DPS | Montgomery County
Department of Permitting Services

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MICRO-BIORETENTION

The Micro-Bioretention methods described in the following section are based on the Micro-Bioretention design found in Chapter 5 of the Maryland Storm Water Design Manual and the ESD Process & Computations Supplement dated July 2010. Where deemed appropriate, the design specifications have been modified by the Montgomery County Department of Permitting Services (DPS). DPS requires that all Micro-Bioretention devices shall include a PVC pipe underdrain system.

A. Facility Description

Micro-Bioretention is a filtration system that treats runoff by passing it through a filter bed mixture of sand, soil, and organic matter. Principal components of the system include: a) surface planting with woody and herbaceous plant species, b) a surface 3 inch thick mulch layer, c) a 2-4 foot planting medium, d) a 6 inch thick sand layer, and e) perforated PVC pipe underdrain within a gravel bed. The facilities should be well landscaped to enhance their function and appearance. When providing additional storage for recharge below the underdrain, refer to the enhanced filter design specifications for additional requirements.

B. System Design Considerations

1. Applicability

The Micro-Bioretention device is appropriate for both new and redevelopment applications. The entire system fits into a relatively small space, making it applicable to concave parking lot islands, linear roadway or median filters, terraced slope facilities, and urban planter boxes. Currently, Micro-Bioretention devices are not permitted in residential cul-de-sac islands due to fire truck access concerns. The total drainage area to the facility, including pervious and impervious areas, is limited to 20,000 square feet. Micro-Bioretention facilities should not be located in areas which contain mature trees or other environmentally sensitive site features, or where existing slopes exceed 15 percent.

2. Conveyance

Micro-Bioretention facilities should be designed offline whenever possible. A flow splitter should be used to safely convey flows in excess of the design treatment volume around the facility. If bypassing the facility is impractical, an internal overflow device must be used to safely convey the runoff to a stable outfall while providing adequate freeboard within the facility, as discussed in section C.3. (Overflow Design Criteria). Runoff shall enter, flow through, and exit the facility in a non-erosive manner. All Micro-Bioretention facilities shall include a PVC underdrain system to convey treated flows to a suitable outfall location.

3. Groundwater

Micro-Bioretention facilities shall not be located where the water table is within 2 feet of the bottom of the facility. If the 2 ft. clearance requirement cannot be met, an alternative stormwater practice must be proposed. An impervious liner may be used in some cases.

4. Setbacks

Micro-Bioretention practices shall be located at least 30 feet from water supply wells and 25 feet from septic systems. Practices should be located down gradient and setback at least 10 feet from building foundations. Micro-Bioretention variants (e.g., planter boxes) that must be located within 10 ft of building foundations must include an impermeable liner and shall not be a structural component of the building. Structural design of concrete planter box enclosures is required.

C. Specifications and Details

1. Sizing

The facility shall be sized to capture and store 100% of the target treatment volume. A minimum of 6" and maximum of 12" of surface ponding must be provided above the filter media. The surface area (A_f) of a Micro-Bioretention practice shall be at least 2% of the contributing drainage area. Planting media shall be between 24 and 48 inches deep. The total storage provided in the facility shall be computed as the storage provided in the temporary ponding area and the storage provided in the planting media and sand layers. Computations shall account for the porosity (n = 0.40) of the planting media and sand. Storage provided in excess of that required to treat the runoff for the 1 year, 24-hour design storm shall not be counted towards the total ESDv provided.

See "Enhanced Filter" design guidelines if additional storage is proposed below the underdrain pipe.

To the extent possible, facilities should have irregular outlines to blend naturally into the environment. Rectangular is not natural.

2. Inflow Design Criteria

Runoff shall enter the Micro-Bioretention facility in a non-erosive manner (less than 2 fps). Inflow may be through depressed curbs with wheel stops, curb cuts, level spreaders, bubblers, or conveyed directly using downspouts, covered drains, catch basins, over grass, or other acceptable conveyance methods. Particular care must be taken to prevent erosion of the surface mulch layer.

3. Overflow Design Criteria

If an internal overflow device is needed, a yard inlet or dome cap inlet may be used. Dome inlet caps may be stacked on top of clean-outs to serve as the overflow devices. When this method is used, the overflow invert of the domed cap must be set at the design storage level. Overflow devices cannot feed into perforated pipe sections.

A safe non-erosive outlet below the outfall must be provided. Safe conveyance of the developed 10-year storm through the facility must be demonstrated.

4. Underdrain Pipe

The underdrain pipe consists of 6-inch diameter schedule 40 or stronger perforated PVC pipe at 0.00% slope. The underdrain pipe will be placed within the gravel layer. A minimum of three inches of gravel must be placed under the pipe, with a minimum of 6 inches of gravel over the pipe. Perforations must be 3/8 inch in diameter and must be located 4 inches on center, every 90 degrees around the pipe. Perforated pipe must begin at least 12" inside the filter media. If this cannot be achieved, then sides of the filter media must be lined with filter fabric. Filter fabric must <u>not</u> be wrapped around the underdrain pipe. An acceptable alternative to perforated pipe is 6" diameter schedule 40 slotted PVC pipe with 0.125 inch slots. Slots shall be 0.125 inches wide and a minimum of 1.9 inches in length, with a minimum of 4 slots per row and 4 rows per linear foot of pipe.

Access for cleaning all underdrain piping is needed. Watertight clean-outs for each pipe shall be level with the top of the mulch. All cleanouts shall have a removable waterproof cap. Cleanouts must be capped immediately after the filter medium is in place.

The required number of perforated underdrain pipes is proportional to the surface area of the Micro-Bioretention facility. The length of perforated pipe shall be 0.05 times the surface area of the facility, rounded to the nearest foot. In no case shall less than 2 ft. of perforated pipe be provided.

5. Gravel Bed

The gravel layer surrounding the underdrain pipe(s) must meet MSHA size #7 (Table 901A), and must provide a minimum of 6 inches cover over the pipe(s), and minimum 3 inches under the pipe. No geotextile or filter fabric is allowed to be placed horizontally anywhere within the filter media. The gravel must be clean and must be stored and installed in such a manner that it does not become contaminated with sediment before or after installation.

6. Sand Bed

A minimum 6-inch fine aggregate sand layer shall be provided below the planting medium. ASTM C33 or AASHTO M6 Fine Aggregate Concrete Sand is required per Montgomery County sand specifications.

7. Planting Medium

The planting medium shall be 24”-48” thick and shall consist of 1/3 perlite or Solite, 1/3 compost and 1/3 topsoil. The perlite shall be coarse grade horticultural perlite. The compost shall be high grade compost free of stones and partially composted woody material. The topsoil component shall meet the following criteria: contain no more than 10% clay, 10-25% silt and 60-75% sand and be free of stones, stumps, roots or other similar objects larger than 2 inches.

The first layer of the planting medium shall be lightly tilled to mix it into the 6-inch sand layer, so as not to create a definitive boundary. The planting bed shall be flooded after placement. Any settlement that occurs shall be filled back to the design elevation.

8. Mulch

The mulch layer is an important part of the Micro-Bioretention device. Much of the pollutant removal capacity of the Micro-Bioretention system is within the mulch layer. The surface mulch layer will consist of standard double shredded aged hardwood mulch. The mulch should be applied uniformly to a depth of 3 inches. Yearly replenishing may be necessary. Pine bark is not acceptable.

9. Plant Materials

Plants, through their pollutant uptake and evapo-transpiration of stormwater runoff, play a key role in the overall effectiveness of the Micro-Bioretention device. Both the number and type of tree and shrub plantings for the system may vary, especially where aesthetics or other considerations are critical to site development. While native plants are encouraged, they are not always appropriate in all situations. While no hard planting rule exists, the plants should be a mix of trees, shrubs and herbaceous materials. However, there should be 2 to 3 shrubs planted per tree and herbaceous plantings shall make up 40% of the total number of plants. Trees shall be a minimum of 1 ½ in. caliper, shrubs shall be minimum 2 gal. size and herbaceous plants shall be a minimum 1 gal size. Mature plant canopy should cover 85% of the Micro-Bioretention device. Alternative planting schemes, including use of grasses, may be considered in some situations, so long as the planting plan is designed by a Registered Landscape Architect registered in the State of Maryland, however lawn grasses are not appropriate for these facilities. All plantings shall be in accordance with the Montgomery County landscape guidelines. All landscape plans must be sealed by a registered landscape architect. Since

the plants are an integral part of the Micro-Bioretention system, no changes to the approved landscape plan will be allowed unless an alternate plant list, prepared by a registered landscape architect, has been approved by DPS prior to installation. Since plant availability can change, DPS suggests including an alternate plant list on the landscaping plans.

D. Micro-Bioretention Sizing Example

A Micro-Bioretention facility is being designed to treat the runoff from a parking lot that is part of a larger development. The target ESD_V for the overall project has already been determined. The total treatment area to the facility is 20,000 square feet (17,500 square feet impervious area and 2,500 square feet of pervious area, yielding an impervious percentage of 88%).

Calculate the maximum volume that can be stored in the facility:

ESDv(MAX) = [(Pe) (Rv) (A)]/12

= [(2.6")(0.84)(20,000sf)]/12

= 3,640 cf

Rv = 0.05 + (.009 x I)

= 0.05 + (.009*88) = 84

Calculate the minimum volume that must be stored in the facility:

ESDv(MIN) = [(Pe) (Rv) (A)]/12

= [(1.0")(0.84)(20,000sf)]/12

= 1,400 cf

Rv = 0.05 + (.009 x I)

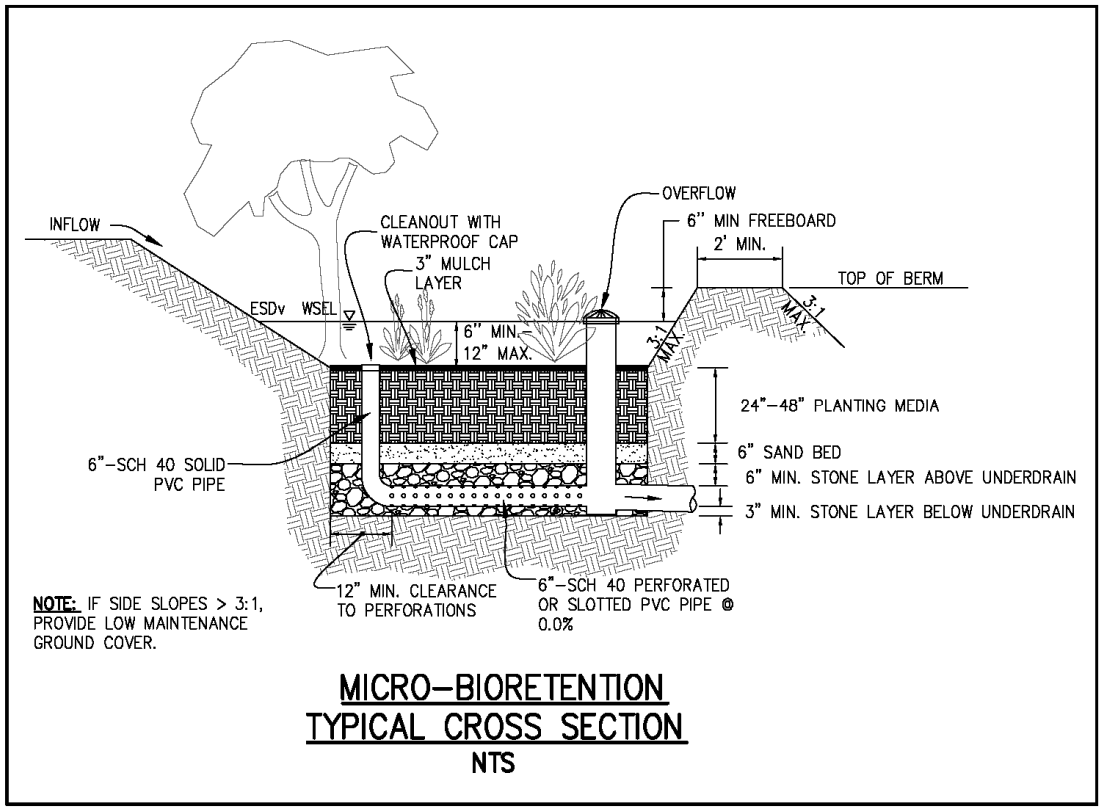
= 0.05 + (.009*88) = 84

To calculate the ESDv provided by this facility we will assume a ponding depth of 0.75' and a 2.5' thick media layer (2' planting media and 0.5' sand). The porosity for the media layer is n = 0.40. Assume the area of the filter bed (Af) is 2,500 sf.

ESDv = Ponding Depth + Storage in Filter Media

=(2,500* 0.75) + [0.4*(2,500*2.5)] = 4,375 cf

Since the proposed ESDv exceeds the maximum allowable storage of 3,640 cf the facility must be reduced in size. In this case, reducing the filter area to 1,500 sf will yield a treatment volume of 2,625 cf, which is larger than the minimum required storage in the facility. Therefore the design is acceptable.



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TYPICAL CROSS SECTION
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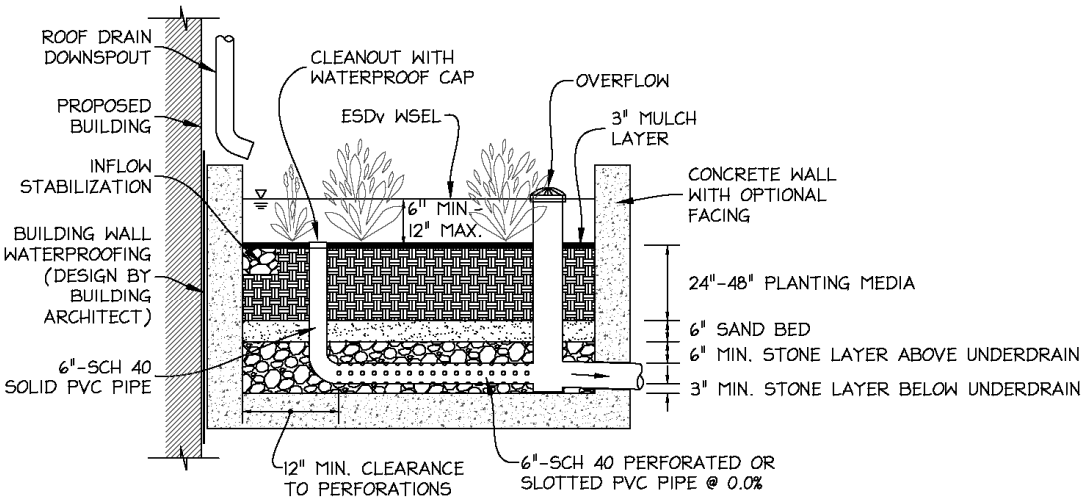

PLANTER BOX MICRO-BIORETENTION
TYPICAL CROSS SECTION
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