Types and Basic Design of Post-Construction BMPs

FOR RESIDENTIAL LANDSCAPERS

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What Are Post-Construction BMPs?

- Permanent practices that reduce storm water volume and/or the discharge of pollutants in storm water runoff

- Two types
  - Non-structural BMPs
    - Prevent the creation of runoff by reducing the footprint and sprawl of impervious area
    - Maintain or enhance protective buffers between the land and the water
  - Structural BMPs
    - Treat runoff before it is discharged from the site by settling, filtering, absorbing or adsorbing pollutants
    - Some rely on biological action, so maintenance of desired plantings is important
    - Reduce runoff by infiltrating, or harvesting and reusing it
Structural vs Non-Structural BMPs

Bioretention Area vs Conservation Development

Wet Extended Detention Pond vs Riparian Setbacks
Requirements for Post-Construction BMPs

- Must be provided on all new development or redevelopment where larger common plan (LCP) disturbs 1 or more acre
  - Includes parcels less than 1 acre if part of LCP
- Structural BMPs must be incorporated into the permanent drainage systems of the site
  - Where LCP disturbs ≥ 5 acres
    - BMP must treat the Water Quality Volume (WQv)
    - BMP must provide an additional storage area for accumulated pollutants ≥ 20% WQv
  - For small construction sites, per requirements of community
- Long-term maintenance plan must be provided for all post-construction BMPs
  - Community must ensure that property owner or home owners’ association (HOA) is implementing plan
BMPs for Residential Development

- **Structural BMPs**
  - Bioretention Area or “Rain Gardens”
  - Rain Barrels
  - Downspout Disconnection to Vegetated Filter Strip or Infiltration
  - Permeable Pavement
  - Extended Detention Ponds
    - Wet and Dry Ponds
    - Constructed Wetlands

- **Non-Structural BMPs**
  - Riparian Corridors
Bioretention Areas

Cleveland WPC Building
Bioretention Retrofit

US EPA Green Infrastructure Demonstration Project

Seven Hills City Hall
Cross Section of Bioretention Area

>24” planting soil mix

2-3” filter – clean concrete sand

2-3” filter - clean gravel (#8)

12” clean gravel (#57)

Use specifications found in *Rainwater and Land Development*
http://www.dnr.state.oh.us/tabid/9186/Default.aspx
# Planting Soil Mix

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Type</td>
<td>Sandy Loam</td>
</tr>
<tr>
<td></td>
<td>➢ &gt; 80% Sand &lt; 10% Clay</td>
</tr>
<tr>
<td></td>
<td>➢ Sand shall be clean and meet AASHTO M-6 or ASTM C-33</td>
</tr>
<tr>
<td>pH</td>
<td>5.2 – 8.0</td>
</tr>
<tr>
<td>Organic Matter</td>
<td>3 – 5% by Weight</td>
</tr>
<tr>
<td>Phosphorus Content</td>
<td>15-60 mg/kg by Mehlich3</td>
</tr>
<tr>
<td>Soil Test Certification</td>
<td>Soil mixes must be certified by a qualified laboratory (1 test per 100 yd³ of soil)</td>
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</tbody>
</table>

By volume, this roughly equates to 75% sand, 15% topsoil & 10% organic matter. Good source of organic matter is leaf compost, pine bark fines & mulch fines.
Installing Bioretention Areas

- Ideal drainage area is 0.5 – 2.0 acres
- Planting soil mix shall be placed in 12-18 in lifts and only lightly compacted
- Mulch shall be placed once planting soil has had chance to settle to avoid excess compaction
  - 3 inches of course shredded hardwood
  - Pine mulch or fine/chipped hardwood not recommended
- Plant selection for bioretention is often intentional
  - Follow landscape plan in approved plan set
Rain Gardens

- Typically installed as a retrofit on existing home
  - Can be used for NEORSD fee credits if treats ≥ 25% of roof
- Not sized to treat WQv
  - Will not satisfy NPDES requirements for post-construction on new development or redevelopment ≥ 1 acre
- There is no underdrain
- Outlet is a berm along the downhill edge
- Bottom should be flat
- Place at least 10 feet from foundation
Rain Garden Cross Section

Figure 3a - Between 3% and 8% slope lawn

Before Digging
- downhill stake
- string
- 5% slope
- start digging here
- 6" depth
- 10' width

After Digging
- downhill stake
- string
- old lawn surface
- base of rain garden
- uphill stake
Rain Garden Specifications

- Ideal depth 4 – 8 in

<table>
<thead>
<tr>
<th>Slope</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 4%</td>
<td>3 – 5 in</td>
</tr>
<tr>
<td>5 – 7%</td>
<td>6 – 7 in</td>
</tr>
<tr>
<td>8 – 12%</td>
<td>8 in</td>
</tr>
</tbody>
</table>

- Surface area based on soil type and size factor
  - Use worksheet in Rain Garden Manual

- Plant list can be found in manual
  - Includes what to avoid too

Rain Barrels

- Harvests runoff from the rooftop for reuse
  - Can be used for NEORSD fee credit if
    - 50% of roof area connected
    - Storage provided ≥ 40 gal per downspout or ≥ 1-inch rainfall volume from 50% of roof area
- Typically, it is only a seasonal practice
  - Will not satisfy NPDES requirements for post-construction on new development or redevelopment ≥ 1 acre
Parts of a Rain Barrel

- Lid or screen
- Overflow for larger storms
  - Must have an appropriate outlet or disconnect to vegetated area
  - Direct away from neighbors, sidewalks, steep slopes and retaining walls
- Must completely drain in 24 hr – 4 days
  - Longer if storage device is larger than minimum
- Base to set upon
- Diverter is a convenience for seasonal operation
- Filter can be added to keep large debris from damaging screen
Rainwater Harvesting is Best with Dedicated Use
Downspout Disconnection to Filter Strip

- Rooftop runoff is redirected onto dense turf grass or meadow grass
- Splash block converts flow to sheet flow
- Can be used for NEORSD fee credit if
  - ≥ 50% of roof directed through strip
  - Fully-vegetated and healthy
  - Slope is 1 – 5%
  - Length 50 – 210 ft, based on slope
- Ohio EPA may approve on a case-by-case basis to meet NPDES requirements for post-construction on new development or redevelopment ≥ 1 acre
Determining Length of Filter Strip

<table>
<thead>
<tr>
<th>Height of string at downhill stake</th>
<th>Approximate slope of filter strip</th>
<th>Minimum length of filter strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 inches</td>
<td>1%</td>
<td>50 feet</td>
</tr>
<tr>
<td>5 inches</td>
<td>2%</td>
<td>120 feet</td>
</tr>
<tr>
<td>7 inches</td>
<td>3%</td>
<td>135 feet</td>
</tr>
<tr>
<td>10 inches</td>
<td>4%</td>
<td>170 feet</td>
</tr>
<tr>
<td>12 inches</td>
<td>5%</td>
<td>210 feet</td>
</tr>
</tbody>
</table>
Downspout Disconnection to Infiltration Trench

- Used for sites where existing soils allow for infiltration
  - Sandy soils (Group A & B)
  - Perform site-specific soil tests to determine conductivity
- Practice calls for stone to surface
- Include observation port
- Direct flow to practice as sheet flow
Permeable Pavement

- Three common types
  - Pavers
  - Asphalt
  - Concrete
- Ohio EPA requires WQv to infiltrate in 24 hrs or be detained for ≥ 48 hrs
  - NEORSD only credits designs which infiltrate
- NEORSD requires
  - ≥ 1000 sq ft must be installed for fee credit
  - Slope of pavement ≤ 4%
  - Stone reservoir depth ≥ 10 in
  - Must meet local building and zoning standards for driveways
Parts of a Permeable Pavement System

- **Storm water control occurs below the pavement surface**
  - Void space in stone stores runoff
  - Aggregate bed is typically 8 – 36 inches deep
- **In an infiltrating system**
  - Storage reservoir ≥ WQv below underdrains
- **In a detention-based system**
  - Underdrain on bottom
  - Discharge from underdrain is controlled by an outlet structure w/ orifice

Source: Hunt and Collins, 2008
Extended Detention Ponds

- **Three types**
  - Dry Extended Detention Basin
  - Wet Extended Detention Basin
  - Constructed Wetland

- **Lowest orifice controls discharge rate of WQv**
  - 48 hours for dry extended detention basins
  - 24 hours for wet extended detention basins and constructed wetlands
These orifice designs reduce clogging and allow pond to trap floatables.
Dry Extended Detention Basins
Dry Extended Detention Basin

- Inlet
- Forebay
- Micropool
- Outlet
Wet Extended Detention Pond
Constructed Wetland

PLAN VIEW

PROFILE

Ohio EPA
40 years and moving forward
Extended Detention Ponds

- Extended detention ponds provide little to no runoff reduction value
  - Thus, ponds are not eligible for storm water fee credits by NEORSD
  - However, they do meet NPDES requirements for post-construction storm water requirements for new development and redevelopment that disturbs ≥ 1 acre
- These ponds do provide a flood control function
  - Peak rate of discharge and total storage volume is set by local requirements, not Ohio EPA
Riparian Corridors
Riparian Corridors

- Buffer area along stream channel
  - Riparian corridors provide benefits such as storm water detention, habitat protection and pollution removal for FREE!
  - Restricts the placement of structures and other development within a certain distance from the stream
- Ohio EPA does not establish a statewide minimum requirement, thus if this BMP is required, it is a local requirement
  - Buffer widths along stream typically range from 25 to 300 feet, depending on drainage area of stream upstream of site
  - Width should be marked on plans and preferably with signage or other markers on site
Riparian Corridors

- Most local ordinances establish the setback as a distance from each stream bank.
- Ohio EPA recommends using a streamway setback that acknowledges the full meander beltwidth.

Traditional stream setback

Streamway setback = $147 \times DA^{0.38}$
Managing Riparian Corridors

- Natural vegetation should be left in place
  - Some local regulations allow replacement of natural vegetation with manicured vegetation, but this is not recommended

- Flow to riparian corridor should be as sheet flow
  - Outlet pipes from ponds should stop short of the setback and be diffused with a level spreader
For More Information

- **Websites**
  - Ohio EPA  [www.epa.ohio.gov/dsw/storm/index.aspx](http://www.epa.ohio.gov/dsw/storm/index.aspx)

- **Ohio EPA Contacts at NEDO**
  - Cuyahoga, Geauga, Lake & Lorain
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