Infiltration Trench

Infiltration trenches are filled with rock with no outlet that receives stormwater runoff, a French drain is a rock-filled trench with a sub-drain installed for overflow. Stormwater runoff passes through some combination of pre-treatment measures, such as a swale into the trench. Runoff is stored in the void space between the aggregate and infiltrates into the surrounding soil. The desired infiltration time is 24 hours. The primary pollutant removal mechanism of this practice is filtering through the soil. Infiltration trenches have select applications due to concerns such as potential groundwater contamination, soils and clogging. Infiltration trenches generally can be applied to relatively small sites less than 5 acres, with relatively high impervious cover. Application to larger sites generally causes clogging, resulting in high maintenance. A design variation is a dry well to control small volumes of runoff, such as rooftop runoff (see dry well design standard).

Limitations

- Potential failure due to improper sitting, design (including inadequate pretreatment), construction, and maintenance. Infiltration trenches usually fail for one or more of the following reasons (Wisconsin DNR, 2000);
    - Premature clogging
    - A design infiltration rate greater than the actual infiltration rate
    - The practice was first used for site construction erosion control
    - Soil was compacted during construction
    - Upland area was not stabilized with vegetation, and sediment was delivered to the practice
- Drainage area should be limited to a 5 acre (2 acres is recommended)
- Restricted in Natural Resource Conservation Service Hydrologic Soil Group (HSG) C & D soils as well as Karst topography
- Requires scheduled inspection and maintenance

Recommended V_Q Credit

Total storage volume, taking into account void space of aggregate, calculated by design professional.

Supporting Practices Required

- Flow splitter
- Vegetation

- Subsurface drain

Sizing Guideline

1. Compute the Water Quality Volume (V_Q) for the given land surface:

$$V_Q = \text{Drainage Area in Square Feet} \times 0.083 \text{ (1 inch rain)}$$

2. Determine infiltration trench volume:

$$A = \frac{V_Q}{nd + (kT / 12)}$$

Where:
A = Surface area of infiltration trench
V_Q = Volume to be infiltrated
n = porosity (default = 0.32)
d = trench depth (feet)
k = infiltration rate (inches/hour)
T = time it takes practice to fill with water 2 hours can be used as fill time for most designs

Recommended Guidelines

1. Design Considerations

1.1. To provide for easier maintenance, trench depths should be limited to 6 feet. Trench width should be 3 to 8 feet. Broader, shallow trenches reduce the risk of clogging by spreading the flow over a larger area for infiltration.

1.2. Infiltration trenches must be designed with a positive overflow.

1.3. Infiltration trenches should not be used as temporary sediment traps during construction.

1.4. Infiltration trenches should only be built after tributary area is stabilized.

1.5. Once a location is sited for the infiltration practice it should be marked and protected from construction traffic to prevent soil profile from compaction. During excavation and trench construction, only light equipment such as backhoes or wheel and ladder type trenchers should be used, to minimize compaction of the surrounding soils.

1.6. The trench surface should evenly distribute the runoff entering the trench, it may consist of exposed rock or vegetation with inlets. Depress the trench surface or place a berm at the down-gradient side of the trench to capture runoff.

1.7. Smearing of the soil at the interface with the trench bottom and sides must be avoided. Trench bottom can be corrected by raking or tilling to relieve compaction.

2. Slopes

2.1. Limit contributing slope to 5% or flatter.

2.2. The bottom slope of a trench should be flat across its length and width to distribute flows evenly, to encourage uniform infiltration through the bottom, and reduce the risk of clogging.

3. Design Flow

    3.1. If stormwater is conveyed to the trench as uniform sheet flow, the length of the trench perpendicular to the flow direction should be maximized.

    3.2. If stormwater is conveyed as channel flow, the length of the trench parallel to the direction of flow should be maximized.

4. Groundwater

    4.1. Four (4) feet clearance from the seasonal high water table is recommended, minimum 1 foot.

5. Drawdown time

    5.1. Trenches should be designed to provide a detention time of 6 to 72 hours. Although trenches may be designed to provide temporary storage of stormwater, the trench should drain prior to the next storm event.

6. Observation well

    6.1. An observation well at the center of the trench is recommended to monitor drawdown time. The observation well is typically a 4 to 6 inch diameter PVC pipe with a lockable cap anchored to a foot plate at the bottom of the trench. A visible floating marker should be provided to indicate water level.

7. Construction Considerations

    7.1. Post-construction soil

        7.1.1. Underlying soil should be permeable with a combined silt/clay content of 40% or less in NRCS hydrologic groups A, B or C.

        7.1.2. A minimum of two soil borings should be taken at the actual location of the proposed infiltration trench to identify localized soil conditions.

        7.1.3. Trenches over 10 feet in length should include at least one additional sample for each 50 foot increment.

        7.1.4. If soil conditions are not appropriate soil quality should be restored or engineered planting soil should be specified.

    7.2. Aggregate material

        7.2.1. Clean-washed aggregate 1.5 to 3-inch diameter.

        7.2.2. Aggregate should be placed within 6 to 12 inches of the finished surface elevation, leaving sufficient depth for topsoil replacement.

    7.3. Filter fabric

        7.3.1. Only non-woven filter fabrics shall be used.

7.3.2. Fabric installation shall provide sufficient length to cover the bottom, sides and top of the aggregate. Filter fabric shall be wrapped over the top of the aggregate such that it becomes completely enclosed and tied with wire or nylon twine or otherwise tightly secured around the horizontal inflow pipe where the pipe protrudes through the fabric.

7.3.3. Fabric shall be overlapped six inches in “shingle” fashion when more than one section is required to enclose aggregate.

7.4. Inlet control

7.4.1. Inlet control is needed when the infiltration trench is covered with vegetation to ensure runoff entering the trench is evenly distributed.

7.5. Outlet control

7.5.1. Not applicable

7.6. Overflow

7.6.1. A bypass (flow splitter) should be implemented for all infiltration trenches. The overland flow path of surface runoff exceeding the capacity of the trench should be provided, including measures to provide non-erosive flow condition on the down slope.

7.7. Final cover

7.7.1. A minimum of 6” of topsoil can be placed over the trench and vegetated to blend into the rest of the landscape.

8. Maintenance Considerations

8.1. Periodically

8.1.1. Inspect to ensure trench is draining properly.

8.1.2. Remove accumulated sediment in pretreatment area as needed.

8.2. Repairs

8.2.1. Clogging in trenches occurs most frequently on the surface. If clogging appears only to be at the surface, it may be necessary to remove and replace the first layer of stone aggregate and the filter fabric.

8.2.2. Ponded water inside the trench (as visible from the observation well) after 24 hours or several days after the storm even often indicates that the bottom of the trench is clogged. In this case, remove stone aggregate and filter fabric or media. Strip accumulated sediment from trench bottom, scarify or till trench bottom to help induce infiltration. Replace fabric and clean stone aggregate in the rehabilitated trench area.

Infiltration Trench Resources

- EPA Stormwater Technology Fact Sheet, No. EPA 832-F-99-019, September 1999
- 2005 Minnesota Stormwater Manual, Version 1.0 Chapter 12-INF Volume 2
- Pennsylvania Stormwater Best Management Practices Manual, Draft January 2005
- Minnesota Urban Small sites BMP Manual / Metropolitan Council / Barr Engineering Co., 3-169, Infiltration Trenches
- SUDAS, Design of Infiltration Practices, DRAFT Section 2F-5-1 Infiltration Trench, January 2005
- Georgia Stormwater Management Manual; Volume 2 (Technical Handbook), 3.2.5 Infiltration Trench http://www.georgiastormwater.com/vol2/3-2-5.pdf