Infiltration Trenches

Description

Infiltration trenches are excavations typically filled with stone to create an underground reservoir for storm water runoff. The runoff volume gradually exfiltrates through the bottom and sides of the trench into the subsoil over a maximum period of 72 hours (three days), and eventually reaches the water table. By diverting storm water runoff into the soil, an infiltration trench not only treats the water quality volume, but it also preserves the natural water balance by recharging groundwater and preserving channel baseflow. Using natural filtering properties, infiltration trenches remove a wide variety of pollutants from the runoff through adsorption, precipitation, filtering, and bacterial and chemical degradation.

When and Where to Use It

Infiltration trenches are limited to areas with highly porous soils where the water table and or bedrock are located well below the trench bottom. They are only applicable for Hydrologic Soil Group A soils, or soils that have a minimum infiltration rate of 0.3-inches per hour. Infiltration trenches are not intended to trap sediment and are designed with a sediment forebay or other pre-treatment measure to prevent clogging in the gravel. Infiltration trenches are used for medium- to high- density residential, commercial, and institutional developments. They are most 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 is very low. Do not use Infiltration trenches for manufacturing and industrial sites where there is potential for high concentrations of soluble pollutants and heavy metals. Infiltration trenches are designed to capture sheet flow from a drainage area or function as an off-line device. Due to the relatively narrow shape, infiltration trenches are adapted to many different types of sites and are utilized in retrofit situations. Unlike some water quality BMPs, infiltration trenches can easily fit into margin, perimeter or other unused areas of development sites.

Design Criteria

- The maximum drainage area for any one infiltration trench is five (5) acres.
- Direct runoff from areas draining to infiltration practices thorough stabilized vegetated filters at least 20-feet in length.
- Underlying soils have an infiltration rate of 0.3-inches per hour or greater determined from site-specific field soil boring samples.
- Do not place infiltration practices in fill material because piping along the fill-natural ground interface may cause slope failure.
- The area of the infiltration trench is determined from 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)
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).

- Use a conservative porosity value (**n**) of 0.32 in volume calculations unless an aggregate specific value is known.
- Design at least (½)-feet between the bottom of the infiltration trench and the elevation of the seasonally high water table, whether perched or regional.
- Determine the seasonally high water table using on-site soil borings and textural classifications to verify the actual site and seasonal high water table conditions.
- The minimum depth of the excavated trench is 3-feet, the maximum depth is 8-feet, and the trench is lined with a permeable geotextile filter fabric.
- Locate infiltration practices greater than 3-feet deep at least ten feet from basement walls.
- Locate infiltration practices a minimum of 150-feet from any public or private water supply well.
- The maximum width of the infiltration trench is 25-feet.
- 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 geotextile filter fabric. This filter fabric prevents sediment from passing into the stone media, and should be easily separated from the geotextiles that protect the sides of the excavated trench.
- Install a 6-inch sand filter or permeable filter fabric on the bottom of the trench.
- The maximum slope bottom of the infiltration practice is 5 percent.
- Design the infiltration trench to fully de-watered within a 24- to 72-hour period depending on trench dimensions and soil type.
- Install an observation well spaced a maximum of 100-feet. The well is made of 4- to 6-inch PVC pipe. Extend the well to the bottom of the trench. The observation well shows the rate of de-watering after a storm event, and helps predict when maintenance is required. 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 and lock it to discourage vandalism and tampering.

Inspection and Maintenance

Regular inspection and maintenance is critical to the effective operation of infiltration trenches as designed. Maintenance responsibility for the infiltration trench should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of the Storm Water Management Permit approval. Typical maintenance responsibilities include:

- Keep a record of the average de-watering time of the infiltration trench to determine if maintenance is required.
- The top 6-inch layer of pea gravel and geotextile separating the pea gravel from the stone media serve as a sediment barrier and require replacement when full of sediment.
- Clear debris and trash from all inlet and outlet structures monthly.
- Check the observation well 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 requiring proper maintenance.
- Remove trees, shrubs, or invasive vegetation semi-annually.
- If complete failure is observed, perform total rehabilitation by excavating the trench walls to expose clean soil, and replacing the gravel, geotextiles, and topsoil.

Average Pollutant Removal Capability

Total Suspended Solids:	80%-90%	Metals:	70%-85%
Copper:	50%-60%	Lead:	80%-90%
Zinc:	80%-90%	Total Phosphorus:	50%-60%
Total Nitrogen:	35%-55%	Pathogens/Bacteria:	90%-98%
Hydrocarbons:	85%		

Infiltration Trench

Summary of Maintenance Requirements

Required Maintenance	Frequency
Ensure that the contributing area is stabilized with no active erosion.	Monthly
Grass filter strips should be mowed and grass clippings should be removed.	Monthly
Check observation wells after 72 hours of rainfall. Wells should be 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 filter fabric.	When clogging or surface standing water is observed
Perform total rehabilitation of infiltration trench.	Upon observed failure