11.0 Post Construction BMP Standards and Specifications

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11.2 Bioretention

11.2.1 Bioretention is defined as practices that capture and store stormwater runoff and pass it through a bed of engineered soil media comprised of sand, lignin and organic matter, known as biosoil. Filtered runoff may be collected and returned to the conveyance system, or allowed to infiltrate into the soil. Design variants include:

11.2.1.1 Traditional Bioretention

11.2.1.2 In-Situ Bioretention including Rain Gardens

11.2.1.3 Streetscape Bioretention

11.2.1.4 Engineered Tree Boxes

11.2.1.5 Stormwater Planters

11.2.1.6 Advanced Bioretention systems

11.2.2 Bioretention Stormwater Credit Calculations

11.2.2.1 The volume management credit for bioretention practices shall be based upon the volume of runoff that is either slowly released or infiltrated from the practice.

11.2.2.2 Advanced Bioretention Systems shall be evaluated on a case-by-case basis and assigned performance credits as deemed appropriate by the Department.

11.2.2.3 Bioretention with underdrain

11.2.2.3.1 The RPv, Cv and Fv runoff reduction performance credits for bioretention with underdrain is 100% of the detention storage.

11.2.2.3.2 The total nitrogen pollutant reduction performance credit for bioretention with underdrain is 30% removal efficiency.

11.2.2.3.3 The total phosphorus pollutant reduction performance credit for bioretention with underdrain 40% removal efficiency.

11.2.2.3.4 The total suspended solids pollutant reduction performance credit for bioretention with underdrain 80% removal efficiency.

11.2.2.4 Bioretention with infiltration

11.2.2.4.1 The RPv, Cv and Fv runoff reduction performance credits for bioretention with infiltration is 100% of the retention storage.

11.2.2.2.2 The total nitrogen, total phosphorous and total suspended solids pollutant reduction performance credits for bioretention with infiltration is 100% of the load reduction.

11.2.3 Bioretention Feasibility Criteria

11.2.3.1 A minimum vertical distance of 2 feet must be provided between the bottom of the infiltrating bioretention practice and the seasonal high water table as determined by the soil investigation procedures or bedrock layer. The minimum vertical distance of 2 feet may be relaxed if a groundwater mounding analysis or piezometer testing has been performed by a qualified professional.

11.2.3.2 Underdrains are required if the permeability of the underlying soils does not have a minimum field-verified infiltration rate of 1 inch per hour.

11.2.3.3 An impermeable bottom liner and an underdrain system must be employed when a bioretention facility will receive untreated hotspot runoff.

11.2.3.4 Infiltrating bioretention practices shall be located a minimum horizontal distance of 200 feet from down-gradient slopes greater than 20% unless slope stability calculations demonstrate stable conditions.

11.2.4 Bioretention Conveyance Criteria

11.2.4.1 Bioretention practices must be designed to pass the maximum design storm event (Fv) if the Fv is being routed through the practice rather than bypassing. An emergency spillway designed to convey the Fv shall be cut in natural ground or, if cut in fill, must be lined with stabilization geotextile and riprap.

11.2.4.2 Bioretention practices constructed to meet regulatory stormwater management requirements in the State of Delaware shall be designed and constructed in accordance with the USDA NRCS Small Pond Code 378 as amended.

11.2.4.3 An overflow structure shall be incorporated into on-line designs to safely convey larger storms through the bioretention facility.

11.2.4.4 The maximum design discharge velocity shall be checked for a non-erosive condition at the outlet point. Outlet protection shall be provided as necessary.

11.2.5 Bioretention Pretreatment Criteria

11.2.5.1 Every bioretention practice shall have pretreatment mechanisms to protect the long term integrity of the practice.

11.2.5.2 Exit velocities from the pretreatment shall be non-erosive during the Cv.

11.2.6 Bioretention Design Criteria

11.2.6.1 Bioretention practices shall have energy dissipation provided at all inlets.

11.2.6.2 Bioretention practices shall be designed so that the RPv either infiltrates or discharges within 48 hours.

11.2.6.3 Bioretention practices shall be designed so that they will:

11.2.6.3.1 Infiltrate the Fv within 72 hours, or

11.2.6.3.2 Dewater the Fv within 72 hours, or

11.2.6.3.3 Manage the Fv on site with no adverse impact.

11.2.6.4 Traditional and advanced bioretention facilities and rain gardens shall be constructed with side slopes above biosoil media of 3:1 or flatter.

11.2.6.5 Biosoil Media

11.2.6.5.1 The Biosoil-14 soil mixture shall have the following volumetric composition:

11.2.6.5.1.1 60% coarse concrete sand having a Fineness Modulus > 2.75)

11.2.6.5.1.2 30% triple shredded hardwood mulch

11.2.6.5.1.3 10% aged, STA certified compost, meeting the requirements of Delaware Erosion and Sediment Control Handbook Appendix A-6 Compost Material Properties.

11.2.6.5.2 Biosoil media must be obtained from a Department approved vendor.

11.2.6.5.3 The design permeability rate for biosoil media shall be 2.83 inches per hour.

11.2.6.5.4 The biosoil media bed depth shall be a minimum of 24 inches for traditional bioretention and advanced bioretention systems.

11.2.6.6 A surface cover shall be provided over the biosoil media.

11.2.6.6.1 Mulch, if used as a surface cover, shall be triple shredded hardwood aged for a minimum of six months.

11.2.6.6.2 Use of alternative surface cover shall be shown on the approved plan.

11.2.6.7 Underdrains

11.2.6.7.1 For bioretention designs that require an underdrain, the underdrain shall be a minimum of 4-inch perforated corrugated polyethylene pipe (CPP).

11.2.6.7.2 The underdrain shall be encased in a layer of clean, washed nominal 1/4” gravel with a maximum of 2.0 percent passing the #200 sieve with a minimum of 3” of cover.

11.2.6.7.3 The gravel layer in traditional bioretention shall be extended a minimum of 2’ below the invert of the underdrain.

11.2.6.8 All traditional and advanced bioretention systems shall include at least one inspection port or cleanout pipe.

11.2.6.9 Traditional sizing approaches using design volume considering void ratio of the stone and biosoil media shall be used when sizing bioretention.

11.2.7 Bioretention Landscaping Criteria

11.2.7.1 A planting plan shall be provided for all bioretention facilities. Minimum elements of a planting plan include the following:

11.2.7.1.1 The proposed bioretention template to be used

11.2.7.1.2 Delineation of planting areas

11.2.7.1.3 Size and spacing of plant material

11.2.7.1.4 The planting sequence, including post-nursery care and initial maintenance requirements.

11.2.7.2 Planting plans must be certified by a qualified professional.

11.2.8 Bioretention Construction Criteria

11.2.8.1 When a bioretention system is used as a sediment trap or basin during construction, the Sediment & Stormwater Plan must include notes and graphic details specifying that:

11.2.8.1.1 The maximum excavation depth of the trap or basin at the construction stage must be at least 1 foot higher than the final invert or bottom of the facility, and

11.2.8.1.2 The bottom of the facility shall be ripped, tilled or otherwise scarified upon final excavation.

11.2.8.2 The plan shall include the proper procedures for converting the temporary sediment control practice to a permanent bioretention facility, including dewatering, cleanout and stabilization.

11.2.8.3 For infiltrating bioretention systems, confirmatory infiltration testing and verification must be completed prior to completion of construction in accordance with the Soil Investigation Procedures. The results shall be included with the Post Construction Verification Documentation upon project completion.

11.2.8.4 The final bottom elevation of any bioretention facility shall not be traversed by construction equipment.

11.2.8.5 Construction reviews are required during the following stages of construction, and shall be noted on the plan in the sequence of construction:

11.2.8.5.1 Pre-construction meeting.

11.2.8.5.2 Initial site preparation including installation of erosion and sediment controls, sensitive area protection surrounding bioretention locations, and blockage of inlets to bioretention locations

11.2.8.5.3 Excavation and grading including interim and final elevations. For infiltrating bioretention systems, confirmatory infiltration testing and a verification must be completed prior to gravel and biosoil media placement.

11.2.8.5.4 Construction of the underdrain, including inspection ports and installation of the overflow structure, as applicable

11.2.8.5.5 Installation of gravel and biosoil media

11.2.8.5.6 Implementation of required stabilization and planting plan

11.2.8.5.7 Final construction review including development of a punch list for facility acceptance

11.2.8.6 Upon project completion, the owner shall submit post construction verification documents to demonstrate that the bioretention practice has been constructed within allowable tolerances in accordance with the approved Sediment and Stormwater Management Plan and accepted by the approving agency.

11.2.8.6.1 Allowable tolerances for bioretention practices are as follows:

11.2.8.6.1.1 The acceptable top of bank elevation may be no lower than the design elevation for top of bank.

11.2.8.6.1.2 The allowable tolerance from the design surface area of the bioretention surface is ten percent less than the design surface area.

11.2.8.6.1.3 The allowable tolerance from the design volume of the bioretention surface storage is ten percent less than the design volume.

11.2.8.6.1.4 The allowable tolerance for elevations on any structure is 0.1 foot.

11.2.8.6.2 When the allowable tolerances are exceeded for bioretention facility surface area or volume or structure elevations, supplemental calculations must be submitted to the approval agency to determine if the bioretention facility, as constructed, meets the design requirements.

11.2.9 Supplemental fertilizer applications shall consist of a 0% phosphorus formulation only as needed to maintain plant vigor.