

SECTION 1 BIO-INFILTRATION BUMP OUTS (BIBO)

This guide specification for U.S. applications describes construction of bio-infiltration bump outs (or “bioretention”) systems. From the surface down to the excavation, the systems consist of 2-3 inches (typically) of triple-shredded hardwood mulch, 2-3 feet of sandy-loam engineered soil media, 4-6 inches of aggregate around a perforated underdrain (typically ASTM No. 57 stone). There is no liner below the stone layer, and thus promotes stormwater to directly exfiltrate into the in-situ soil. As a factor of drainage safety, excess drainage is directed to an outlet via perforated drain pipes in the subbase. While this guide specification does not cover excavation, liners and drain pipes, notes are provided on these aspects.

The text must be edited to suit specific project requirements. It should be reviewed by a qualified civil or geotechnical engineer, or landscape architect familiar with the site conditions. Edit this specification term as necessary to identify the design professional in the General Conditions of the Contract.

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

- a. Mulch
- b. Engineered soil media (“bioretention media”)
- c. Open-graded subbase aggregate
- d. Underdrainage pipe
- e. Custom curbing
- f. Plants
- g. Inlet flumes
- h. Underdrainage pipe

B. Related Sections

- | | | |
|------------|--------|--|
| 1. Section | 00455: | Curbs and gutters |
| 2. Section | 00430: | Erosion control. |
| 3. Section | 00475: | Storm sewer |
| 4. Section | 00425: | Earthworks/excavation/soil compaction. |

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

- a. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- b. C 33, Standard Specification for Concrete Aggregates.
- c. D3385 – 09, Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer.

B. Phosphorus Index

- a. Mehlich A. 1984. Mehlich-3 soil text extractant: a modification of Mehlich-2 extractant. *Commun Soil Sci Plant Anal.* 15(12):1409-16.
- b. North Carolina Department of Agriculture & Consumer Services. “Agronomic Services – Soil Test Methodologies”. Accessed via: www.ncagr.gov/agronomi/stmethod.htm

1.03 SUBMITTALS

- A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Minimum 3 lb. (2 kg) samples of subbase, base and bedding aggregate materials.
- C. Soils report indicating density test reports, classification, and infiltration rate measured on-site under compacted conditions, and suitability for the intended project.
- D. Erosion and sediment control plan.

1.04 QUALITY ASSURANCE

- A. Bioretention Installation Subcontractor Qualifications:
 - 1. Utilize an installer having successfully completed a minimum of five bioretention similar in design and material indicated on the project plan.
 - 2. Utilize an installer with job foremen or site manager holding a record of completion of the North Carolina State University Stormwater BMP Inspection & Maintenance Certification Workshop.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged container (if applicable), with packaging with identification tags intact on each paver bundle.
 - 1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
 - 2. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by forklift or clamp lift.
 - 3. Unload pavers at job site in such a manner that no damage occurs to the product or existing construction
- D. Storage and Protection: Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials. Do not store any soil or aggregate media in a location that could, during a rain event, wash-out sediment particles into an ongoing installation of this or another stormwater control measure. This could result in clogging, and would require immediate restorative action to keep any stormwater practice functioning as designed.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not install in rain or snow.
- B. Do not install frozen bedding materials.

1.07 MAINTENANCE

- A. Extra materials: Provide 10% additional material for use by owner for maintenance and repair.

PART 2 PRODUCTS

2.01 BIORETENTION MEDIA

- A. Manufacturer: Varies, contact project manager for a list of local suppliers.
- B. Bioretention Engineered Soil Media
 - 1. Material Standard: Comply with North Carolina State Bioretention Specification (Chapter 12 of the NC DENR Stormwater BMP Manual).
 - 2. Soil texture and composition: Homogenous soil mix of 85-88 percent by volume sand (USDA Soil Textural Classification, ASTM C-33), 8 to 12 percent "fines" (silt and clay), and 3 to 5 percent organic matter (such as peat moss or pine bark fines).
 - 3. Phosphorus index: Phosphorus content or Phosphorus index ("P.I.", also known more formally as the Mehlich 3 P-Index) should result in no less than 10 and no greater than 30. Soil that falls out of this range will be rejected by the site engineer.
 - 4. Saturated conductivity. The media should be specified to have 1 – 2 inches per hour post-installation infiltration rate / hydraulic conductivity, which should be a quality control specification provided by the manufacturer.

2.02 PRODUCT SUBSTITUTIONS

- A. Substitutions: No substitutions permitted.

2.03 DRAINAGE SUBBASE AGGREGATE

- A. Crushed stone with 90% fractured faces, LA Abrasion < 40 per ASTM C 131, minimum CBR of 80% per ASTM D 1883.
- B. Do not use rounded river gravel.
- C. All stone materials shall be double-washed with less than 1% passing the No. 200 sieve.
- D. Subbase: conforming to ASTM D 448 gradation as shown in Tables 1

Table 1
ASTM No. 57 Base
Grading Requirements

Sieve Size	Percent Passing
37.5 mm (1 1/2 in.)	100
25 mm (1 in.)	95 to 100
12.5 mm (1/2 in.)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

2.04 MULCH

- A. Manufacturer: varies
- B. Specification of mulch composition:
 - a. Mulch type: Triple-shredded hardwood
 - b. Color: Brown
 - c. Mulch composition: Shall not be composted using animal waste as an organic component.

2.05 UNDERDRAIN PIPE

- A. Manufacturer: varies
- B. Pipe material: Schedule 40 rigid polyvinyl chloride (PVC) compound, Type 1 Grade 1 with a Cell Classification of 12454 as defined in ASTM D 1784 trade name designation H707 PVC, being white in color.
- C. Pipe size: 4-inches (10 cm) in diameter (nominal size)
- D. Perforation specification (for only the pipe within the bioretention drainage area itself—does not include the pipe that conveys water below sidewalks, curbs, or other non-stormwater-related practices to the existing stormwater network).
 - a. Size of perforation: 3/8 inch (9.5 mm) circular diameter hole
 - b. Method of perforation: Mechanical drilling preferred
 - c. Linear spacing of perforations: Perforations should be spaced every 4 inches (10 cm) on center along the length of pipe to act as drainage pipe within bioretention cell
 - d. Radial spacing of perforations: Perforations should be placed every 90-degrees radially within a given cross-section (See Figure 1).
 - e. Any PVC not located in the practice shall be solid, not perforated.
- E. Joints, accessories, adaptors, or other PVC pipe additions
 - a. Attachment specification: Must be hydraulically-sealed

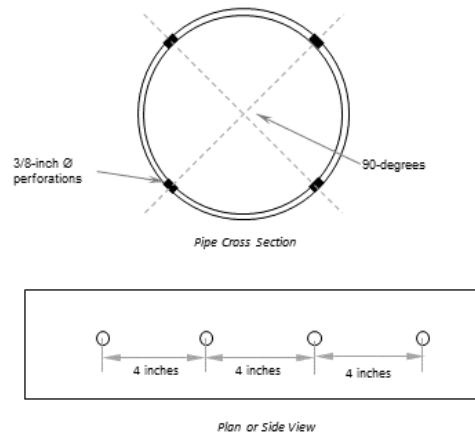


Figure 1. Schematic of perforation pattern on underdrain PVC pipe.

2.06 PLANTS

- A. Manufacturer: varies
- B. Specifications:
 - a. Plant species: Follow the species key on the Planting Plan of the design
 - b. Plant container: All plants should be gallon pots, not plugs, to increase initial survivability

2.07 ACCESSORIES

- A. Provide accessory materials as follows:

Note: Curbs will typically be cast-in-place concrete. Concrete curbs may be specified in Section 00455. Do not use plastic edging with steel spikes to restrain the paving units for vehicular applications.

1. Curbing

- a. Manufacturer: Varies
- b. Material: Concrete.
- c. Material Standard: 3000 psi (21 MPa)
- d. Follow instructions of curbing on BIBO details.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. See Installation Subcontractor Qualifications in Section 1.04 (Quality Assurance)

3.02 EXAMINATION

Note: The elevations and surface tolerance of the soil subgrade determine the final surface elevations of the mulch. The bioretention installation contractor cannot correct deficiencies excavation and grading of the soil subgrade with additional materials. Therefore, the surface elevations of the soil subgrade should be checked and accepted by the General Contractor or designated party, with written certification presented to the paver installation subcontractor prior to

starting work.

A. Acceptance of Site Verification of Conditions:

1. General Contractor shall inspect, accept and certify in writing to the bioretention installation subcontractor that site conditions meet specifications for the following items prior to installation of plants.

Note: Under no circumstance is there to be compaction of the sub-grade (in-situ) soil after or during excavation. This will significantly alter the performance of the cell by reducing the infiltration capacity of the soils. The sub-grade soil of all BIBO cells must be scarified or raked with the teeth of an excavator bucket to break up the soil and promote infiltration. This is to be done before any aggregate or piping is laid.

- a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
2. Do not proceed with installation of mulch and plants until subgrade soil conditions are corrected by the General Contractor or designated subcontractor.

3.03 PREPARATION

- A. Verify that the soil subgrade is free from standing water.
- B. Stockpile engineered media, mulch, and subbase aggregate such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

3.04 INSTALLATION

Note: The minimum slope of the soil subgrade is 0%. Actual slope of soil subgrade will depend on the drainage design and exfiltration type. All drain pipes, observation wells, overflow pipes, and (if applicable) geotextiles, berms, baffles and impermeable liner should be in place per the drawings prior to or during placement of the subbase and base, depending on their location. Care must be taken not to damage drainpipes during compaction and paving. No mud or sediment can be left on the base or bedding aggregates. If they are contaminated, they must be removed and replaced with clean materials.

A. General

1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the subbase materials.
2. Keep area where the Bio-infiltration Bump-Out (BIBO) is to be constructed free from sediment during entire job. Materials contaminated with sediment shall be removed and replaced with clean materials.
3. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.

C. Open-graded subbase and base (No. 57 stone)

Note: Compaction of areas or sites that cannot accommodate a roller vibratory compactor may use a minimum 13,500 lbf (60 kN) vibratory plate compactor with a compaction indicator. At least three passes should be made over each lift of the subbase and base aggregates.

1. Moisten, spread and compact the No. 57 base layer in one 4 in. (100 mm) thick lift.
 - i. On this layer, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (8 T) vibratory roller until there is no visible movement of the No. 57 stone. Do not crush aggregate with the roller.

- ii. The surface tolerance the compacted No. 57 base should not deviate more than. ± 1 in. (25 mm) over a 10 ft (3 m) straightedge.

G. PVC Underdrain pipe

- 1. Only install PVC underdrains in the applicable PICP systems—not all installation on the project have underdrains.
- 2. Attach a utility trace wire to all PVC for future utility locate ease.
- 3. The underdrain should be manually perforated by a drill, with circular perforations being 3/8-inch in diameter. They should be spaced every 4-inches on center, and every 90-degrees radially around the pipe. (Figure 1)
- 4. Any PVC not located directly in the aggregate shall be solid, and not perforated. Attach and hydraulically seal perforated sections, solid sections, and any adapters (elbows, tees, wyes, etc.).
- 5. PVC pipe that connects with the storm sewer system (where applicable) shall be at the elevations specified in the plan. The up-turned 90-degree elbow is an essential part of the functioning of the systems, and should be brought as close to specified elevations as possible within the catch basins.

3.05 FIELD QUALITY CONTROL

- A. After laying the mulch, check final elevations for conformance to the drawings.
- E. Verify the surface infiltration at a minimum of 1 in./hour using test method ASTM D3385-09.

3.06 PROTECTION

- A. After work in this section is complete, the General Contractor shall be responsible for protecting work from sediment deposition and damage due to subsequent construction activity on the site.

END OF SECTION