Lesson 2: Stormwater Best Management Practices (BMPs)

Environmental Stewards Class
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Christopher C. Obropta, Ph.D., P.E.
Extension Specialist in Water Resources
732-932-9800 ext. 6209
obropta@envsci.rutgers.edu
www.water.rutgers.edu
Stormwater BMPs

- "a technique, measure or structural control that is used for a given set of conditions to manage the quantity and improve the quality of stormwater runoff in the most cost-effective manner"
  - USEPA
- Two Types
  - Structural
  - Nonstructural
Stormwater BMPs

- Structural
  - Engineered to control both the quantity and quality of stormwater runoff

- Non-structural
  - Educational
  - Policy changing
  - Source-targeting (pollution prevention)
Reducing nonpoint source pollution

- **Structural**
  - stormwater management basins
  - silt fences

- **Non-structural**
  - minimize impervious cover
  - minimize disturbance
  - maximize vegetation, minimize lawns
  - minimize vegetation that needs fertilizer
Stormwater BMPs

• Ultimate goal of both BMP types:
  1. control stormwater flow
  2. remove pollutants
  3. manage and/or reduce pollutant sources
Household BMPs

- “Careless or uninformed household management contributes to NPS pollution problems”
  - USEPA
- “Although individual homes might contribute only minor amounts of NPS pollution, the combined effect of an entire neighborhood can be serious”
  - USEPA
Household BMPs

1. Limit impervious surfaces
2. Low impact development
3. Green Landscaping
4. Water conservation
5. Proper chemical use, storage, and management
6. Proper septic management
7. Stormwater control measures
Impervious Surfaces

- Prevent water infiltration
- Cause pollutants to accumulate
- Cause runoff to funnel into storm drains at high speeds
- Paved surfaces transfer heat to runoff (biological and ecological implications)
## Impervious Surfaces

<table>
<thead>
<tr>
<th>Traditional</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete or mortared brick or stone patios</td>
<td>Wood decks or dry (not mortared) brick or stone patios</td>
</tr>
<tr>
<td>Concrete or conventional asphalt driveways</td>
<td>Gravel, pervious asphalt, or grass paving (with open cells of plastic or concrete)</td>
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<tr>
<td>Paved paths</td>
<td>Gravel or mulch paths, pervious asphalt</td>
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Types of Impervious Cover

Total Impervious Area (TIA) vs. Effective Impervious Area (EIA)

Connected vs. Disconnected
Runoff Direction

1 acre directly connected
impervious cover
CN = 98

2 acres pervious cover
CN = 65

Total drainage area = 3 acres

Runoff Direction

For 1.25 inch storm, 3,811 cubic feet of runoff = 28,500 gallons.
For 1.25 inch storm, 581 cubic feet of runoff = 4,360 gallons.
Comparing
Connected
Impervious Surfaces
to
Disconnected
Impervious Surfaces
Problems with Traditional Landscaping

- Excess application and improper use and disposal of pesticides and fertilizers
  - The average homeowner over-applies pesticides and fertilizers
  - Most people dump excess pesticides on the ground, in drains, and in the trash rather than taking them to hazardous waste collection sites
- Erosion
  - Traditional turf lawns are poor at preventing erosion and absorbing rainfall
  - Native plants have better root structure for preventing erosion
- Spills and emissions from power equipment
- Over watering
- Ornamental plants can become invasive, require more maintenance
Green Landscaping

- Native plants instead of ornamental gardens and turf grass lawns
- Increased plant variety
- Naturally designed landscapes
- Integrated Pest Management
Green Landscaping

Reduce the use of power equipment
Benefits of Green Landscaping

- Requires less maintenance
- Reduces environmental harm
- Benefits wildlife
- Provides seasonal interest
- Saves money
To use less water:

• Cluster plants together and mulch them with compost to conserve moisture.
• Avoid planting or transplanting during the summer.
• Water in the early morning instead of mid-day so that less water evaporates.
• Water once deeply rather than several times lightly to encourage the development of deep roots.
• Use a rain gauge and timers to avoid over watering.
Stormwater Controls

Diverting stormwater from drains will help reduce the impact to receiving lakes and streams

1. Rain Gardens (bioretention systems)
2. Rain Barrels
3. Green Roofs
4. Dry Wells
Examples

Building on the Past – Providing Solutions for the Future
Rain Gardens

• Can be placed in strategic areas around the home landscape to capture rainfall and roof and impervious runoff

• Native plants that are water and climate tolerate are used

• Help control stormwater and nonpoint pollution while adding to the aesthetics of the landscape
Rain Gardens (Bioretention Basins)

Grass Buffer  This surrounds a rain garden and reduces runoff velocities, filtering out particulates.
Depression  The depression stores runoff awaiting treatment, presetting particulates that have not been filtered out by the grass buffer.

Plants  Plants are selected on their ability to cycle and assimilate nutrients, pollutants, and metals.

Ponding Area  Surface must be level for maximum infiltration.

Organic or Mulch Layer  This layer acts as a filter for pollutants, protects the soil from eroding, and provides an environment for microorganisms to degrade petroleum-based products and other pollutants.
Sand Bed  A sand bed further slows runoff, spreading the water over the basin. The sand helps to prevent anaerobic conditions in the planting soil and enhances exfiltration from the basin.

Planting Soil Layer  The soils provide needed nutrients while absorbing heavy metals, hydrocarbons, and other pollutants.
Your Rain Garden is composed of woody plants (trees and shrubs) and herbaceous species (flowers, grasses, and ground covers) planted in three wetness zones.

The lowest zone supports plant species that can tolerate standing water and fluctuating water levels.

The middle zone is slightly drier, but also supports plant species that can tolerate fluctuating water levels.

The outer edge or highest zone generally contains plant species that prefer drier conditions.
Pollutant Removal Mechanisms

- Absorption to soil particles
  - Removes dissolved metals and soluble phosphorus
- Plant uptake
  - Removes small amounts of nutrients
- Microbial processes
  - Removes organics and pathogens
- Exposure to sunlight and dryness
  - Removes pathogens
- Infiltration of runoff
  - Provides flood control, groundwater recharge, and nutrient removal
- Sedimentation and filtration
  - Removes total suspended solids, floating debris, trash, soil-bound phosphorus, some soil-bound pathogens

NOTE: 90% of all storm events produce less than 1 inch of rain. Therefore, the key to reducing pollutant loads is to treat the runoff associated with the first 1 inch of rain (Clayton & Schueler, 1996).
Rain Gardens/Bioretention Systems

• Stormwater runoff entering the bioretention system is filtered first through the vegetation and then the sand/soil mixture before being conveyed downstream by the underdrain system.

• They can be installed in lawns, median strips, parking lot islands, unused lot areas, and certain easements. They are intended to receive and filter storm runoff from both impervious areas and lawns.

Dry Well

- Receives and temporarily stores stormwater runoff from roofs.
- Discharge of this stored runoff from a dry well occurs through infiltration into the surrounding soils.
- Structural chamber and/or an excavated pit filled with aggregate.

Stormwater Wetlands

- Temporarily store runoff in relatively shallow pools that support conditions suitable for the growth of wetland plants.
- Remove a wide range of stormwater pollutants from land development sites.
- Provide wildlife habitat and aesthetic features.

Extended Detention Basins

- Detains and attenuates runoff inflows
- Promotes the settlement of pollutants
- Address both the stormwater runoff quantity and quality impacts of land development
Infiltration Basin

- Constructed within highly permeable soils that provides temporary storage of stormwater runoff.
- Does not normally have a structural outlet to discharge runoff
- Used to remove pollutants and to infiltrate stormwater back into the ground
Manufactured Treatment Devices

- pre-fabricated stormwater treatment structure utilizing settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to remove pollutants from stormwater runoff.
Pervious Paving

UNI ECO-STONE®

Sand Filters

Optional Topsoil and Turf Grass

Sand Bed
18” Minimum Thickness

Gravel and Perforated Pipe Underdrain

Typical Sand Bed Section

Vegetative Filters

Wet Ponds