Forebay full of sediment



Clogged trash rack



Cracked outfall



Algae blooms



Bank failure

Maintenance Costs

ROUTINE MAINTENANCE COST CONSIDERATIONS

Routine maintenance costs can vary based on the type of BMPs you have. Costs for mowing, weed control, fertilization and debris removal are typically calculated per acre, per year. Cost estimates can be obtained from lawn care companies and a general rule of thumb is to increase your yearly maintenance budget by three to four percent for these activities.

NON-ROUTINE MAINTENANCE COST CONSIDERATIONS

Non-routine costs are often the most expensive and usually are not budgeted. It is advised that a BMP maintenance fund, with annual contributions, be established. You may want to consider hiring a consulting engineer to conduct a replacement fund study. When a fund is started, the primary non-routine maintenance cost is typically related to wet basin pollutant and sediment removal or dredging.

TIP: The non-routine maintenance needs of a BMP, while infrequent, can be a major undertaking in terms of funding and logistics, and should always be performed by a consulting engineer.

Wet Basin Dredging

Associations should have a copy of the approved design of their wet basin(s) depth contours. It is recommended that depth contours be checked about every two years unless there is a significant change in the basin's function. Seek a consulting engineer or basin management company to determine if the depths of the basin have changed to the point that they no longer resemble what was designed and built.

A major cause of depth reduction includes high sediment loads from upstream construction site erosion, erosion, agricultural runoff and decaying aquatic plants. Ideally, you would want to correct these types of problems prior to dredging.

If dredging is the last option, a dredging feasibility study would be performed to determine areas to be dredged and to estimate dredging costs. The cost depends on the volume of sediment removed based on cubic yards, and sediment disposal. Don't forget that permits may be needed from local, state, and federal agencies. Your cost considerations should include:

- Mobilization and Demobilization
- Disposal
- Permits

Mobilization and Demobilization. Depending on the size of the basin, equipment will either be waterborne or on the perimeter of the basin. Additional costs for the construction of access roads and heavy equipment may be required in the cost.

Disposal. The primary determinant of disposal costs is whether on-site disposal is an option. If on-site disposal is not available, landfill and transportation costs can be high.

Permits. Permits may be needed from local, state and federal agencies. This cost should be included in your feasibility study.



**Dredging is an eventual cost.
Plan ahead and set funds aside.**

Need a Retrofit?

Retrofits are stormwater treatment practices put into place after development has occurred to improve water quality, protect downstream BMPs and water resources, reduce flooding, or meet other watershed restoration goals. Several types of retrofit opportunities exist including:

Create a wet stormwater wetland basin: Dry basins can be converted to wetland basins by excavating portions of the basin bottom to create wetland pockets and/or redesigning the outlet to allow for some water retention. Wetland and native prairie vegetation is then planted on the bottom and on banks.

Stabilize banks and improve buffers: Banks of wet basins with erosion problems could be stabilized using native vegetation. Native vegetation buffers should be established around the perimeter of all basins, where possible, to stabilize banks and filter pollutants.

Seek a consulting engineer to retrofit your BMP.

Annual Reports/City Inspections

Regular inspections are necessary to maintain the effectiveness of stormwater BMPs. An essential part of the inspection process is the annual report and City inspection. The annual report will describe the maintenance and repair activities of the subject year. In addition, the report will document the condition of the facility including any deficiencies in need of repair. The City will verify these conditions upon its inspection.

ANNUAL REPORT

Annual Reports are the responsibility of the property owner/homeowners association. They shall be completed on the anniversary of the facilities acceptance. This date is available at the City of Greenville Public Works Department - Engineering Division, (252) 329-4467.

The report will need to include a copy of the sites maintenance log documenting any work performed on the facility, and a copy of the inspection performed by the qualified professional. The inspection shall cover the entire facility; berms, outlet structure, pond areas, access roads, etc. Deficiencies shall be noted in the inspection report.

CITY INSPECTIONS

City inspections will be scheduled thirty (30) days in advance. This will give you time as the property owner/home owners representative to collect your information and prepare for the inspection. Key items we look for while completing our site inspection are as follows:

- Maintenance Logs (provided by owner)
- Annual Reports (provided by owner)
- Outfall Channel Condition
- Vegetation
- Sediment Build Up
- Erosion
- Water Level
- Failed Structural Components

Qualified Professional: *An individual who (1) has received a baccalaureate or post graduate degree in the natural sciences or engineering; and (2) is trained and experienced in stormwater treatment techniques and related fields as may be demonstrated by state registration, professional certification, or completion of coursework that enable the individual to make sound, professional judgments regarding stormwater control/treatment and drainage planning.*

Annual reports shall be kept on record for a minimum of five years and shall be made available to the City upon request.

Pond/Wetland Inspection Form

This is an example of an inspection form that can be obtained by contacting the Engineering Division with the City of Greenville at (252) 329-4467.

POND / WETLAND MAINTENANCE INSPECTION FORM									
Facility Number: _____		Date: _____		Time: _____		Watershed: _____		Inspector(s): _____	
Subdivision Name: _____		Weather: _____		Date of Last Rainfall: _____		Amount: _____		Inches: _____	
Mapbook Location: _____		GPS Coordinates: _____		Property Classification: Residential **		Government **		Commercial **	
Other: _____		Type of Practice: Wet Pond **		Dry Pond **		Micropool ED **		Multiple Pond System **	
Pocket Pond **		Shallow Wetland **		Shallow ED **		Pond/ Wetland **		Pocket Wetland **	
Confined **		Unconfined **		Barrel Size _____		As-built Plan Available? Yes **		No **	
Is Facility Inspectable? Yes **		No **		Why? _____		Comments Specific Location(s): _____			
Scoring Breakdown:									
N/A = Not Applicable		1 = Monitor (potential for future problem exists)		* Use open space in each section to further explain scoring as needed					
NI = Not Investigated		2 = Routine Maintenance Required							
0 = Not a Problem		3 = Immediate Repair Necessary							
1. Outfall Channel(s) from Pond									
Woody growth within 5' of outfall barrel	N/A	NI	0	1	2	3			
Outfall channel functioning	N/A	NI	0	1	2	3			
Manholes, Frames and Covers	N/A	NI	0	1	2	3			
Released water undercutting outlet	N/A	NI	0	1	2	3			
Erosion	N/A	NI	0	1	2	3			
Displaced rip rap	N/A	NI	0	1	2	3			
Excessive sediment deposits	N/A	NI	0	1	2	3			
Other:	N/A	NI	0	1	2	3			
2. Downstream Dam Bank									
Cracking, bulging, or sloughing of dam	N/A	NI	0	1	2	3			
Erosion and/or loss of dam material	N/A	NI	0	1	2	3			
Animal burrows	N/A	NI	0	1	2	3			
Soft spots or boggy areas	N/A	NI	0	1	2	3			
Woody growth or unauthorized plantings on dam	N/A	NI	0	1	2	3			
Other:	N/A	NI	0	1	2	3			
3. Upstream Dam Bank									
Cracking, bulging, or sloughing of dam	N/A	NI	0	1	2	3			
Erosion and/or loss of dam material	N/A	NI	0	1	2	3			
Animal Burrows	N/A	NI	0	1	2	3			
Soft spots or boggy areas	N/A	NI	0	1	2	3			
Woody growth or unauthorized plantings on dam	N/A	NI	0	1	2	3			
Other:	N/A	NI	0	1	2	3			
N/A = Not Applicable		1 = Monitor for Future Repairs							
NI = Not Investigated		2 = Routine Repairs Needed							
0 = Not a Problem		3 = Immediate Repair Needed							
								Page 1 of 6	

What Can You Do To Prevent Pollution

Whether you live in the city or the country...whether your home is large or small, there is something you can do to improve water quality.

- ◆ Collect oil and other automotive products preferably for recycling, or tightly seal and wrap them for proper disposal.
- ◆ Wash cars on the lawn, where soapy water can't quickly run toward the nearest stormdrain, picking up other pollutants as it goes. Wash your car with non-toxic, low phosphate soap and use water sparingly. Ideally, take your car to a car wash where water goes to a wastewater treatment plant.
- ◆ Keep cars tuned up and in good operating condition. Check for drips and repair leaks immediately to keep nuisance oils off pavement. Better yet, walk, bike or take the bus.
- ◆ Monitor fuel use from any underground gas and oil tanks to make sure they are not leaking.
- ◆ Clean up pet waste from which nutrients and bacteria could be washed into BMPs, lakes and streams.
- ◆ Direct downspouts away from foundations to planting beds and lawns where water can safely soak into the ground. Install a bio-retention cell/rain garden.
- ◆ Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. Yard clippings and leaves left on the street can wash into storm drains. The decomposition of this load of organic matter in the stream decreases the oxygen needed by fish.
- ◆ Replace impervious surfaces, such as concrete or asphalt, with wood chips, or permeable pavement.
- ◆ Sweep your walks and driveways instead of hosing them down.
- ◆ Buy no-phosphate cleaners and detergents. Phosphates act as a fertilizer and increases algae and aquatic weeds in wet basins. When these plants

The storm drain system was built to collect and transport rain water and prevent flooding in urban areas. Anything that flows into the storm drain system goes directly into local creeks.

Stormwater is NOT treated!

MOSQUITOES AND WATER

Wet and dry basins traditionally are not mosquito breeding grounds. In fact, mosquito larvae must live in still water for five or more days to complete their growth cycle before becoming adult mosquitoes capable of transmitting disease. Often, the number of mosquitoes in an area can be reduced by removing sources of shade and standing water.

- ◆ Selectively remove cattail monoculture in wetland or wet basin.
- ◆ Remove large woody, overhanging vegetation that provides shade.
- ◆ Discard old tires, buckets, drums and any water holding containers.
- ◆ Keep outlets clear of trash and debris.
- ◆ Treat and remove algae blooms.

CONSIDER A RAIN GARDEN

Rain gardens are just what they sound like...gardens that soak up rain water, mainly from your roof, but also from your driveway and lawn.



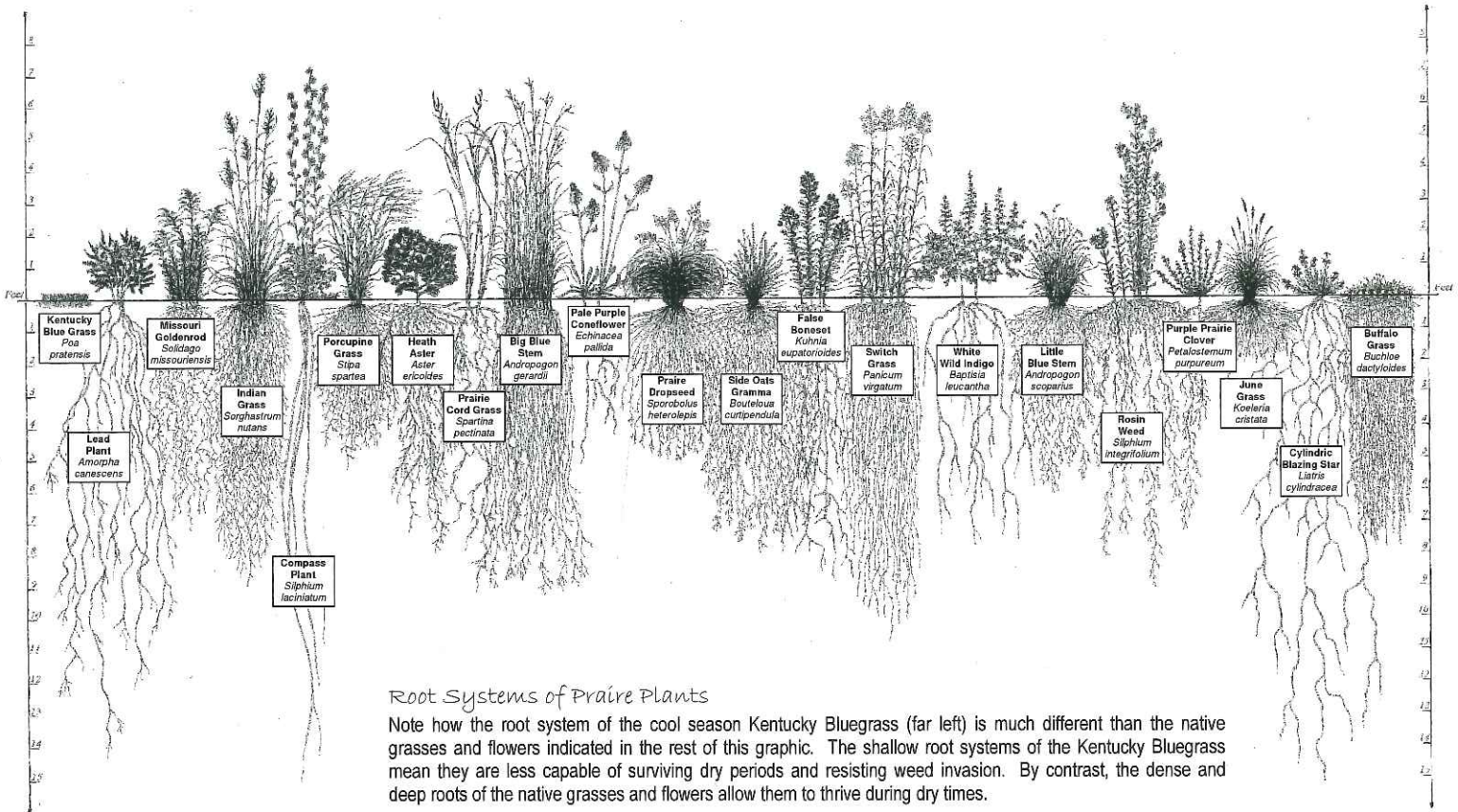
They are landscaped areas planted with wildflowers and other native vegetation to replace areas of lawn. The gardens fill with a few inches of water and allow the water to slowly filter into the ground rather than running off to stormdrains. Compared to a patch of conventional lawn, a rain garden allows about thirty (30) percent more water to soak into the ground.

Holding back the runoff helps prevent pollutants such as fertilizers from washing off your yard, into storm drains and eventually into nearby streams and lakes. By reducing the amount of water that enters the local storm drain systems, rain gardens can also reduce the chance for local flooding, as well as bank erosion where storm drains empty into streams and lakes.

Benefits of a Native Vegetation

Site designers, developers and individual homeowners continue to realize the benefits of native vegetation used in wet basins, vegetated buffers and bio-retention cells/rain gardens. What is native vegetation?

Native plants are plants that have evolved over thousands of years in a particular region. They have adapted to the geography, hydrology, and climate of that region. Native plants occur in communities, that is they have evolved together with other plants. As a result, a community of native plants provides habitat for a variety of native wildlife species such as songbirds and butterflies. Native plants save time and money by eliminating or significantly reducing the need for fertilizers, pesticides, water and lawn equipment. Native plants, through their deep root systems, help absorb stormwater pollutants, and assist in bank stabilization.



Root Systems of Prairie Plants

Conservation Research Institute
March 1995

Native plants reduce soil erosion. Natural landscaping has distinct advantages over conventional turf grasses in stabilizing easily erodible soils. Native plants are particularly effective on steeply sloped sites, stream banks, and areas where moving water is present. The roots of native prairie plants are very dense, fine, and often very deep (5 to 10 feet in mature plants). By contrast, typical turf grass root systems are only four to six inches deep.

Native plants do not require fertilizers. Vast amounts of fertilizers are applied to lawns. Excess phosphorous and nitrogen (the main component of fertilizers) run off into wet basins, swales and nearby water bodies like wetlands and lakes, which harms aquatic life and interferes with recreational uses.

Native plants require less water than lawns. The modern lawn requires significant amounts of water to thrive. The deep root systems of many native plants increase the soils capacity to store water. Native plants can significantly reduce water runoff and, consequently, flooding.

Native plants help reduce air pollution. Natural landscapes do not require mowing. Lawns, however, must be mowed regularly. One gas-powered lawn mower emits eleven (11) times the air pollution of a new car for each hour of operation. Native plants sequester, or remove, carbon from the air.

Native plants are less expensive to maintain. USEPA reports that a wetland costs approximately \$150 per year, per acre to maintain, while the same amount of lawn costs \$1,000 per year, per acre to maintain.

A Few Words About Stormwater and Mitigated Wetlands

In recent years there has been a national movement towards introducing wetlands where none currently exist, and replacing wetlands that have been impacted, to improve water quality, reduce flooding and to retain natural habitats.

STORMWATER WETLANDS

Stormwater wetlands, or constructed wetlands, are incorporated into the shallow pools of wet basins. These "naturalized basins" are designed primarily to treat stormwater runoff.

While stormwater wetlands usually have less biodiversity than natural wetlands in terms of plant and animal life, they do offer water quality benefits and natural habitat, and can support macro- and micro- invertebrates.

Stormwater wetlands are not required, but are highly recommended as a BMP to meet water quality provisions. Stormwater wetlands also offer aesthetic value and require less maintenance than mitigated wetlands.

It is well worth the time to include stormwater wetlands in your routine maintenance schedule. Watch for invasive plant species and sediment accumulation.



A typical stormwater wetland at the edge of a wet basin.

MITIGATED WETLANDS

Stormwater Wetlands address water quality and create generic habitat. Mitigated Wetlands are constructed to replace all the inherent features of a natural wetland (bio-diversity and ecological function).

Mitigated wetlands are created on a site to replace lost wetland functions due to fill or other negative impacts. Mitigated wetlands are usually placed on a site independent of a wet basin.

The US Army Corps of Engineers requires that wetlands be replaced at certain ratios depending on the quality of the impacted wetland. The mitigated wetlands can either be replaced on site or in a wetland bank within the same watershed. The goal is ensure that more wetlands are replaced rather than destroyed.

Since mitigated wetlands are designed to replace the inherent features of a natural wetland, mitigated wetlands are required to meet strict performance standards established by the US Army Corps of Engineers. Those standards require mitigated wetlands to be monitored for at least five (5) years. The developer is responsible for developing and implementing the monitoring and management plan until the performance standards are met.

Once it is determined that the developer has met the five-year monitoring and maintenance standards in the plan, the homeowner's association takes "ownership" of the wetlands. The association should then monitor the wetlands for invasive species and other negative impacts, and implement an annual maintenance program to keep the wetland thriving.

Easements on Your Property

If you have a BMP in your subdivision or on your property, a deed restriction or easement is required. These legally binding agreements noted on the plat and in your purchasing agreement for your home allows access to stormwater facilities, and requires the property owner to maintain the access point.

BMPs that typically need a dedicated easement include detention basins, overland flow paths, swales, wetlands, and buffers.

Here are some standard guidelines for easement maintenance.

EASEMENT DO'S AND DON'TS

Recommended

- ◆ Plant trees and shrubs at the top of the embankment or berms to avoid blocking the flow of water. Native, water tolerant grasses and wetland plants however can be planted at the base of a basin or swale.
- ◆ Plant non-woody trees, shrubs and flowers away from outlets and inlets to avoid root blockages.

Not Recommended

- ◆ Do not erect any permanent structures like buildings, walls or fences made of brick or blocks.
- ◆ Do not install tennis courts, swimming pools, dams or anything that might block the flow of water.

Agency Resources

City of Greenville
Public Works Department
Engineering Division
1500 Beatty Street
PO Box 7207
Greenville, NC 27835
(252) 329-4467

Amanda C. Boone, PE—Program Management
(252) 329-4350
David Fields—Inspections/Volunteer Activities
(252) 329-4681

www.greenvillenc.gov

State Contact

NC Department of Environment and Natural Resources
General website for information regarding all aspects of North Carolina rules and regulations of stormwater management.

www.enr.state.nc.us

Federal Contact

Environmental Protection Agency
Information on current issues, reports on 17 key environmental topics from air to water, kids page, laws/regulations and further official agency information.

www.epa.gov

Websites

NC DENR
Stormwater Runoff Pollution
www.ncstormwater.org

Stormwater Manager's Resource Center
www.stormwatercenter.net/

USEPA
Wetlands Website
www.epa.gov/OWOW/wetlands/

USEPA
Nonpoint Source Pollution
Education Resources
www.epa.gov/OWOW/nps/eduinfo.html

NC Cooperative Extension
Environmental Information
www.ces.ncsu.edu/index.php?pag=environment

Piedmont Triad Partnership
www.stormwatersmart.org