Chapter 2 Selecting BMPs

Pollution Prevention BMPs

Design Phase

Replacing natural cover and soils with impervious surface leads to increased runoff, which adversely affects natural systems through flooding, channel erosion and increased pollutant loads. Research demonstrates a marked drop in fish, amphibian and insect species when the percentage of imperviousness in a watershed exceeds 10 to 15 percent. (Schueler, 1994.)

With careful site planning, developers and municipalities can reduce the amount of impervious area created by pavement and roofs and thus reduce the volume of runoff and associated pollutants requiring control. The Impervious Surface Reduction section of Chapter 3 of this manual includes details in these six areas:

- Cul-de-Sac Design
- Driveway Design
- Parking Lot Design
- Street Design
- Turf Pavers
- Green Rooftops

Construction Phase

Erosion and sediment control are critical to every construction project. Methods to prevent the export of sediments should be planned during the site design process. The most effective practices are presented in Chapter 3 under the following headings:

Construction Practices

- Vehicle Tracking Pads
- Grading
- Sequencing

Sediment Control

- Silt Fences
- Inlet Protection
- Temporary Sedimentation Basins/Traps
- Check Dams

Soil Erosion Control

- Mulch, Blankets and Mats
- Structural Methods
- Vegetative Methods

Questions to Ask Before Construction

- ***Will vehicles be entering and exiting the construction site with soil-laden tires?***

  If yes, implement Vehicle Tracking Pads.

- ***Will grading occur on site?***

  If so, try to minimize its extent – see the Grading BMP section. In addition, refer to the Sequencing and Silt Fence BMPs for other ways to erosion potential. When grading is complete, disturbed soil should be covered as soon as possible; see the Fabrics and Mulch, Blankets and Mats and Vegetative Methods sections.

- ***Will there be long slopes of disturbed soil?***

  If so, refer to the Structural Methods BMP section.

- ***Will a stormwater inlet be constructed on site?***

  If so Inlet Protection must be constructed.

- ***Will sediment loads be too large to be captured in a silt fence or is there a sensitive water body downstream?***

  If this is the case, employ Temporary Sedimentation Basins or Traps for extra protection.

- ***Will you be designing a swale or water diversion resulting in channelized or concentrated flow over disturbed soil?***

  To prevent excessive sediment transport, Check Dams could be constructed within the swale to capture the sediment. At minimum, erosion control blankets and/or mats will be necessary (Mulch, Blankets and Mats).

Post-Construction

After a project is built, cleanup practices and appropriate ongoing management are necessary to prevent contaminants from washing off the land and pavement and into water bodies. The Housekeeping portion of this manual describes these four basic areas of concern:

- Pavement Management
- Animal Management
- BMP Maintenance
- Landscape Design and Maintenance

See these sections in Chapter 3 for in-depth information on a variety of practices.

Source

1. Schueler, Thomas R. 1994. “The Importance of Imperviousness” in *Watershed Protection Techniques*. 1(3):100-111. Center for Watershed Protection, Ellicott City, MD.

Stormwater Treatment BMP Selection Matrix[1]

This section outlines a process for selecting the best stormwater treatment BMP or group of BMPs for a small site and provides factors to consider for their placement. The three-step process described below should be used to select which BMPs can best meet predetermined pollutant removal targets. This process guides the designer through three steps that progressively screen:

- Stormwater Treatment Suitability
- Physical Feasibility Factors
- Community and Environmental Factors

The Three-Step Process

Step ❶ Stormwater Treatment Suitability

Use the stormwater treatment matrix to answer the following question:

Can the BMP meet the stormwater rate, volume, and water quality treatment requirements mandated by local regulations at the site or are a combination of BMPs needed?

In this step, designers can screen the BMP list using the Step 1 matrix to determine if a particular BMP can meet the rate, volume, and water quality requirements they have identified. At the end of this step, the designer can reduce the BMP options to a manageable number and determine if a single BMP or a group of BMPs are needed to meet stormwater sizing criteria at the site.

Step ❷ Physical Feasibility Factors

Use the stormwater treatment matrix to answer the following question:

Are there any physical constraints at the project site that may restrict or preclude the use of a particular BMP?

In this step, the designer screens the BMP list using Step 2 matrix to determine if the soils, water table, drainage area, slope or head conditions present at their development site might limit the use of a particular BMP. In addition, the second matrix indicates whether a BMP is capable of treating hotspot runoff and provides comparative indexes on land consumption.

Step ❸ Community and Environmental Factors

Use the stormwater treatment matrix to answer the following question:

Do the remaining BMPs have any important community or environmental benefits or drawbacks that might influence the selection process?

In this step, the third matrix is used to compare the 16 stormwater treatment BMP options with regard to maintenance, community acceptance, habitat and cost.

[1]Adapted from the *Maryland Stormwater Design Manual*, Maryland Department of the Environment.

Step ❶ Stormwater Treatment Suitability Matrix

Runoff Hydrology

Rate Control

The matrix indicates the relative capacity of the BMP to provide rate control. If a particular BMP cannot meet the full rate control requirement it should not be necessarily eliminated from consideration, but it is an indication that more than one practice may be needed at a site (e.g., a bioretention area and a downstream stormwater wetland).

Volume Reduction

The matrix indicates the relative effectiveness in reducing the volume of stormwater runoff. Again, the fact that a particular BMP cannot fully meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at a site.

Water Quality

The four columns under the Water Quality heading are (1) TSS - Total Suspended Solids, (2) P & N - Phosphorus and Nitrogen, (3) Metals, and (4) Fecal Coliform. These columns indicate a particular BMP's expected benefits for each of the four constituents. A "primary" in a column indicates that this is a primary benefit of the BMP. A "secondary" indicates the BMP has some benefit but it is not the intended or primary benefit. A "minor" indicates there is little or no benefit using this BMP to control this constituent. It should be understood that a "primary" rating under the TSS column, for example, for wet vaults and a "primary" rating of TSS for an infiltration basin does not mean that the benefit or performance is the same or even similar. Rather it means that TSS removal is a primary benefit of each of these BMPs. It is not a comparison of BMP performance to one another.

Step ❶ Stormwater Treatment Suitability Matrix

BMP Family	BMP List	RUNOFF HYDROLOGY		WATER QUALITY BENEFIT			
		Rate Control	Volume Reduction	TSS	P & N	Metals	Fecal Coliform
Retention	Wet Pond	High	Low	Primary	Secondary	Secondary	Secondary
	Extended Storage Pond	High	Low	Primary	Secondary	Secondary	Secondary
	Wet Vaults	Medium	Low	Primary	Secondary	Secondary	Minor
Detention	Dry Pond	High	Low[1]	Secondary	Minor	Minor	Minor
	Oversized Pipes	High	Low	Minor	Minor	Minor	Minor
	Oil Grid/Separator	Low	Low	Secondary	Minor	Minor	Minor
	Dry Swale	Medium	Low[1]	Primary	Secondary	Primary	Minor
Infiltration	On-Lot Infiltration	Medium	High	Primary	Primary	Primary	Secondary
	Infiltration Basin	Medium	High	Primary	Primary	Primary	Secondary
	Infiltration Trench	Medium	High	Primary	Primary	Primary	Secondary
Wetland	Stormwater Wetland	High	Medium	Primary	Secondary	Secondary	Primary
	Wet Swale	Low	Low	Primary	Secondary	Secondary	Minor
Filtration	Surface Sand Filters	Low	Low[1]	Primary	Secondary	Primary	Secondary
	Underground Filters	Low	Low	Primary	Secondary	Primary	Secondary
	Bioretention	Medium	Medium	Primary	Primary	Primary	Secondary
	Filter Strips	Medium	Medium	Secondary	Minor	Minor	Minor

[1]Mayprovide some volume reduction depending on permeability of native soil.

Step ❷ Physical Feasibility Factors Matrix

At this point, the designer has narrowed down the BMP list to a manageable size and can evaluate the remaining options given the actual physical conditions at a site. The six primary factors are:

Soils

The key soils evaluation factors are based on an initial investigation of the Natural Resources Conservation Service (NRCS) hydrologic soils groups at the site. Note that more detailed geotechnical tests are usually required for infiltration feasibility and during design to confirm permeability and other factors.

Water Table

This column indicates the recommended minimum depth to the seasonally high water table from the bottom or floor of a BMP. The designer should check to see that local regulations do not require further restrictions, primarily with respect to infiltration and runoff from hot spots.

Drainage Area

This column indicates whether or not the BMP is considered suitable for small sites of 5 acres or less. The restrictions indicated for ponds and sometimes wetlands should not be considered inflexible limits and may be increased or decreased depending on water availability (baseflow or groundwater).

Head

This column provides an estimate of the elevation difference needed at a site (from the inflow to the outflow) to allow for gravity operation within the practice.

Area Requirements

This comparative index expresses the typical space or area requirements for the BMP. A "low" indicates that the BMP consumes a relatively small amount of land, whereas a "high" indicates the BMP may consume a relatively high fraction of land at a site. This factor is included in this early screening stage because many BMPs are severely constrained by land consumption.

The Ability to Accept Hotspot Runoff

This last column examines the capability of a BMP to treat runoff from hotspots. Hot spots are sites that produce exceptionally contaminated stormwater from surfaces such as vehicle salvage yards or industrial sites. A BMP that receives hotspot runoff may have design restrictions as noted, in addition to Local and State restrictions.

This does not imply that a single BMP would be adequate to treat an entire small site. Typically several BMPs, either the same type or different, will be required to adequately treat the runoff from a small site.

Step ❷ Physical Feasibility Factors Matrix

BMP Family	BMP List	Soil Considerations	Water Table[1]	Suitable for Site ≤ 5 acres	Head (feet)	Area Require-ments	Accepts Hotspot Runoff
Retention	Wet Pond	"A" soils may require pond liner	3 feet if hotspot or aquifer	Limited[4]	3 – 8	High	Varies[2]
	Extended Storage Pond	"B" soils may require testing		Limited	4 – 8	High	Varies[2]
	Wet Vaults	NA	NA	Yes	4 – 8	Low	Yes
Detention	Dry Pond	"A" soils may require pond liner "B" soils may require testing	3 feet if hotspot or aquifer	Yes	3 – 8	High	Varies[2]
	Oversized Pipes	NA	NA	Yes	5 – 10	Low	Yes
	Oil Grit/Separator	NA	NA	Yes	4 – 8	Low	Yes
	Dry Swale	Any soil type	3 feet	Yes	3 – 5	Med.	Yes[3]
Infiltration	On-Lot Infiltration	"A" and "B" soils preferred "C" soil difficult "D" soil not recommended	3 feet	Yes	1	Med.	No
	Infiltration Basin		3 feet	Yes	3 – 5	High	No
	Infiltration Trench		3 feet	Yes	2 – 4	Med.	No
Wetland	Stormwater Wetland	Any soil type if below water table	NA	Limited	2 – 6	High	Varies[2]
	Wet Swale	Any soil type if below water table	Below water table	Yes	3 – 5	Med.	No
Filtration	Surface Sand Filters	Any soil type	3 feet or 0 feet with liner	Yes	2 – 4	High	Yes[3]
	Underground Filters	NA	NA	Yes	4 – 8	Low	Yes
	Bioretention	Planting soil	3 feet	Yes	3 – 5	High	Yes[3]
	Filter Strips	Any soil type	3 feet	Yes	1	Med.	Yes

1 Recommended minimum elevation above water table. Check with state and local regulations.

2 Varies depending on type and concentration of contaminants in the runoff and depth to the water table.

3 Yes, but only if bottom of facility includes an impermeable liner that prevents infiltration of highly contaminated water into the groundwater.

4 Suitable only if a consistent source of water (such as groundwater) is available or if the pond is constructed with a liner or in clay soils.

Step ❸ Community and Environmental Factors Matrix

Maintenance

This column in the matrix assesses the relative maintenance effort needed for a BMP in terms of three criteria: frequency of inspection, scheduled maintenance and chronic maintenance problems (such as clogging). It should be noted that all BMPs require routine inspection and maintenance.

The amount of maintenance required is also a function of proper BMP selection, design, and construction. For this column, it was assumed that these steps were all completed properly.

Community Acceptance

This column in the matrix assesses community acceptance, as measured by three factors: market and preference surveys, reported nuisance problems, and visual orientation (e.g., is it prominently located or is it in a discreet underground location). It should be noted that a low rank can often be improved by a better landscaping plan.

Construction Cost

The BMPs are ranked according to their relative construction cost per impervious acre treated as determined from cost surveys and local experience.

Wildlife Habitat

BMPs are evaluated on their ability to provide wildlife or wetland habitat, assuming that an effort is made to landscape them appropriately. Objective criteria include size, water features, wetland features and vegetative cover of the BMP and its buffer.

Step ❸ Community and Environmental Factors Matrix

BMP Family	BMP List	Maintenance	Community Acceptance	Cost (Relative to Drainage Area)	Wildlife Habitat
Retention	Wet Pond	Low	High	Low	Medium
	Extended Storage Pond	Low	Medium	Low	Medium
	Wet Vaults	High	High	High	None
Detention	Dry Pond	Medium	Medium	Low	Low
	Oversized Pipes	Low	High	High	None
	Oil Grit/Separator	High	High	High	None
	Dry Swale	Medium	High	Medium	Low
Infiltration	On-Lot Infiltration	Medium	Medium	Low	Medium
	Infiltration Basin	Medium	Medium	Medium	Medium
	Infiltration Trench	Medium	Medium	Medium	None
Wetland	Stormwater Wetland	Low	High	Medium	High
	Wet Swale	Medium	High	Low	Medium
Filtration	Surface Sand Filters	Medium	Medium	High	Low
	Underground Filters	High	High	High	None
	Bioretention	Medium	Medium	Medium	Medium
	Filter Strips	Low	High	Low	Medium