Section 5.5: Filtering Practices

- Sand/organic filters
- Bioretention areas/Tree filters

Sand/Organic Filter: Design Notes

- Pretreatment essential (25% WQv)
- Sized for temporarily holding at least 75% of WQv, including pretreatment
- Minimum depth of 18” (12” allowed in some instances)
- Use conservative permeability coef. (3.5 ft/day for sand, 2 ft/day for peat, and 8.7 ft/day for leaf compost)
- Need maintenance access to filter bed
- Useful to treat LUHPPL runoff
**Bioretention: Design Notes**

- Pretreatment essential (25% WQv)
- Sized for temporarily holding at least 75% of WQv, including pretreatment
- 6"-9" ponding above surface
- Typically, 2'-4' planting soil bed (12" allowed in some instances)
- Specific engineered soil media
- Use a conservative permeability coefficient
- Detailed landscape plan

**Approved WQ BMPs**

**Lots of Different Materials**

**Slightly Different Equipment List**

- Backhoe/Excavator (note mini-excavator);
- Front End Loader;
- Dump Trucks;
- Pumps/compactors/saws/etc;
- Shovels/Rakes/Wheelbarrows
- Roto-tillers
Basic Materials for Filters

1. Inlet Structures
2. Outlet Structures
3. Filter Bed
   - Gravel Underdrain Jacket
   - Underdrain Pipe and Cleanout
   - Filter Fabric
   - Pea Gravel
   - Filter Media
   - Mulch
4. Pretreatment
   - Forebay Structure
5. Plantings
   - Plants (tolerant of wet and dry conditions)
   - Watering
6. Other
   - Loam/Erosion Control Blanket (side slopes)
   - Grass Seed/Sod
   - Landscape Stone/Riprap
   - Chambers

1. Inflow structures

   • HDPE Pipe with flared end section
   • Riprap or landscape stone apron

Inlet Structure
2. Outlet Structure

- Fiberglass Nyloplast (ADS, Inc.) catch basin structures
  - With frame and grate
- Typically 24” Diameter with main outlet and 1 to 2 underdrain inlets

Other Outlets

Concrete:
- 5000 psi concrete
Joint Sealant:
  1) Mortar
  2) Rubber Gasket
  3) Butyl Joint Sealant
Air content: 6 % by volume

Trash Racks:
- Glass reinforced HDPE
  - Load Rating: 2030 lbs./sq.ft.
  - Ultimate yield Strength: 1855 lbs./sq.ft.
- Maximum Deflection (@ 90 degrees F): < 2.00 inches
- UV protection must meet or exceed ASTM D2565-99.
- Grid material is 1 ½” thick with 5/8” webbing on center.
3. Filter Bed Materials

- AASHTO M-43 standard
- Washed, clean and open graded
- Size Varies;
  - ASTM # 2 or 3 Stone (<2 to 2 ½”)
  - ASTM #57 Stone (<1⅛”)
  - ASTM #8 (1-2”)

Gravel (Underdrains and Storage)
Underdrain Pipe Cleanout

- Rigid schedule 40 PVC pipe with 3/8” perforations @ 6” O.C. meeting ASTM D 1785
- T’s and Y’s as needed depending upon the underdrain configuration

Underdrain Cleanout

- Non perforated rigid schedule 40 PVC pipe with 3/8” perforations @ 6” O.C. meeting ASTM D 1785
- PVC elbow, cap and all associated fittings

Filter Fabric

- Non-woven geotextile fabric with a flow rate of > 110 gal./min./sf.
- For use over the underdrain and along the side walls
Impermeable Liners?

30MIL PVC impermeable liner:
- Specific Gravity (ASTM D 792): 120 (min.)
- Tensile (ASTM D 882): 73 (lb/in-width, min)
- Elongation at Break (ASTM D 882): 380 (% min.)
- Modulus (ASTM D 882): 30 (lb/in-width, min)
- Tear Resistance (ASTM D 1004): 30 (lb/in-min.)

Bentonite Clay
- Bentonite shall be a free flowing, high swelling, granular sodium bentonite.

Pea Gravel
- 3/8” Washed stone
- Between the bioretention soil layer and approved sub grade or underdrain gravel

Filter Media - Sand Filters
- Clean AASHTO M-6 or ASTM C-33 concrete sand
Bioretention Soil Mix

- USDA soil type loamy sand or sandy loam
- Filter Media to contain:
  - 85-88% sand
  - 8-12% Soil Fines
  - < 2% clay
  - 3-5% Organic Matter
- Organic Matter
  - Well aged (6-12 months), well aerated, leaf compost or approved equivalent

Bioretention - Lab Testing

- Textural analysis is required from the site stockpiled topsoil. If topsoil is imported, then a texture analysis shall be performed for each location where the top soil was excavated.
- Minimum requirements:
  - Sand 85-88%
  - Silt 8 - 12%
  - Clay 0 - 2%
  - Organics 3 - 5% in form of leaf compost
- Soil shall be a uniform mix, free of stones, stumps, roots or other similar objects larger than one inch.
- Consult the bio construction specs (Appendix F)

Table H-1 Infiltration Testing Summary

<table>
<thead>
<tr>
<th>Type of Facility</th>
<th>Design Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infiltration Practice</td>
<td>1 infiltration test and 1 test pit per 5,000 ft²</td>
</tr>
<tr>
<td>Permeable Pavement Practices</td>
<td></td>
</tr>
<tr>
<td>Filter Practice**</td>
<td>1 infiltration test and 1 test pit per 5,000 ft² (no underdrains required if infiltration rate &gt; 0.5 in/hr ***)</td>
</tr>
<tr>
<td>Dry Soil**</td>
<td>1 infiltration test and 1 test pit per 1,000 ft of dry slope (no underdrains required if infiltration rate &gt; 0.5 in/hr ***)</td>
</tr>
</tbody>
</table>

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*For use with residential rooftop runoff, testing requirements are reduced to 1 infiltration test and 1 test pit per 5,000 ft² assuming consistent lateral and R박의 soil series. If lateral and soil series are not consistent, then requirements increase to 1 infiltration test and 1 test pit per 1 ft².

**Proposed as part of a bioretention system, infiltration testing analysis is not strictly required but a test pit is strongly suggested to verify depth to seasonal high groundwater or bedrock.

***Underdrain infiltration still strongly suggested.
Mulch

• Fine shredded well aged (6 month min.) hardwood mulch
• A finely shredded, well aged, organic dark pine mulch may be acceptable
• Sample submitted to design engineer for approval, if applicable
• Do not use dyed or color treated mulches

Sand Filters
### 4. Pretreatment Requirements

<table>
<thead>
<tr>
<th>BMP Group</th>
<th>Required %WQ</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>WYTS</td>
<td>10%</td>
<td>• Provided at each inlet, unless inlet provides &lt;10% of inflow</td>
</tr>
<tr>
<td>Infiltration</td>
<td>25%</td>
<td>• Grass channel, filter strip, sediment forebay, proprietary device</td>
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<tr>
<td></td>
<td></td>
<td>• Deep sump catch basin combined with one of the following:</td>
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<tr>
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<td></td>
<td>– Upper sand layer; or</td>
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<tr>
<td></td>
<td></td>
<td>– Washed pea gravel (1/8” to 3/8”)</td>
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<tr>
<td></td>
<td></td>
<td>• Not required for permeable pavements (unless there is “run-on”) or drywells</td>
</tr>
<tr>
<td>Filtering Practices</td>
<td>25%</td>
<td>• Deep sump catch basins may not be used as sole pretreatment.</td>
</tr>
<tr>
<td>Green Roofs</td>
<td>Not Applicable</td>
<td>No pretreatment required for direct rainfall.</td>
</tr>
<tr>
<td>Open Channels</td>
<td>10%</td>
<td>• Forebays/checkdams at pipe inlets and/or driveway crossings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Filter strip</td>
</tr>
</tbody>
</table>

#### Stone Forebay Structures
- Stone size in accordance with DA
- Concave shape
- Filter fabric below subbase
- Height below overflow spillway

#### Landscape Timbers
- 6" x 6" Pressure treated timbers
- Sediment Forebay Weir Wall
5. Plantings

- Native plants referred, non-invasive mandatory;
- Tolerant to drought
- Tolerant to wet/inundation
- Mix of shrubs and perennials
- Smaller plant sizes to keep costs down?

Plantings

- All plant material shall conform to the guidelines of the "American Standard for Nursery Stock" latest edition

Planting Plan
Watering

- Soaker hose to water plants
- Both plants and grass will need watering during the initial establishment period.
- A watering schedule should be determined based upon plant species and the time of year.
- If the plants are chosen properly watering should not be necessary after the plants are established.

6. Other: Loam/ESC Blanket

- pH range of 5.5 to 7
- A minimum of 6% and a maximum of 20% organic material content
- Free of stones 1” or larger in any dimension
- Woven 100% biodegradable jute fiber
- Bionet S150BN
- To be used on >3:1 side slopes for stabilization

Grass Seed/Sod

- New England Conservation/Wildlife mix or approved equivalent
  - http://www.newp.com
- To be used on side slopes
- Sod can be used for faster results, but will increase the cost.
Landscape Stone/Rip Rap

- Rounded landscape river stone
- Min 4" diameter
- Greater aesthetic value but is more expensive
- Provide durable stone meeting RIDOT requirements
- D50 varies
- Less aesthetic value but is less expensive

Construction
Mandatory Inspection

- Bottom of Bed Inspection
  - Confirm sub grade layer
  - Prior to the installation of the underdrain
  - Rip bottom soils to a depth of 6"

Perimeter Sand Filter
Mandatory Inspection
- **Cover Inspection**
  - Prior to covering the underdrain
  - Check underdrain slope and inverts

Final Construction
- Install 6" pea gravel layer

Final Construction
- Backfill with approved bioretention soil
  - Do not compact
  - Apply in 12" layers
  - Wait 3 days to check for settlement
  - Add additional soil as necessary
  - Level bottom
Mandatory Inspection

- Site and Slope Stabilization Inspection
  - Prior to bioretention planting
  - All disturbed areas and side slopes
  - Confirm the bioretention floor is properly graded

Planting

- No planting to occur until stabilization is complete or silt fence installed
- The contractor will be required to remove any sediment that washes in during the planting phase

Planting
Sand/Organic Filters - Maintenance

- Clean-out pretreatment chamber when approx ½ full via vactor truck, clam shell or equiv;
- If standing water is observed above filtration bed, the top 2-3" should be removed and replaced;
- Repair structural components (concrete, valves, pipes, inlet frame/grate, underdrain system).

Bioretention - Maintenance

- Remove sediment from pretreatment when depth exceeds ½ design depth, clean/repair when drawdown exceeds 36 hours;
- Remove sediment from filter bed when depth exceeds 1", rehabilitate bed if standing water is present 48 hours after a storm (rototill or aerate);
- Refurbish mulch every other year (till existing materials into soil) as needed;
- Vegetative maintenance
- Repair erosion gullies; repair structural components.
Weeding

- Do not use chemical herbicides
- Remove by hand
- A list of invasive species can be found at: http://www.rinhs.org/resources/RI-invasive-species-resources/invasive-list/

Weeding

- Be on the lookout for invasive species:
  - Oriental Bittersweet
  - Japanese Knotweed
**Plant Replacement**

- Replace dead or diseased plant material
- Place plant in the same location
- Re-seed the side slopes
- Best time to replant:
  - Early to mid Fall
  - Early to mid Spring

*Photo courtesy of Rutgers New Jersey Agricultural Experiment Station*

**Questions?**