WQ-04: INFILTRATION TRENCHES

1.0 Infiltration Trenches

1.1 Description

Infiltration Trenches are excavations filled with stone to create an underground reservoir to manage stormwater runoff. Use individual Infiltration Trenches for drainage areas up to two (2) acres in size.

The stormwater runoff volume enters the Infiltration Trench, is temporarily stored, and gradually exfiltrates through the bottom and sides of the trench into the subsoil. Infiltration Trenches fully de-water within a 24- to 72-hour period depending on trench dimensions, soil type, and underdrain system.
By diverting storm water runoff into the soil, the Infiltration Trench not only treats the water quality volume, but it also preserves the natural water balance. Using natural filtering properties, Infiltration Trenches can remove a wide variety of pollutants from the runoff through adsorption, precipitation, filtering, and bacterial and chemical degradation.

Use Infiltration Trenches to capture sheet flow from a drainage area or function as an off-line device. Due to the relatively narrow shape, Infiltration Trenches can be adapted to many different types of sites and can be utilized in retrofit situations. Because Infiltration Trenches are sensitive to fine sediments, do not install them on sites where the contributing area is not completely stabilized or is periodically being disturbed.

Infiltration Trenches are limited to areas with highly porous soils where the water table and or bedrock are located well below the trench bottom. Infiltration Trenches:

- Are only applicable for Hydrologic Soil Group A soils, or soils that have a minimum infiltration rate of 0.5-inches per hour determined from site specific soil boring samples.
- Are located to avoid ground water contamination.
- Are not intended to trap sediment during construction activities.
- Have a sediment forebay or other pre-treatment measure to prevent clogging in the gravel.
- Have 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 very low.

1.2 Design

Calculate the Infiltration Trench area using the following equation:

$$A = \frac{V}{\left(nd + \frac{kT}{12} \right)}$$

Where:

A = Surface area of Infiltration Trench (feet^2)

V = Water Quality volume (1-inch)

n = Porosity of stone in infiltration trench (0.3 to 0.5 depending on stone)
*Use conservative porosity value (**n**) of 0.32 in unless an aggregate specific value is known.*

d = Depth of trench (ft)

k = Percolation rate of soil (in/hour)

T = Fill time(hours). A fill time of 2 hours is recommended for most design calculations.

1.3 Materials

1.3.1 Stone Fill

The stone fill media consists of 1.0- to 2.5-inch D_{50} crushed stone with 6-inches of pea gravel located on top separated by a permeable nonwoven geotextile filter fabric.

1.3.2 Permeable Nonwoven Geotextile Fabric

Place a permeable nonwoven geotextile filter fabric between the pea gravel and stone fill and the stone fill and adjacent soil. The filter fabric prevents sediment from passing into the stone media, and is easily separated from the nonwoven geotextile fabric that protects the sides of the excavated trench.

1.2.3 Sand Filter

Place a 6-inch sand filter or permeable nonwoven filter fabric on the bottom of the trench.

1.3.3 Observation Well

Install observation wells spaced a maximum of 100-feet in every infiltration trench. The well is made of 4- to 6-inch PVC pipe. Extend the observation well to the bottom of the trench. The observation well shows the rate of de-watering after a storm event, and predicts when maintenance is required for the Infiltration Trench. Install the observation well along the centerline of the trench, flush with the ground elevation of the trench. Cap the top of the well to discourage vandalism and tampering.

Table 1: Material Specifications

Material	Specification
No. 57 Aggregate	Use course aggregate No. 57 consisting of crushed slag or gravel
1.0- to 2.5-inch D_{50} Crushed Stone	Coarse Aggregate Size No.: 2, 24 or 3
Pea Gravel	ASTM D 448; Stone Size No. 6 or 1/8" to 3/8"
Sand Filter Material	AASHTO Std. M-43, Size No. 9 or No. 10) (SCDOT FA-10 Size No. 8)
Pipe Underdrains	Use perforated pipe underdrains with a minimum diameter of 4-inches
Observation Well and Outlet Pipe	Use non-perforated pipe underdrains with a minimum diameter of 4-inches
Type C Permeable Non-Woven Geotextile Fabric	Use Type C non-woven geotextile fabric

1.4 Construction Requirements

Ensure stormwater runoff from areas draining to Infiltration Trenches passes through stabilized vegetated filter at least 20-feet in length, a sediment forebay or other pre-treatment measure before discharging to the Infiltration Trench. Do not install Infiltration Trenches in fill material because piping along the fill and natural ground interface may cause slope failure.

1.4.1 Site Preparation

Ensure a vertical distance of 4 feet between the Infiltration Trench bottom and the elevation of the seasonally high water table, whether perched or regional. The water table is determined by direct piezometer measurements and on-site soil borings.

Locate Infiltration Trenches greater than 3-feet deep a minimum of 10 feet from basement walls.

Locate Infiltration Trenches a minimum of 150-feet from any public or private water supply well.

Construct Infiltration Trenches with a maximum width of 25-feet.

1.4.2 Installation

Construct an excavated trench with a minimum depth of 3-feet, and a maximum depth of 8-feet. The maximum slope bottom of the infiltration practice is 5 percent.

Do not install Infiltration Trenches in fill material as piping along the fill/natural ground interface may cause slope failure.

Do not install an Infiltration Trench on or atop a slope whose natural angle of incline exceeds 20 percent.

Line the excavated trench with a permeable nonwoven geotextile filter fabric.

Place a 6-inch sand filter on the bottom of the trench and place a permeable geotextile filter fabric over the sand filter.

Install observation wells spaced a maximum of 100-feet. Extend the well to the bottom of the trench.

Install the observation well along the centerline of the trench, and flush with the ground elevation of the trench. Cap the top of the well to discourage vandalism and tampering.

Place the crushed stone fill media to a depth of 6-inches below the top ground surface and place a permeable geotextile filter fabric over the crushed stone. Install this permeable filter fabric so it is easily separated from the geotextile filter fabric that protects the sides of the excavated trench.

Place 6-inches of pea gravel on top of the crushed stone.

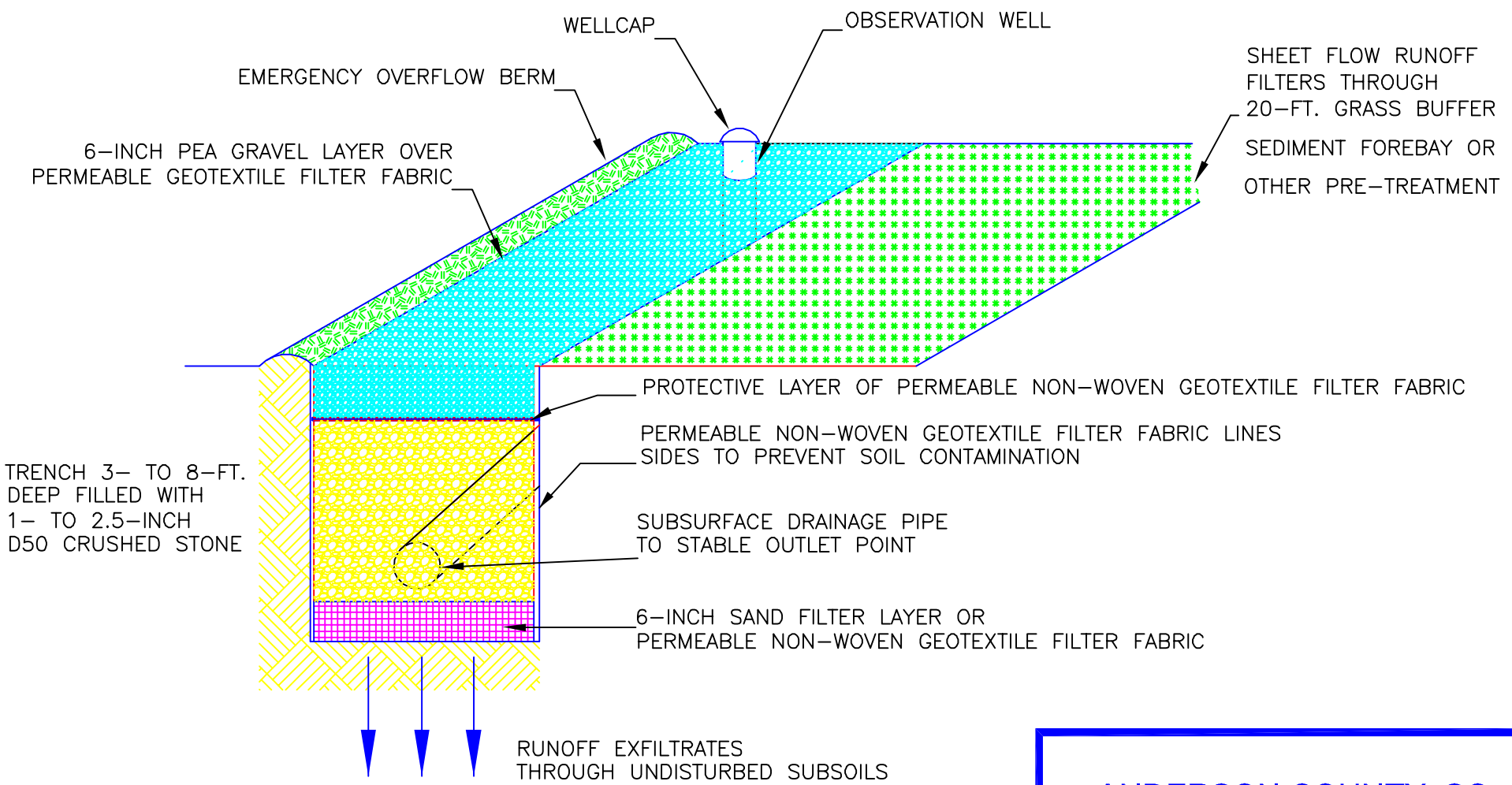
1.5 Inspection and Maintenance of Infiltration Trenches

Regular inspection and maintenance is critical to the effective operation of Infiltration Trenches. Maintenance responsibility for the Infiltration Trench 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. Typical maintenance responsibilities include:

- Keeping a record of the average de-watering time of the Infiltration Trench to determine if maintenance is required.
- Replacing the top 6 inch layer of pea gravel and the permeable nonwoven geotextile filter fabric separating the pea gravel from the stone media when they become full of sediment.
- Clearing debris and trash from all inlet and outlet structures monthly.
- Checking the observation wells after three consecutive days of dry weather after a rainfall event. If complete de-watering is not observed within this period, there may be clogging within the trench and proper maintenance is required.
- Removing trees, shrubs, or invasive vegetation semi-annually.
- If complete failure is observed, performing total rehabilitation of the trench by excavating the trench walls to expose clean soil, and replacing the gravel, geotextile filter fabric, and topsoil.

Table 2: Summary of Maintenance Requirements

Required Maintenance	Frequency
Ensure that the contributing area is stabilized with no active erosion	Monthly
Mow grass filter strips and remove grass clippings.	Monthly
Check observation wells after 72 hours of rainfall. Ensure Wells are empty after this time period. If wells have standing water, the underdrain system or outlet may be clogged.	Semi-annual (every 6 months)
Remove evasive vegetation.	Semi-annual (every 6 months)
Inspect pretreatment structures for deposited sediment.	Semi-annual (every 6 months)
Replace pea gravel, topsoil and top surface geotextile filter fabric.	When clogging or surface standing water is observed
Perform total rehabilitation of infiltration trench.	Upon observed failure



SCHEMATIC OF AN INFILTRATION TRENCHES

ANDERSON COUNTY, SC

TYPICAL INFILTRATION TRENCH

STANDARD DRAWING NO.

APPROVED BY: _____ JAN, 2012
DATE

INFILTRATION TRENCH MAINTENANCE AND RESPONSIBILITY AGREEMENT

The Permanent *Stormwater System Maintenance and Responsibility Agreement* requires adequate maintenance for stormwater management/Best Management Practices (BMP) facilities including Infiltration Trenches. Document Infiltration Trench deficiencies during **annual** inspections. Complete any necessary repairs and/or preventive maintenance procedures in a timely manner to ensure proper functioning as an Infiltration Trench.

Important maintenance procedures:

- Ensure the drainage area is stabilized to reduce sediment discharge.
- Replace the top 6-inch layer of pea gravel and geotextile separating the pea gravel from the stone media when full of sediment.
- Record the water level in the monitoring wells after every storm event greater than 1.0 inches.
- Check the observation well after three consecutive days of dry weather after a rainfall event greater than 1.0 inches. If complete de-watering is not observed, there may be clogging within the trench requiring maintenance.
- Keep a record of the average de-watering time to determine when maintenance is required.
- If complete failure is observed, perform total rehabilitation by excavating the trench walls to expose clean soil, and replacing gravel, geotextiles and topsoil.

After the Infiltration Trench is established, perform inspections once a quarter and after every storm event greater than 1.0 inch for the first year, and annually thereafter. Keep operation and maintenance records in a known location and make them available upon request.

Perform recommended maintenance activities as follows:

Required Maintenance	Frequency
Clear trash and debris from all inlet and outlet structures	Monthly
Remove trees, shrubs or evasive vegetation	Every 6-months
Ensure that the contributing area is stabilized with no active erosion.	Monthly
Mow grass filter strips and remove grass clippings.	Monthly, or as needed
Check observation wells after 72 hours of rainfall. Ensure Wells are empty after this time period. If wells have standing water, the underdrain system or outlet may be clogged.	Every 6-months
Inspect pretreatment structures for deposited sediment.	Every 6-months
Replace pea gravel, topsoil, and top surface filter fabric.	When clogging or surface standing water is observed
Perform total rehabilitation of infiltration trench.	Upon observed failure

Perform trouble shooting activities as follows:

BMP Component	Problem	Solution
Entire Infiltration Trench	Trash/debris is present.	Remove the trash/debris.
Pretreatment area	Areas of bare soil and/or erosive gullies have formed.	Re-grade the area as necessary, plant vegetation, and water until established.
	Sediment has accumulated and reduced the depth to 50% of the original design depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of in a proper location.
Flow diversion structure	The structure is clogged	Unclog the conveyance and dispose of any sediment off-site.
	The structure is damaged.	Make any necessary repairs or replace if damage is too large for repair.
Trench	Water is ponding on the surface for more than 24 hours after a storm.	Check observation wells and outlets to ensure system is not clogged or blocked.
	The depth in the trench is reduced to 75% of the original design depth.	Remove accumulated sediment from the infiltration system and dispose in a proper location.
	Grass, weeds or other plants are growing on the surface of the trench.	Remove the plants, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
Observation well(s)	The water table is within one foot of the bottom of the system for a period of three consecutive months.	The infiltration trench may be deemed non-functional and additional BMPs may be required.
	The outflow pipe is clogged.	Clean repair or replace the outflow pipe.
	The outflow pipe is damaged.	Repair or replace the pipe.
Emergency overflow	Erosion or other signs of damage have occurred at the outlet.	Repair or replace as needed.