

---

**Greenville County Technical Specification for:**  
**WQ-09 INFILTRATION BASIN**

---

**1.0 Infiltration Basin**

**1.1 Description**

Infiltration Basins are shallow, impounded areas designed to temporarily store and infiltrate stormwater runoff from impervious areas. The size and shape can vary and designs can use one large basin, or multiple smaller basins throughout a site. Infiltration Basins may be used as a stand-alone practice or in series with other stormwater management practices as part of a treatment train. The maximum drainage area for any single Infiltration Basin is 2 acres. Infiltration Basins can remove a wide variety of pollutants from the runoff through adsorption, precipitation, filtering, and bacterial and chemical degradation.

**1.2 Design**

**1.2.1 General Design**

The required method to design an individual Infiltration Basin or to design an Infiltration Basin as part of a treatment train with other water quality BMPs is to use the Greenville County IDEAL Model to demonstrate overall site compliance with applicable County water quality standards. See County Design Manual for site-specific applicable water quality standards.

Infiltration Basins work best when constructed off-line, capturing only the flows designed to be treated for water quality. Divert excess runoff away from the Infiltration Basin area or collect it with an overflow catch basin. Infiltration Basins are limited to areas with highly porous soils where the water table and or bedrock are located below the Infiltration Basin bottom. The following are general design guidance for Infiltration Basins:

- The maximum ponding depth is 2 feet.
- Designed to dewater in 24-72 hours after storm event.
- Do not place Infiltration Basins in fill material because piping along the fill-natural ground interface may cause slope failure.
- Not intended to trap sediment during construction activities.
- Includes a sediment forebay or other pre-treatment measure to prevent clogging of the filter media.
- Has an overflow system to provide non-erosive flow velocity along the length and at the outfall.
- Are applicable for impervious areas where there are low levels of fine particulates in the runoff and the site is completely stabilized and the potential for possible sediment loads are low.
- Basin requires a continuous, flat bottom area.
- Provide at least a 5-foot setback from property lines.
- Do not install Infiltration Basins on slopes greater than 20%.
- Provide underdrain cleanouts every 100 feet along the infiltration practice to allow for access and maintenance.
- Provide at least a 25-foot setback down gradient from structures and dry wells.
- Located no closer than 150 feet away from all drinking water wells and 100 feet up-gradient from building foundations and septic systems.

- During the design consider depth of bedrock, proximity to wells, slope, watershed, depth to water table, etc.
- Side slopes in the basin are no steeper than 3H:1V.
- The bottom of the basin is located at least 4 feet above seasonal high water table.
  - **Note:** The 4-foot depth helps prevent soil compaction occurring from the weight of stored water.
- Not used in an industrial or commercial area where solvents and /or petroleum are loaded, unloaded, stored or applied or pesticides are loaded, unloaded or stored.
- Not used where installation creates a significant risk for basement seepage or flooding or interferes with the operation of subsurface sewage disposal systems.
- To ensure success of the Infiltration Basin function; follow these steps during construction:
  - Construct basins at the end of the development's construction and final stabilization of the site.
  - Smearing of the soil at the interface with basin floor is avoided and/or corrected by raking or compaction rototilling.
  - Compaction of the basin bottom during construction by construction equipment traffic is kept to a minimum.

### 1.2.2 Basin Surface Area

To assist in the Infiltration Basin design, the Infiltration Basin invert area (A) may be estimated by using the following equation:

$$A = \frac{DA * Rv}{kt}$$

Where:

DA	=	Contributing impervious drainage area of Infiltration Basin (feet <sup>2</sup> )
Rv	=	Runoff volume (feet) 0.083-feet (1-inch) as a rule of thumb for estimation
k	=	Field measured hydraulic conductivity of filter media
t	=	Drawdown time (24-72 hours)

### 1.2.3 Water Draw Down Time

Design Infiltration Basins to fully de-water within a 24- to 72-hour period. Design the underdrain system to safely pass the peak draw down flow rate of the filter media. The general equation used to determine draw down time is Darcy's Equation:

$$Q = 2.3e^{-5} K A \frac{\Delta H}{\Delta L}$$

Where:

Q	=	Flow rate through Infiltration Basin (cfs)
K	=	Hydraulic conductivity of the filter media (in/hr) (Value varies based on actual filter media used)
A	=	Surface area of Infiltration Basin (feet <sup>2</sup> )
ΔH	=	Maximum ponding depth above bottom of filter media (feet)
ΔL	=	Depth of filter media (feet)

Typical hydraulic conductivity (K) values for filter media are 1 to 6 inches per hour.

Determining the total draw down time is a three-step process.

1. Determine the time it takes to drain the ponded water.
  - Utilize Darcy's Equation to calculate the flow rate (cfs).
  - Calculate the total ponded water volume (feet<sup>3</sup>) by multiplying the Infiltration Basin area (feet<sup>2</sup>) by the ponded water depth (feet).
  - Divide the total ponded water volume (feet<sup>3</sup>) by the flow rate (cfs) to calculate the time to drain the ponded water (seconds)
2. Determine the time it takes to drain the saturated filter media.
  - Calculate the total volume of water contained in the filter media (feet<sup>3</sup>) by multiplying the Infiltration Basin area (feet<sup>2</sup>) by the filter media depth (feet) by the porosity (dimensionless) of the filter media.
  - Divide the filter media water volume (feet<sup>3</sup>) by the flow rate from Darcy's Equation (cfs) to calculate the time to drain the ponded water (seconds).
3. Add up the time to drain the ponded water with the time that it takes to drain the filter media to calculate the total Infiltration Basin area draw down time.

### 1.3 Materials

Infiltration Basins consist of an underdrain system, a filter media, an overflow system, a pre-treatment system, and plantings.

#### 1.3.1 Underdrain System

Place an underdrain system beneath the filter media for **all** Infiltration Basin areas as many of the native soils found in Greenville County do not allow for adequate infiltration. The perforated underdrain drain pipe must be connected to a stormwater conveyance system or discharge to a stabilized outlet that daylights (emerges from the ground and is open to the air). When applicable, connect underdrain system to overflow riser. Avoid piping underdrain below compacted berms.

In extreme situations where an underdrain is not feasible due to unique site constraints, infiltration rate must be a minimum 0.5 inches per hour, verified by site specific soil samples at the elevation of the bottom of the Infiltration Basin where infiltration will occur.

Provide an underdrain system that consists of continuous closed joint perforated plastic pipe underdrains with a minimum 4-inch diameter, an 8-inch minimum gravel filter layer, a non-woven geotextile filter fabric to wrap the perforated pipe and to separate the gravel from the native soils and the gravel from the filter media, and minimum 4-inch diameter non-perforated PVC outlet pipe and clean out wells.

The maximum spacing of pipe underdrain is 10 feet.

Design the underdrain system to safely pass the peak draw down rate calculated in Section 1.2.3.

Underdrain systems will be made of materials specified in Table 1.

**Table 1: Underdrain Material Specifications**

<b>Material</b>	<b>Specification</b>
Aggregate	Use coarse aggregate No. 57 or No. 5 consisting of crushed slag or gravel.
Pipe Underdrains	Use PVC perforated pipe (AASHTO M 252) underdrains with a minimum diameter of 4 inches.
Clean Out and Outlet Pipe	Use non-perforated PVC pipe with a minimum diameter of 4 inches.
Non-woven Geotextile Fabric	Use Class 2 Type C non-woven geotextile fabric.

**1.3.2 Filter Media**

The filter media provides a medium for physical filtration for the stormwater runoff with enough organic matter content to support growth and provide water and nutrients for plant life.

Ensure the filter media of the Infiltration Basin area is level to allow uniform ponding over the entire area. The minimum filter media depth is 3 feet. The maximum ponding depth above the filter media is 2 feet to allow the Infiltration Basin area to drain within a reasonable time and to prevent long periods of plant submergence. Provide a filter media with a minimum infiltration rate of 1 inch per hour (optimal range is 1 to 6 inches per hour). The filter media is to be furnished, and on-site soils are not acceptable. The filter media shall be a uniform mix of sand and organic material meeting the following criteria.

**Sand**

- 75% to 85% composition by weight
- Medium to coarse washed sand
- Washed river sand and concrete/masonry sand are acceptable
- Do not use lime stone screenings

**Organic Material**

- 15% to 25% composition by weight
- Compost material that is well decomposed, stable, and weed free
- Derived from leaves, yard debris, wood waste, food waste, or other organic materials
- Does not include manure or biosolids
- Do not use manure-based mushroom compost
- US Composting Council Seal of Testing Assurance (STA) compost is preferred

**Acidity/Alkalinity (pH)**

- Between 5.2 and 8.0 with an optimal range of 6.0 to 7.5
- Tested prior to installation with documentation to be provided to County
- Utilizing Clemson Extension Agricultural Service Laboratory is recommended. For more information, visit their website at <https://www.clemson.edu/public/regulatory/ag-srvc-lab/soil-testing/index.html>.

Should the filter media pH fall outside of the acceptable range, modify with pelletized lime (to raise pH) or iron sulfate plus sulfur (to lower pH). Uniformly mix lime or iron sulfate into the filter media prior to use in Infiltration Basin.

The Engineer will submit the source and makeup of the filter media and the pH test results to the County prior to the start of construction of Infiltration Basin. Do not add material to a stockpile of filter media once a stockpile has been sampled. Allow sufficient time for filter media preparation and testing. It is recommended that the Engineer or Contractor consult the County regarding the list of landscape suppliers

with the acceptable material that are capable of providing pre-mixed filter media in order to reduce testing and mobilization time and construction delays.

Use a filter media that is uniform, free of stones, stumps, roots or other similar objects larger than 2 inches excluding mulch. Do not mix or dump materials or substances within the Infiltration Basin that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations.

A filter media that fails to meet the minimum requirements must be amended or replaced.

### 1.3.3 Overflow System

Design an overflow system to pass runoff volumes greater than the designed volume away from the Infiltration Basin area. Place an outflow structure at the elevation of the maximum 2 feet ponding depth above the Infiltration Basin surface to carry excess runoff to a stormwater conveyance system or stabilized outlet.

### 1.3.4 Pre-treatment System

Provide a pre-treatment system to reduce incoming velocities, evenly spread the flow over the entire Infiltration Basin area, and to trap coarse sediment particles before they reach the filter media. Several pre-treatment systems are applicable, depending on whether the Infiltration Basin area receives sheet flow, shallow concentrated flow or deeper concentrated flows. The following are appropriate pretreatment options:

- **Forebay** (for channel flow): Located at pipe inlets or curb cuts leading to the Infiltration Basin area consisting of energy dissipation and flow dispersion sized for the expected peak discharge rate. The Forebay may be formed by a wooden or stone check dam or an earthen or rock berm. Ensure the Forebay is protected with the proper erosion prevention measures. The Forebay does not require an underlying filter media.
- **Grass Filter Strips** (for sheet flow): Extend a minimum of 20 feet from edge of pavement to the upstream edge of the Infiltration Basin area with a maximum slope of 5%.
- **Gravel or Stone Diaphragms** (for sheet or concentrated flow): Located at the edge of pavement or other inflow point, running perpendicular to the flow path to promote settling. Size the stone according to the expected peak discharge rate.
- **Level Spreaders** (for sheet flow): Level spreaders reduce incoming energy from the runoff and convert concentrated flow to sheet flow that is evenly distributed across the entire Infiltration Basin area. See Specification and Details for WQ-13 Level Spreader.
- **Manufactured Stormwater Treatment Devices (MTDs)**: An approved MTD may be used to provide pre-treatment.

### 1.3.5 Plantings

Use plantings that conform to the standards of the current edition of *American Standard for Nursery Stock* as approved by the American Standards Institute, Inc.

Use plant materials that have normal, well developed stems or branches and a vigorous root system. Only use plantings that are healthy, free from physical defects, plant diseases, and insect pests.

Use plant species that are tolerant to wide fluctuations in soil moisture content. Use plantings capable of tolerating saturated soil conditions for the length of time anticipated for de-watering, as well as anticipated runoff constituents.

Acceptable Infiltration Basin plantings include:

- Turf Grass only, and
- Native Grasses and Perennials.

#### 1.3.5.1 Turf Grass Only

Use turfgrass species with a thick dense cover, slow growing, applicable to the expected moisture conditions (dry or wet), do not require frequent mowing, and have low nutrient requirements. The preferred method of establishing turf grass is sodding. Use temporary erosion control blankets to provide temporary cover when establishing turf grass by seeding.

#### 1.3.5.2 Native Grasses and Perennials

Create a low maintenance native grass or wildflower meadow with native grasses and native perennial species. Use temporary erosion control blankets for erosion prevention during establishment. Plant native grasses and perennials of the same species in clusters 1.0 to 1.5 feet on-center.

### 1.4 Construction Requirements

Do not construct Infiltration Basin areas until all contributing drainage areas are stabilized as directed by the Engineer. Do not use Infiltration Basin areas as sediment control facilities for during construction sediment control. Do not operate heavy equipment within the perimeter of Infiltration Basin areas during excavation, underdrain placement, backfilling, planting, or mulching.

Separate Infiltration Basin areas from the water table to ensure groundwater does not enter the facility leading to groundwater contamination or Infiltration Basin failure. Ensure a vertical distance of 4 feet between the bottom of the Infiltration Basin area and the seasonally high ground water table, to be verified by a geotechnical report if requested by the County.

#### 1.4.1 Site Preparation

Pre-treat stormwater runoff to reduce the incoming velocities, evenly spread the flow over the entire Infiltration Basin area, and provide removal of coarse sediments. Because Infiltration Basin areas are sensitive to fine sediments, do not install them on sites where the contributing area is not completely stabilized or is periodically being disturbed.

#### 1.4.2 Excavation

Excavate the Infiltration Basin area to the dimensions, side slopes, and elevations shown on the Plans.

Ensure excavation minimizes the compaction of the bottom of the Infiltration Basin area. Operate excavators and backhoes on the ground adjacent to the Infiltration Basin area or use low ground-contact pressure equipment. Do not operate heavy equipment on the bottom of the Infiltration Basin area.

Remove excavated materials from the Infiltration Basin area and dispose of them properly.

#### 1.4.3 Underdrain System

Prior to placing the underdrain system, alleviated compaction on the bottom of the Infiltration Basin area by using a primary tilling operation such as a chisel plow, ripper, or subsoiler to a depth of 12 inches. Substitute methods must be approved by the Engineer. Rototillers typically do not till deep enough to reduce the effects of compaction from heavy equipment.

Remove any ponded water from the bottom of the excavated area. Place a Class 2, Type C non-woven geotextile fabric underneath areas where the underdrain will be placed.

Place a layer of No. 5 or No. 57 Aggregate 3-foot wide, and minimum of 3 inches deep on top of the non-woven filter fabric. Place the pipe underdrains on top of the underlying aggregate layer. Wrap underdrain

pipes with a non-woven geotextile filter fabric before they are installed. Lay the underdrain pipe at a minimum 0.5% longitudinal slope. The perforated underdrain drain pipe may be connected to a stormwater conveyance system or stabilized outlet. Cap the ends of underdrain pipes not terminating in an observation well.

Install observation wells/cleanouts of non-perforated pipe vertically in the Infiltration Basin. Install observation wells and/or clean-out pipes at the ratio of one minimum per every 1,000 square feet of surface area as shown on the Plans. Connect the wells/cleanouts to the perforated underdrain with the appropriate manufactured connections as shown on the Plans. Extend the wells/cleanouts 6 inches above the top elevation of the Infiltration Basin area mulch layer, and cap with a screw cap.

Place No. 5 or No. 57 Aggregate around the pipe underdrain system to a minimum depth of 8 inches. Place a Class 2, Type C non-woven geotextile fabric at the boundary between the gravel and the filter media to prohibit the filter media from filtering down to the perforated pipe underdrain.

Place an outflow structure at the elevation of the maximum 2-foot ponding depth of the Infiltration Basin area to carry excess runoff from the Infiltration Basin area to a stormwater conveyance system, or stabilized outlet.

#### 1.4.4 Filter Media

Place and grade the filter media using low ground-contact pressure equipment or excavators and/or backhoes operating on the ground adjacent to the Infiltration Basin area. Do not use heavy equipment within the perimeter of the Infiltration Basin area before, during, or after the placement of the filter media. Place the filter media in vertical layers with a maximum thickness of 12 to 18 inches per layer. Compact the filter media by saturating the entire Infiltration Basin area after each lift of filter media is placed until water flows from the underdrain system. Apply water for saturation by spraying or sprinkling. Perform saturation of each lift in the presence of the Engineer. Do not use equipment to compact the filter media. Use an appropriate sediment control BMP to treat any sediment-laden water discharged from the underdrain during the settling process.

The Engineer will provide documentation from the supplier to verify the makeup of the pre-mixed filter media to the County.

## 1.5 Inspection and Maintenance

Regular inspection and maintenance are critical to the effective operation of Infiltration Basin areas. Maintenance responsibility of the Infiltration Basin area is vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

Records of inspections and maintenance will be provided on plans and in the SWPPP.

The surface of the ponding area will become clogged with fine sediments over time. Perform core aeration and cultivate unvegetated areas as required to ensure adequate filtration. Other required maintenance includes but is not limited to:

- Perform pruning and weeding to maintain appearance periodically as needed.
- Remove trash and debris periodically as needed.

Required maintenance activities and their frequencies are listed in Table 2.

**Table 2: Summary of Maintenance Requirements**

Required Maintenance	Frequency
Pruning and weeding.	As needed
Remove trash and debris.	As needed
Core Aeration	Semi-annual (every 6 months)
Inspect inflow points for clogging. Remove any sediment	Semi-annual (every 6 months)
Repair eroded areas. Re-seed or sod as necessary.	Semi-annual (every 6 months)
Inspect vegetation to evaluate health.	Semi-annual (every 6 months)
Remove and replace dead or severely diseased vegetation.	Semi-annual (every 6 months)
Removal of invasive vegetation.	Semi-annual (every 6 months)
Test filter media for nutrient/fertilizer requirements.	Annual
Nutrient management per soil test results.	As needed
Pesticide management.	As needed
Test filter media for pH.	Annual
Apply pelletized lime if pH < 5.2.	As needed
Add iron sulfate + sulfur if pH > 8.0.	As needed



## 1.6 IDEAL Modeling

The County's required method of demonstrating compliance with its water quality standards is to use the Greenville County IDEAL model. To facilitate use of this model, Table 3 shows how to represent this BMP and BMPs similar to this one in the IDEAL model. It lists the parameters needed to successfully run the model and the parameters that affect the sediment trapping efficiency of the BMP.

**Table 3: IDEAL Modeling Guide**

<b>Bioretention Cell Modeling in IDEAL</b>		
What to Model as in IDEAL	Bioretention Cell	
Similar BMPs	Stormwater Alley	
	Green Roofs	
	Planter Box	
	Rain Gardens	
	Natural Infiltration Area/Basin	
	Bioretention Area/Swale/Basin	
Specifications Needed for IDEAL	Cell area and number of layers within the cell	
	If applicable, underdrain details such as: - Subgrade infiltration soil texture and degree of saturation - Underdrain orifice diameter	
	Type of media and depth of each layer of the cell	
	Shape and dimensions of the riser	
	Dimensions, slope, Manning's roughness coefficient, and entrance loss coefficient of the barrel	
	Type, shape, and dimensions of the emergency spillway if present	
	Direct loading of bacteria that will be entering the cell	
Parameters that Drive Performance	<b>Feature</b>	<b>How Value Affects Sediment Trapping Efficiency (TE)</b>
	Underlying Soil Texture	Soils with higher infiltration capabilities increase TE
	Area	Increasing area increases TE
	Amount of Clay in Media	More clay increases TE but decreases infiltration rate