A Citizen's Guide to Stormwater Management in Maryland

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Stormwater Management in Maryland

August 2004

This guide was written and designed by James Melonas under the direction of Senior Planner George Maurer. It draws its information about Maryland's stormwater management regulations primarily from the Annotated Code of Maryland, Environment Article, Title 4, Subtitle 2; the Code of Maryland Regulations (COMAR) 26.17.02; and from the *Maryland Stormwater Design Manual, Volumes I and II*. Cover photo by the Chesapeake Bay Foundation.

This guide is a supplement to the Chesapeake Bay Foundation publication, *Influencing Development in Your Community: A Citizen's Guide for Maryland*. Other related supplements include:

- *A Citizen's Guide to Erosion and Sediment Control in Maryland*
- *A Citizen's Guide to the Forest Conservation Act in Maryland*
- *A Citizen's Guide to Protecting Wetlands in Maryland*
- *A Citizen's Guide to the Critical Area Program in Maryland*

These publications are available on-line from the Chesapeake Bay Foundation at www.savethebay.cbf.org.

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I. Introduction

Stormwater runoff from developed land is a major contributor of pollutants and sediment to the Bay. In 2002, the Chesapeake Bay Program reported that 16 percent of all nitrogen, 20 percent of phosphorus, and 9 percent of all sediment in the Bay comes from urban stormwater runoff.[1] While runoff from farms is decreasing with improved agricultural practices, urban runoff is increasing as more forests and agricultural land is developed.

A healthy Bay requires proper stormwater management to reduce the amount of pollution and sediment originating from developed land. Active citizens with a good understanding of stormwater management systems and Maryland's stormwater management regulations can help ensure that developers fully comply with requirements and that existing stormwater management facilities are properly maintained.

This guide focuses on stormwater management, which is the permanent control of runoff from a site. Reading this guide will help you understand:

1. The importance of stormwater management in restoring the Bay
2. The evolution and current approach to stormwater management
3. Stormwater management regulations in Maryland
4. How citizens can help ensure that developers comply with stormwater management requirements and that stormwater management facilities are properly maintained

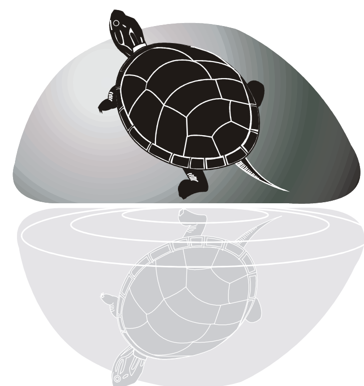
The Chesapeake Bay Foundation publication, *A Citizen's Guide to Erosion and Sediment Control in Maryland*, addresses the temporary control of runoff during construction.

[1] *State of the Chesapeake Bay, 2002,* Chesapeake Bay Program.

Effects of Stormwater Runoff on the Bay and its Tributaries

In a natural system, soil, forests, and wetlands act like a sponge—soaking up the rain. Most of the water infiltrates into the soil and is slowly released into streams and rivers. The steady absorption and release of water to streams minimizes pollution, flooding, and drought.

The construction of roads, buildings, and other impervious surfaces disrupts this natural hydrology, changing land from a filter to a funnel for stormwater runoff. This change alters stream hydrology, transports pollution downstream, and increases both the volume and velocity of stormwater runoff. Runoff volume increases because impervious surfaces prevent infiltration and replace natural areas that soak up stormwater. Runoff picks up velocity as it surges across rooftops and pavement.



Hydrology:
The study of the waters of the earth. Specifically, how stormwater and evaporation affects the character of water in streams, lakes, and rivers on or below the land surface.

Impervious Surfaces:
Rooftops, roads, parking lots, driveways, pools, decks, and other surfaces that prevent rainfall from soaking into the ground.

Effects on Stream Hydrology

- **Lowered Water Table**
  Stormwater runs off roads, parking lots, and other impervious surfaces very quickly. Rain cannot infiltrate the soil to recharge the groundwater, which results in lower stream base-flows and leads to water shortages and lower water levels in underground aquifers.

US Geological Survey

- **Streambank Erosion**
  The increased velocity and volume of runoff from development and the loss of natural vegetation along streams erodes stream banks. Stream bank erosion can cause loss and damage to property,
  loss of valuable top soil, road undercutting, and destruction of aquatic habitats from sediment and channel widening. A wide, shallow stream, accompanied by streambank erosion, is a sign of damage from excessive amounts of stormwater.

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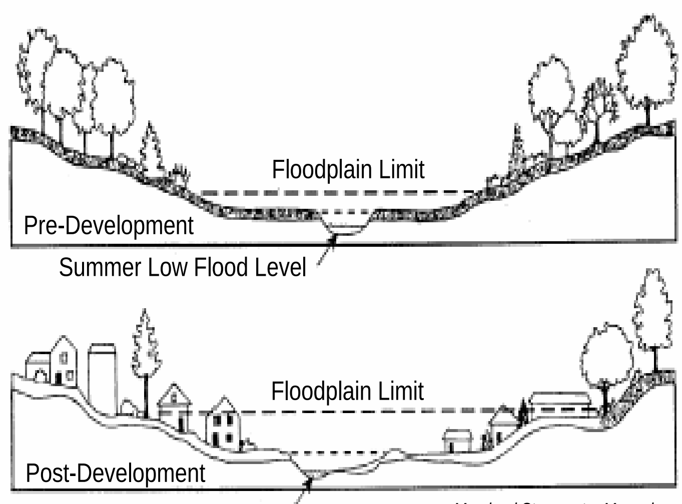
- **Flooding**
  When buildings and pavement replace forests, fields, and natural areas, the volume of stormwater pouring into streams and rivers increases. The increased volume of stormwater raises the height of floodwaters and consequently raises the floodplain limit (land adjacent to streams and rivers susceptible to flooding) above pre-development levels.



Maryland Stormwater Manual,
Maryland Dept. of the Environment

Effects on Water Quality

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Runoff from impervious surfaces carries a witches brew of pollutants—nutrients, sediment, oil, and toxic chemicals—into streams, rivers, and ultimately to the Chesapeake Bay. Roofs and pavement heat up runoff before it enters streams, and the higher temperatures are detrimental to cool-water fish such as trout. Nutrients, primarily nitrogen and phosphorus, cause algal blooms which cloud water and cause "dead zones" devoid of oxygen. Small sediment particles decrease water clarity. Larger sediment settles to river bottoms, smothering bottom life and fish spawning areas. Heavy sediment loads can even fill stream channels. Oil and toxic chemicals can kill aquatic life, make parts of the Bay unsafe for swimming, and make fish unsafe for consumption. Cumulatively, these pollutants cause a decline in the crab, oyster, and fish population in the Bay. The following table shows some of the most harmful pollutants and their sources.

Common Stormwater Pollutants and Their Sources

	Vehicle Exhaust	Power Plants	Tire and Vehicle Parts Wear	Vehicle oil, Grease, and Fuel	Road Surfaces and De-icing Salts	Household, Lawn, and Garden Chemicals
Lead	X	X	X	X		X
Zinc			X	X	X	X
Arsenic		X				
Copper			X	X		
Cadmium		X	X			X
Chromium		X	X			
Nickel		X	X	X	X	
Manganese		X	X			
Mercury	X	X				X
Iron			X			
Cyanide						X
Nitrogen and Phosphorus	X	X				X

What Goes Up Does Come Down

Exhaust from power plants and motor vehicles are the two largest sources of airborne nitrogen pollution affecting the Chesapeake Bay. Precipitation brings this airborne nitrogen back to earth where stormwater runoff carries it to the Bay and its tributaries.

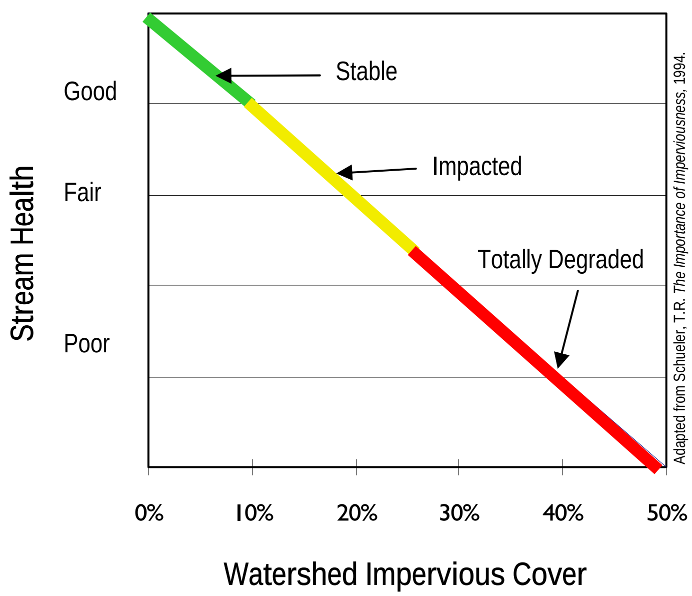
Impervious Surface: What Drives Runoff

Even relatively small amounts of impervious surface can impact water bodies. Studies have documented that the quality of aquatic habitat in streams, lakes, and wetlands begins to decline when the area of impervious surface located in upstream watersheds is as little as 10 percent of the total land area.[2] Impervious surface area can add up quickly. In an average subdivision, more than 20 percent of the total land area is impervious. In a typical shopping center, 95 percent of the land area is impervious. The graph below demonstrates the relationship between stream health and the amount of impervious surface in the watershed.

Stable — Vegetated streambanks, large forests, fields, and wetlands protect streams by filtering out pollutants and soaking up stormwater. Stream water flows clear and contains low levels of nutrients. Stable streams support diverse and abundant fish and wildlife populations.

Impacted — Increased runoff volume from impervious surfaces erodes and widens streambanks and transports a crippling amount of pollution to streams. Overall water quality deteriorates as nutrients create algae blooms and sediment clouds the water. The populations of fish and aquatic insects that are sensitive to pollution, such as brown trout, decline sharply. At this stage, proper stormwater management can help mitigate the stream degradation.

Totally Degraded — Stream water runs brown with sediment and pollutants from developed areas. Streams in watersheds with more than 25 percent impervious cover can only support a few fish species able to tolerate high levels of pollution, such as carp. This level of development is a point of no return—even the best SWM practices cannot mitigate the impacts of overwhelming runoff.[3]



[2] Schueler, T.R. *The Importance of Imperviousness,* 1994.

[3] Descriptions from Schueler, T.R. *The Importance of Imperviousness,* 1994.

II. The Evolution of Stormwater Management

The approach to managing stormwater has evolved over the years. Historically there have been three basic approaches to managing stormwater: curb and gutter systems, large stormwater structures, and Low Impact Development.

Best Management Practices (BMPs)
BMPs are methods and structures determined to be the most effective, practicable means of reducing the chance for flooding, encouraging water infiltration, and preventing or reducing non-point source pollution from entering the Bay.

- Curb and Gutter Systems — Curb and gutter systems are designed to quickly transport stormwater out of developed areas, sending pollution and floodwaters downstream. There is no attempt to manage either the volume of stormwater runoff or the amount of pollutants it contains.
- Large Stormwater Structures — In the early 1980s, researchers and governments realized that stormwater runoff played a large role in the decline of waterbodies. Large stormwater structures were the first attempt to control and manage stormwater and focused primarily on managing stormwater quantity. The structures, typically manmade ponds, temporarily store runoff and slowly release it to prevent flooding. While large stormwater structures serve mostly to control floods, some structures can also improve stormwater quality.
- Low Impact Development — Low Impact Development is a comprehensive, environmentally sensitive approach to site design and stormwater management. This the current approach to stormwater management. It manages both stormwater quantity and quality by encouraging soil infiltration through the use of innovative Best Management Practices (BMPs) and by minimizing impervious surfaces—much like nature.

The following pages detail these three approaches to stormwater management.

Curb and Gutter Systems

Since ancient times, cities were designed to control stormwater runoff from impervious surfaces. The earliest systems moved stormwater off the streets and buildings as quickly as possible and discharged the runoff directly into water bodies. Curb and gutter systems, still in use today in older communities, work the same way.

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Curbs contain runoff to the streets and direct the water to gutters, storm drains, and paved channels that empty into streams, rivers, and the Bay. Urban streams are often cemented and piped underground. Piped streams convey floods and pollutants more rapidly downstream and are void of trees and plants that naturally filter pollutants. Curb and gutter systems may prevent some local flooding, but they create floods downstream because water cannot infiltrate the soil. Curb and gutter systems also deliver untreated runoff and its pollutants directly into receiving waters.

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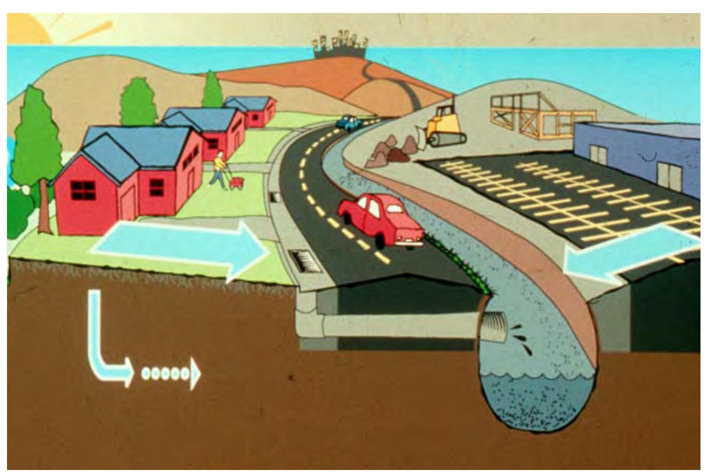
Many of Maryland's older communities have curb and gutter systems. Fortunately, streets with curb and gutter systems can be retrofitted to improve their effectiveness in filtering out pollutants and reducing flooding. The Low Impact Development section details several BMPs that are suitable in urban areas with existing curb and gutter systems. Maryland provides funding to communities to upgrade outdated and ineffective curb and gutter systems. See Section IV, "Opportunities for Citizen Involvement," for more information.



Curb and gutter systems deliver runoff laden with pollutants directly into streams and rivers.

Keith Stichler, Chesapeake Bay Foundation

Large Stormwater Structures

Approximately twenty years ago the approach to stormwater management changed from the curb and gutter system to one which slows stormwater runoff and allows pollutants to settle out. Typically with this approach, a network of pipes directs all the runoff from a development into a man-made pond or wetland where the water is temporarily stored and slowly released. The primary purpose is to limit flooding.

J. Melonas, Chesapeake Bay Foundation

As pollutants and sediment settle to the bottom of the pond or wetland, they form a barrier that prevents soil infiltration. Since no water infiltrates the soil, all of the runoff volume is slowly released into a receiving stream. Even with a slowed release, streambank erosion still occurs because the volume of stormwater released to a stream still exceeds the natural volume of runoff.

Large stormwater management structures are expensive to construct and maintain, and require large areas of land. Most local governments require community associations to maintain large stormwater structures in their neighborhoods. However, communities are often unaware of their obligation for maintaining large stormwater structures, or they may not realize that the neighborhood pond is actually a structure for managing stormwater.

Because of these limitations, Maryland recommends that designers reduce the size or eliminate the use of large stormwater structures in favor of Low Impact Development techniques that allow runoff to soak into the ground and require less maintenance.

The following pages describe the two main types of large stormwater structures—stormwater ponds and constructed wetlands.

See Section IV, “Opportunities for Citizen Involvement,” for information and publications that help communities maintain large stormwater structures.

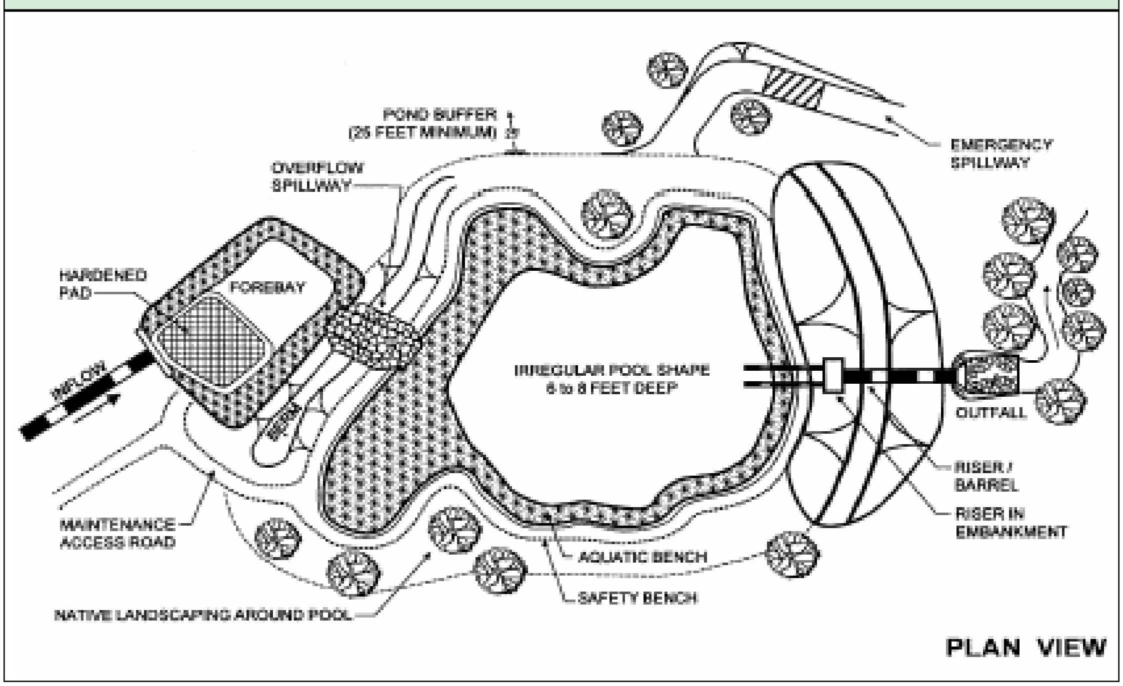
Stormwater Pond

Stormwater ponds are the most widely used BMP in Maryland, especially in suburban areas.

There are two main types of stormwater ponds. A detention or “dry” pond is designed to only hold runoff for 12 to 24 hours after a storm. A retention or “wet” pond is designed to permanently maintain a low water level and accommodate additional runoff from storm events. Wet ponds are more effective than dry ponds in removing pollutants since water stays in the pond longer, allowing more time for pollutants to settle out. However, the longer water stays in a pond the more time it has to heat up. This heated water can adversely affect aquatic life when released into streams—especially cool-water fish such as trout.

Regular maintenance includes mowing of slopes, removing debris from inlets and outlets, and dredging accumulated sediments.

Typical Design for a Stormwater Pond

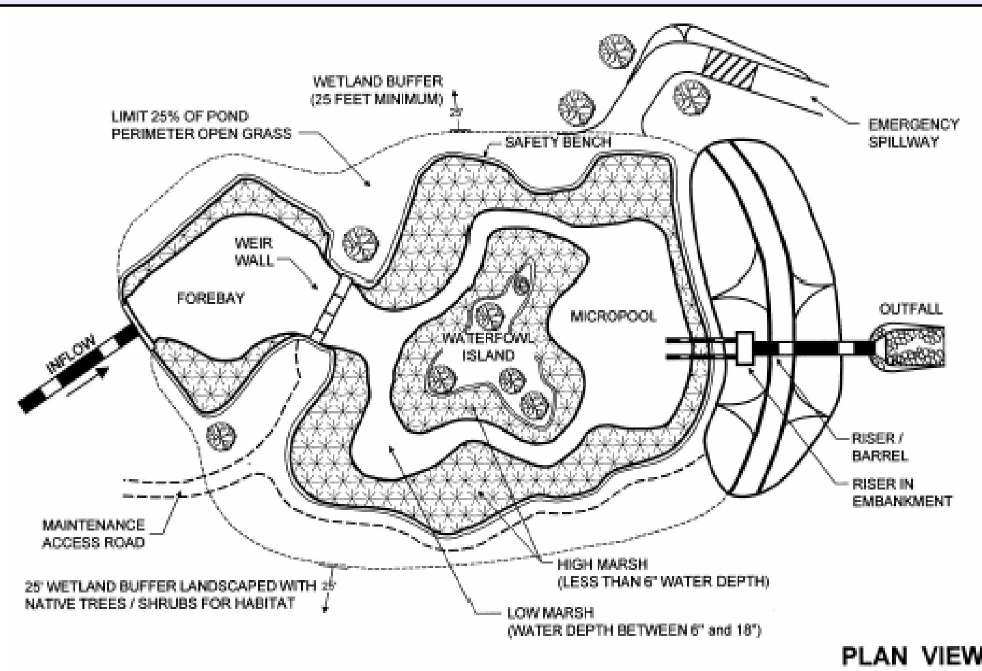


Maryland Stormwater Manual, Maryland Dept. of the Environment

Constructed Wetland

Constructed wetlands act as a filter, like natural wetlands, to remove sediment and pollutants from runoff. Constructed wetlands are more effective than stormwater ponds in improving stormwater quality, but like wet ponds they can also heat up stormwater. Wetlands are planted with native grasses that require less maintenance than a stormwater pond and provide wildlife habitat. Regular maintenance includes removing debris from inlets and outlets, dredging accumulated sediments, ensuring native plants are healthy, and removing invasive species.

Typical Design for a Constructed Wetland



Maryland Stormwater Manual, Maryland Dept. of the Environment

Low Impact Development

New Maryland stormwater regulations encourage developers to use Low Impact Development techniques instead of large stormwater structures.

See Section II, "Stormwater Management Regulations in Maryland" for more information.

The latest approach to stormwater management is called Low Impact Development. Low Impact Development represents a significant change in the approach to managing stormwater. Instead of using complex engineered solutions, Low Impact Development minimizes impervious surface area, conserves natural vegetation, protects streams and wetlands, and uses smaller and less expensive BMPs. Incorporating these simple principles into a new development can:

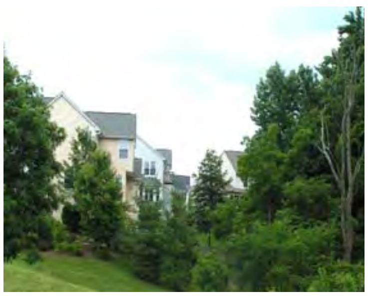
- Reduce impervious cover by 10 to 50 percent and lower capital costs by 10 to 33 percent by minimizing sidewalks, roads, and large stormwater structures.
- Decrease the need for grading by 35 to 60 percent and preserve 40 to 80 percent of the site as open space by clustering buildings and using natural areas for stormwater management.[4]

Low Impact Development benefits communities, developers, and the Bay. Communities enjoy natural areas and open space, developers save money, and stormwater is treated much like a natural system.

The most common Low Impact Development BMPs are described in the following pages. They fall into two categories: designs that reduce impervious surfaces and small BMPs that reduce runoff by promoting soil infiltration.

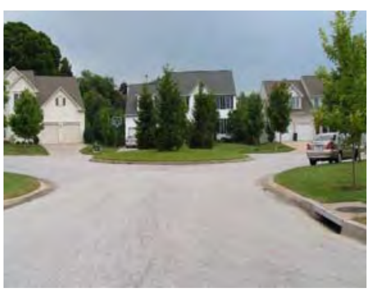
[4] Schueler, Tom. *The Economics of Watershed Protection.*

Designs for Reducing Impervious Surfaces



J. Melonas, Chesapeake Bay Foundation

- **Cluster Zoning and Natural Area Conservation**
  In conventional subdivisions, the entire development is cut into equally sized parcels. This cookie-cutter approach often requires reducing the size of existing forests and natural areas that naturally filter out pollution and allow water to infiltrate the soil. Many times, any remaining forest is too small and fragmented for adequate wildlife habitat or recreation. A cluster subdivision uses smaller lot sizes and places lots closer together, leaving most of the land as natural areas and community open space. The amount of impervious surface is lowered because roads do not need to extend throughout the entire site. Another bonus of cluster zoning and natural area conservation is that homebuyers appreciate preserved natural areas and are willing to pay more for developments that have them.



J. Melonas, Chesapeake Bay Foundation

- **Alternative Turnarounds**
  Standard cul-de-sacs have a 40-foot radius. Reducing the radius to 30 feet and using landscaping in the middle of the cul-de-sac (as shown at left) can greatly reduce the impervious area.

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- **Shallower Front Setbacks**
  Zoning laws in many jurisdictions require houses to be set back from the road by a sizeable minimum distance. By reducing setback distances, driveways are shortened (less impervious surface) and developers have the flexibility to design more inviting neighborhoods.

Designs for Reducing Impervious Surfaces (cont.)

- **Flexible Sidewalk and Driveway Designs**
  Building neighborhood sidewalks on just one side of the street (shown at right) cuts impervious surfaces and saves ten dollars for every foot of sidewalk eliminated. Roads with low traffic volumes do not require a sidewalk on each side. Shared driveways are another simple but effective way to cut costs and remove unnecessary impervious surfaces.

J. Melonas, Chesapeake Bay Foundation

- **Reduced Parking**
  Often, parking lots are built to accommodate high volume shopping days that occur only a few times a year. The low impact alternative is to provide parking for standard parking volumes—saving about $1,100 in construction costs per space. A section with smaller spaces for compact cars also cuts down on the parking lot area. Shared parking lots can also cut impervious surface area significantly. Shared parking works best with complimentary uses, like an office building and a church. Overflow parking areas utilize grass, gravel, alternative pavers (shown at right) or other pervious surfaces instead of asphalt. See the Chesapeake Bay publication, *A Citizen's Guide to the Forest Conservation Act in Maryland,* for more information about reduced parking.

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- **Narrower Streets**
  In many cases, residential streets are excessively wide for their low traffic volume, largely because of outdated ordinances that require widths of 32 to 40 feet for residential streets. A 22 to 26-foot wide road is sufficient for most neighborhoods. Every mile of road narrowed by eight feet translates into a construction savings of $35,000 and reduces impervious surface by an area roughly equal to one football field. See the Chesapeake Bay Foundation publication, *A Citizen's Guide to the Forest Conservation Act in Maryland,* for more information about narrower streets.

J. Melonas, Chesapeake Bay Foundation

BMPs that Encourage Soil Infiltration

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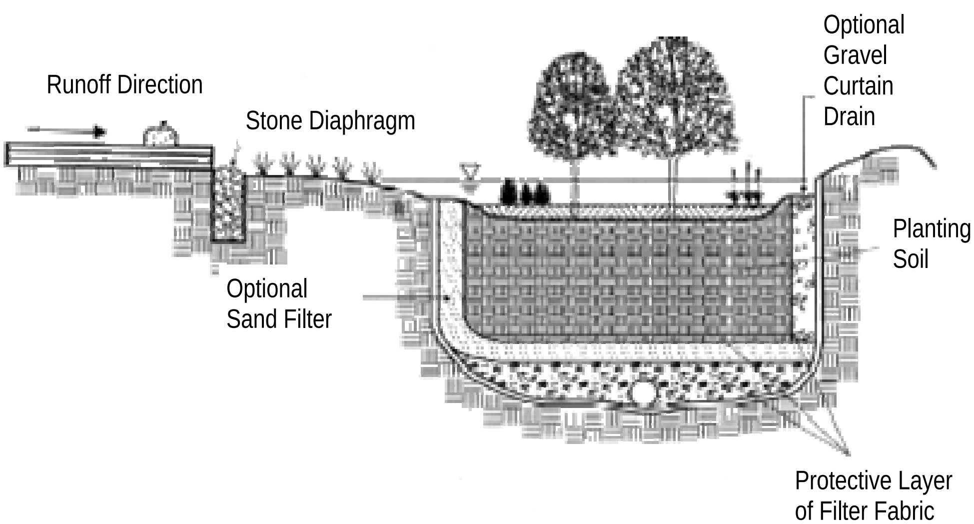
- **Disconnecting Impervious Surfaces**
  Instead of piping runoff from rooftops, driveways, and parking lots to a stormwater management structure or a curb and gutter system, runoff is channeled to vegetated areas, a bioretention area, or a holding device. The Chesapeake Bay Foundation's Merrill Center uses cisterns to capture roof runoff that is used for laundry, fire suppression, and handwashing.

- **Bioretention Facility**
  A bioretention facility temporarily pools runoff in a specially landscaped area, as shown in the diagram below. A thick layer of porous planting soil encourages infiltration, and layers of gravel, sand, and filter fabric trap pollutants before the water exits the area. Infiltration recharges the water table and prevents stream erosion by reducing runoff volume. Bioretention facilities require normal maintenance like any landscaped area. To prevent clogs, accumulated trash and debris should be removed twice a year. Maryland recommends the use of bioretention as an alternative to stormwater ponds and constructed wetlands.



Maryland Stormwater Manual, Maryland Dept. of the Environment

BMPs that Encourage Soil Infiltration (cont.)

Maryland Dept. of Natural Resources

- **Vegetated Buffer**
  A forested or natural area along a stream soaks up and slows the flow of runoff, protects the stream bank, and traps pollution. A 50 to 100-foot buffer is most effective, but, if space is limited, even a 25-foot buffer can improve water quality and quantity.

J. Melonas, Chesapeake Bay Foundation

- **Grass Channel**
  Grass channels along roadways (shown at left) allow water to infiltrate the soil, which captures pollutants and sediments. Grass channels can replace curbs along roadways and are less expensive to build and maintain than curb and gutter systems.

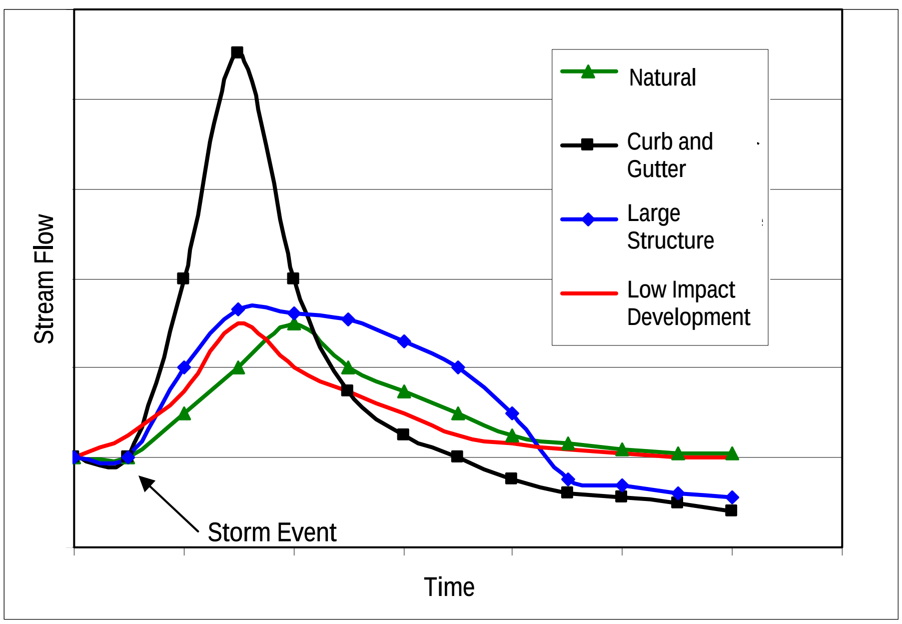
Maryland Dept. of the Environment

- **Green Roof**
  A green roof is vegetated with low growing plants which slow and soak up rooftop runoff while helping to insulate and cool a building. The Montgomery Park Building in Baltimore (shown below) was renovated and retrofitted with a green roof. It is now home to the Maryland Department of the Environment.

Measuring Up to Nature

In a natural system (before development), stream flow gradually increases after a storm and slowly dissipates. Between rains, stream flow remains at a stable level of low flow. With the curb and gutter approach, stream flow increases rapidly, causing floods and streambank erosion. Stream flow rapidly falls below normal levels after the storm event because curb and gutter systems do not provide for the recharging of groundwater. The use of large structures to detain stormwater runoff reduces peak flows, but high stream flow persists because the structures have limited storage capacity and do not allow infiltration, causing erosion. Low Impact Development reduces impervious surfaces and encourages infiltration—more closely matching a site's natural hydrology.

Comparative Performance of Stormwater BMPs



Adapted from *Maryland Stormwater Design Manual,* Maryland Dept. of the Environment

III. Stormwater Management Regulations in Maryland

Maryland regulations represent the state of the art for stormwater policy in the United States. Faced with a declining Chesapeake Bay, Maryland was one of the first states to recognize the importance of managing stormwater, especially in regard to water quality, and has continued to improve its regulations.

The Maryland Department of the Environment (MDE) is the overall authority for implementing Maryland's stormwater management program. MDE delegates authority to counties and municipalities to administer and enforce their own stormwater management programs. Counties and municipalities formulate local ordinances that follow the Maryland state regulations or enact even stricter regulations.

As part of the development process, a stormwater management plan must be approved by the county or municipal authority before construction begins. The local inspector ensures that the plan is properly implemented and can levy fines and other penalties if a developer fails to follow the plan or address problems promptly.

Spelling It Out

- Maryland's stormwater management law is written in the Annotated Code of Maryland, Environment Article, Title 4, Subtitle 2.
- Stormwater regulations are contained in the:
  - Code of Maryland Regulations (COMAR) 26.17.02
  - *Maryland Stormwater Design*

Construction Projects in Maryland that Require a Stormwater Management Plan:

Any project that disturbs more than 5000 square feet of earth. Some counties require plans for any project that disturbs over 1000 square feet.

Performance Standards

MDE has identified fourteen specific performance standards that each plan must address. The standards can be divided into four main categories (note that these categories coincide with the effects of runoff discussed in the beginning of this guide):

1. Recharge the Water Table — Maryland regulations require the amount of stormwater that can infiltrate into the soil after development is equal to the amount that infiltrated the soil when the site was undeveloped. If a site was completely forested, for example, a development project's stormwater management plan must allow as much stormwater to infiltrate the soil as the original forest cover did.
2. Flood Protection — Stormwater management practices must be able to temporarily store and convey runoff from large storm events to prevent floods.
3. Stream Channel Erosion Protection — Stormwater management practices must slow down and temporarily hold runoff to protect streams from erosion.
4. Water Quality Improvement — Plans must be designed to remove harmful pollutants from stormwater. Specifically, BMPs should remove 80 percent of post-development Total Suspended Solids and 40 percent of total phosphorus. Although most BMPs are also effective in removing nitrogen, MDE doesn't require specify a standard because nitrogen is very difficult to monitor in field tests.

Designing a Stormwater Management Plan

The procedure for calculating the size of stormwater BMPs is outlined in the *Maryland Stormwater Design Manual.* A qualified engineer designs stormwater management plans using complex calculations, like the formula shown to the right. In particular, engineers must calculate four storage volumes which correspond to the four main performance categories outlined above:

1. Recharge Volume — The amount of stormwater storage needed to maintain pre-development water recharge rates.
2. Overbank Flood Protection Volume — The storage needed to prevent the peak flow rate from a two-year storm (about 3.3 inches of rain) from exceeding the pre-development peak flow rate.
3. Channel Protection Storage Volume — The storage needed to detain a 1-year storm event (about 2.6 inches of rain) for 12 or 24 hours to protect streams from erosion.
4. Water Quality Volume — The storage needed to capture and remove the pollutants from the runoff of a one-inch storm. The vast majority of pollutants are carried in the runoff from the first inch of rainfall.

These four volumes determine the size of stormwater structures, ponds, constructed wetlands, and Low Impact Development BMPs such as bioretention facilities. Site plans that meet all four storage volume criteria are assumed to be in compliance with the four main performance categories and therefore in compliance with the stormwater management regulations.

Water Quality Volume Formula

$WQv = (P)(Rv)(A)/12$

where:

WQv = water quality volume (in acre-feet)

P = 1.0 inches of rainfall

$Rv = 0.05 + 0.009(I)$ where I is the percentage impervious cover

A = area in acres

The larger the total impervious surface area, the larger the stormwater management structures must be. A developer who uses Low Impact Development techniques can significantly reduce impervious surface area, thereby reducing the size of large stormwater structures or the need for large structures entirely.

Incentives for Low Impact Development

The Maryland stormwater regulations provide credits for developers who use Bay-friendly, Low Impact Development practices. The credits allow for reductions in the size of large stormwater structures.

- Low Impact Development Credit — All disconnected impervious surface runoff directed towards BMPs like grass channels or vegetated areas is subtracted from the site's overall impervious surface area. For example, the plan for a new development includes a total impervious surface area of 10,000 square feet. The developer decides to divert the runoff from a 1,000 square-foot roof away from a stormwater pond and towards a vegetated area. Now, the impervious surface area for determining the size of the stormwater pond is 9,000 square feet.
- Natural Area Conservation Credit — Natural areas permanently conserved in a land trust or conservation easement are subtracted from the total site area when calculating the size of large stormwater structures.
- Environmentally Sensitive Development Credit — If a new development meets all the following criteria, *no large stormwater structures* need to be constructed.
    1. Less than 15 percent of the site is impervious.
    2. Rooftop runoff is disconnected and directed to a vegetated area.
    3. Grass channels are used instead of curb and gutter systems.
    4. At least 25 percent of site is permanently conserved.
    5. Lots are larger than two acres or, preferably, lots are clustered and at least one-half acre in size.
    6. Any remaining impervious surfaces, like roads or driveways, must satisfy all four storage volume criteria by using Low Impact Development techniques.

See Chapter 5 of the *Maryland Stormwater Design Manual* for complete information on Maryland's incentives for Low Impact Development.

Inspections and Enforcement

County and municipal inspectors must perform periodic inspections during and immediately after construction to certify that developers follow the approved SWM plans. Subsequent inspections are required: once during the first year after construction and then once every three years to ensure that structures are properly maintained and performing up to standard.

County and municipal inspectors have several tools for enforcing stormwater regulations and ensuring problems are quickly addressed. They can issue fines and penalties as described in the following table.

County and Municipal Consequences for Stormwater Management Violations

Enforcement Method	Time Frame	Fines	Comments
Formal Complaint	During or after construction	Not applicable	Complaints are issued first if stormwater management techniques are not effective. Developers must correct deficiencies to avoid further penalties. Issued when: 1. Stormwater management plan is not followed. 2. Stormwater management structures are not properly maintained. 3. Stormwater management structures not adequate, even if the plan is followed.
Stop Work Order	During construction	Not applicable	All construction onsite is stopped until violation is resolved. Used if problem is not fixed promptly—can be more effective than fines since "time is money" for developers.
Fines	During or after construction	Up to $1,000 per day of violation*	Used after formal complaint if not addressed promptly. Similar to a ticket issued by a police officer.
Civil Penalties	During or after construction	Up to $10,000 per day of violation*	Court proceedings—last resort for prosecuting developers that refuse to fix problems.
Criminal Penalties	During or after Construction	Up to $10,000 per day of violation* and/or up to one year in jail	

* Each day a violation remains uncorrected may be considered as a separate violation. For example, the fine issued by an inspector for a 10-day unresolved violation would total 10 times $1000, or up to $10,000.

IV. Opportunities for Citizen Involvement

Although citizens are not qualified to challenge the complex calculations behind stormwater management plans, citizens can play an important role in the planning and management of stormwater systems. Listed below are several ways in which citizens can help promote proper stormwater management practices and ensure that existing stormwater structures function properly.

What to Look for in New Developments

- Encourage Low Impact Development — Inform developers about Maryland's incentives for using Low Impact Development techniques. Encourage designs that preserve natural vegetation, protect streams and wetlands, and reduce impervious surfaces. The Low Impact Development Center and Prince George's County are excellent resources. (See Section V, "For More Information.")

- Advocate for Upgrades to Your Local Zoning, Site Plan, and Subdivision Ordinance to Protect Water Quality — Low Impact Development techniques that reduce impervious surfacing may require a change in local ordinances. These include setbacks, clustering, parking standards, road-width standards, and stream buffer requirements.

- Report Stormwater Violations — Usually, there are only a few inspectors responsible for checking all the stormwater management systems in a county or municipality. Therefore, citizens can play a crucial role in ensuring that systems are properly constructed and maintained. Often, problems with stormwater management structures are most evident during a storm event. Be aware that a stormwater management system is not necessarily malfunctioning if you see an overflowing pond or runoff flowing across your lawn from houses uphill. Stormwater management systems are not designed to handle very large storms. Appendices A-C can help you identify and address the most common large stormwater structure problems. Refer to Part 3 of *Influencing Development in Your Community*: *A Citizen's Guide for Maryland* for procedures on reporting violations.

See the Chesapeake Bay Foundation publication, *Influencing Development in Your Community*: *A Citizen's Guide for Maryland,* for information on how citizens can get involved in the development and planning process.

County and municipal inspectors usually work under the Offices of Inspections and Permits or Planning and Zoning. Links to county and municipal offices can be found at: www.mdp.state.md.us/info/localplan/counties.html

Opportunities for Citizen Involvement (cont.)

What to Look for in Existing Stormwater Facilities

- Ensure the Proper Maintenance of Stormwater Management Structures — Organize your neighbors or community association to develop an inspection and maintenance plan for your neighborhood's large stormwater structures. Appendix B lists common stormwater problems and their solutions. Appendix C is a simple inspection and maintenance schedule for large stormwater structures. Two excellent publications provide further guidance for community associations and are available online. See the Section V, "For More Information," to learn where to download *A Citizen's Guide to Maintaining Stormwater Best Management Practices* and *Maintaining Urban Stormwater Facilities: A Guidebook for Common Ownership Communities*.

- Propose the Retrofit of Old Stormwater Systems to Meet Current Standards — Encourage local officials to seek funding through the Maryland Stormwater Pollution Control Cost-Share Program if your community uses curb and gutter systems to convey stormwater or if your stormwater management system is outdated and ineffective. Inadequate systems are common in older communities. Appendix A presents common signs of a system failure.

- Install Rain Barrels and Rain Gardens for Your Own Home — Rain barrels are placed at the bottom of downspouts to collect rainwater and prevent runoff. When connected to a watering hose, a rain barrel can be used to water gardens, trees, and even indoor plants. A rain garden is a small vegetated patch located at a downspout outlet. Rain gardens are planted with low-maintenance native grasses and shrubs that slow runoff and allow it to infiltrate the soil. For more information, visit www.savethebay.cbf.org and search for "rain barrels" and "rain gardens."

> The Maryland Stormwater Pollution Control Cost-Share Program provides grants to counties and local municipalities for upgrading old stormwater systems.
>
> Grants cover up to 75 percent of project costs, with a maximum of $500,000 per project.

Lake County, Illinois Stormwater Management Commission

US Environmental Protection Agency

V. For More Information

Websites
Center for Watershed Protection. A nonprofit organization based in Ellicott City, dedicated to providing stormwater management and watershed planning information to governments, communities, and other organizations. www.cwp.org
Low Impact Development Center. Good information on the economic and environmental advantages of Low Impact Development. Click on "Brochures," a particularly useful section. www.lowimpactdevelopment.org
Low Impact Development Urban Design Tools. An interactive website from the Low Impact Development Center with a design page showing how low impact practices are used in urban, residential, and transportation projects. www.lid-stormwater.net/
Stormwater Center. A comprehensive site by the Center for Watershed Protection with information on BMPs, Low Impact Development (called Better Site Design on this website), and model ordinances. www.stormwatercenter.net
Publications
A Citizen's Guide to Maintaining Stormwater Best Management Practices. Lake County, IL Stormwater Management Commission. A practical guide for community associations interested in maintenance and inspection schedules for large stormwater structures. Download online at www.co.lake.il.us/elibrary/publications/smc/bmpguide.pdf.
Better Site Design: A Handbook for Changing Development Rules in your Community. Center for Watershed Protection. Describes 22 Better Site Design (Low Impact Development) Guidelines and their economic and environmental benefits. Also provides case studies and sample ordinances. Order from www.cwp.org.
Catching the Rain: A Great Lakes Guide for Natural Stormwater Management. American Rivers. An up-to-date and in-depth guide to Low Impact Development (called Natural Stormwater Management on this website). Download the guide from www.americanrivers.org/newreportonstormwatermanagement.html.
Clean Water in Your Watershed: A Citizen's Guide to Watershed Protection. Terrene Institute in cooperation with the US Environmental Protection Agency. A guide to help citizens work with government to protect their watershed from runoff pollution. Order from www.enviroscapes.com.
Maintaining Urban Stormwater Facilities: A Guidebook for Common Ownership Communities. Montgomery County Department of Environmental Protection. A practical guidebook for communities to maintain and inspect large stormwater structures. Available online from www.montgomerycountymd.gov.
Maryland Stormwater Design Manual. The complete stormwater guide for Maryland. Visit www.mde.state.md.us, and search for *Stormwater Design Manual*.
Prince George's County Stormwater Manuals. Excellent information on bioretention and Low Impact Development. Visit www.goprincegeorgescounty.com, and search for bioretention and Low Impact Development.
Turning the Tide: A Citizen's Guide to Reducing Nonpoint Source Pollution. Harborwatch, Inc. and South Carolina Department of Health and Environmental Control. Describes nonpoint pollution (runoff) and what citizens can do to reduce it in their community. To order, call 803/734-5300.
Applicable Maryland Stormwater Management Laws and Regulations
State Code of Maryland, Environment Article, Title 4, Subtitle 2: Stormwater Management.
Code of Maryland Regulations (COMAR), 26.17.02.
Maryland Department of the Environment. *Maryland Stormwater Design Manual, Volumes I and II.* October 2000.

Appendix A: Signs of a Degraded Stormwater BMP

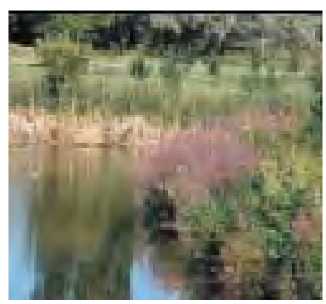
Eroding bank

Algae blooms

Native vegetation mowed to water's edge

Broken outlet pipe

Clogged trash rack



Invasive plants, such as Purple Loosestrife

Cracked outlet pipe

From *A Citizen's Guide to Maintaining Stormwater Best Management Practices.* Lake County, Illinois Stormwater Management Commission.

Appendix B: Solutions to Stormwater BMP Problems

Problem	Evidence	Solution
Trash accumulation in and around the BMP	Trash and debris settled in basin bottom, floating in wet pond, collected on trash rack, or blocking inlets or outlets.	Remove trash from BMP; organize neighborhood trash pickup; contact local school or scout troop and offer prizes for largest item found or most trash collected.
BMP clogged with accumulated sediment	Pond or wetland depth and volume noticeably reduced, excessive algae blooms	Contact the county cooperative extension office for reputable environmental consulting firms or dredging companies in your area. Dredging is an expensive but infrequent requirement for stormwater BMPs. See Appendix C for a complete maintenance schedule.
Using excess or incorrectly applied fertilizers	Excessive algal growth and fish kills	Go to www.savethebay.cbf.org click on *Take Action*, then *Bay Friendly Living*, then *10 Steps to a Bay Friendly Lawn* for a factsheet on organic lawn and garden fertilizer and on proper fertilizer use. Distribute it in your neighborhood; encourage your neighbors to closely follow manufacturer's instructions on concentration and application rates for fertilizers and follow recommended application periods (contact the county cooperative extension office).
Oil or other toxic substances	Oily sheen on basin bottom or on surface of pool area; presence of dead fish or other aquatic organisms	Go to www.savethebay.cbf.org click on *Take Action*, then *Bay Friendly Living*, then *De-tox Your Home* for a factsheet on reducing the use of hazardous chemicals and proper disposal of hazardous household waste. Encourage your neighbors to follow manufacturer's directions for concentrations and application of pesticides. Encourage the recycling of used motor oil—go to www.menv.com for a list of Maryland recycling locations.
Bare, exposed areas in or around pond or in areas draining to or from the BMP	Water in pond is cloudy; eroded soil	Fill eroded areas with soil and spread hay on temporarily disturbed areas; reseed and stabilize disturbed areas as soon as possible; organize planting of grass or shrubs in disturbed areas; plant water loving shrubs if disturbed areas are adjacent to pond.

Adapted from *Maintaining Urban Stormwater Facilities: A Guidebook for Common Ownership Communities.* Montgomery County Department of Environmental Protection.

APPENDIX C: STORMWATER BMP INSPECTION SCHEDULE

ROUTINE MAINTENANCE
Wet and Dry Ponds (with or without strormwater wetlands)

	Inspection Schedule
☑ Remove accumulated debris and litter, especially around the inlet areas.	monthly
☑ Mow routinely unless there is native vegetation.	as needed
☑ If native vegetation exists, do not mow. Consider burning as an alternative.	annually
☑ Remove woody vegetation from all embankment areas.	as needed
☑ Stabilize/revegetate side and bottom areas.	as needed

NON-ROUTINE MAINTENANCE

☑ De-thatch grass to remove accumulated sediment and debris	< every 2 years
☑ Aerate compacted areas to promote infiltration	< every 2-3 years
☑ Monitor sediment accumulations, and remove sediment when the pool volume has become reduced significantly (roughly 15-20% of the pond), or when the pond becomes eutrophic; 2-10 years for dry ponds; 5-15 for wet ponds	semi-annual inspection
☑ Replace BMP components, reconstruct embankments and spillways	> 20 years if maintained

ROUTINE MAINTENANCE
Vegetated Swales, Buffers

☑ Remove accumulated debris, litter and sediment.	monthly
☑ Mow routinely unless there is native vegetation.	as needed
☑ If native plants exist, do not mow. Use burning as an alternative.	annually
☑ Remove woody vegetation and stabilize and revegetate side and bottom areas.	annually
☑ Stabilize and revegetate contributing areas to reduce incoming sediments.	annually

NON-ROUTINE MAINTENANCE

☑ Remove accumulated sediment/pollutants.	as needed

ROUTINE MAINTENANCE
Stormwater Wetland

☑ Remove accumulated debris and litter.	monthly
☑ Supplement wetland plants if a signficant portion have not established (at least 50% of the surface area).	annually
☑ Inspect for invasive species and remove where possible.	monthly
☑ Hire a professional for prescribed burns to encourage native plant growth and discourage non-natives.	annually

NON-ROUTINE MAINTENANCE

☑ Remove accumulated sediment/pollutants.	as needed

From *A Citizen's Guide to Maintaining Stormwater Best Management Practices.* Lake County, Illinois Stormwater Management Commission.

CHESAPEAKE BAY FOUNDATION
Save the Bay

Founded in 1967, the Chesapeake Bay Foundation is the largest nonprofit conservation organization working solely to Save the Bay. CBF's mission is to restore and sustain the Chesapeake Bay's ecosystem by substantially improving the water quality and productivity of the watershed, with respect to water clarity, resilience of the system, and diversity and abundance of living resources, and to maintain a high quality of life for the people of the Chesapeake Bay region.

The Chesapeake Bay Foundation is a charitable, tax-exempt organization under Section 501(c)(3) of the Internal Revenue Code.

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