Infiltration Basin/Trenches Design Considerations, Construction Issues, Problems and Solutions

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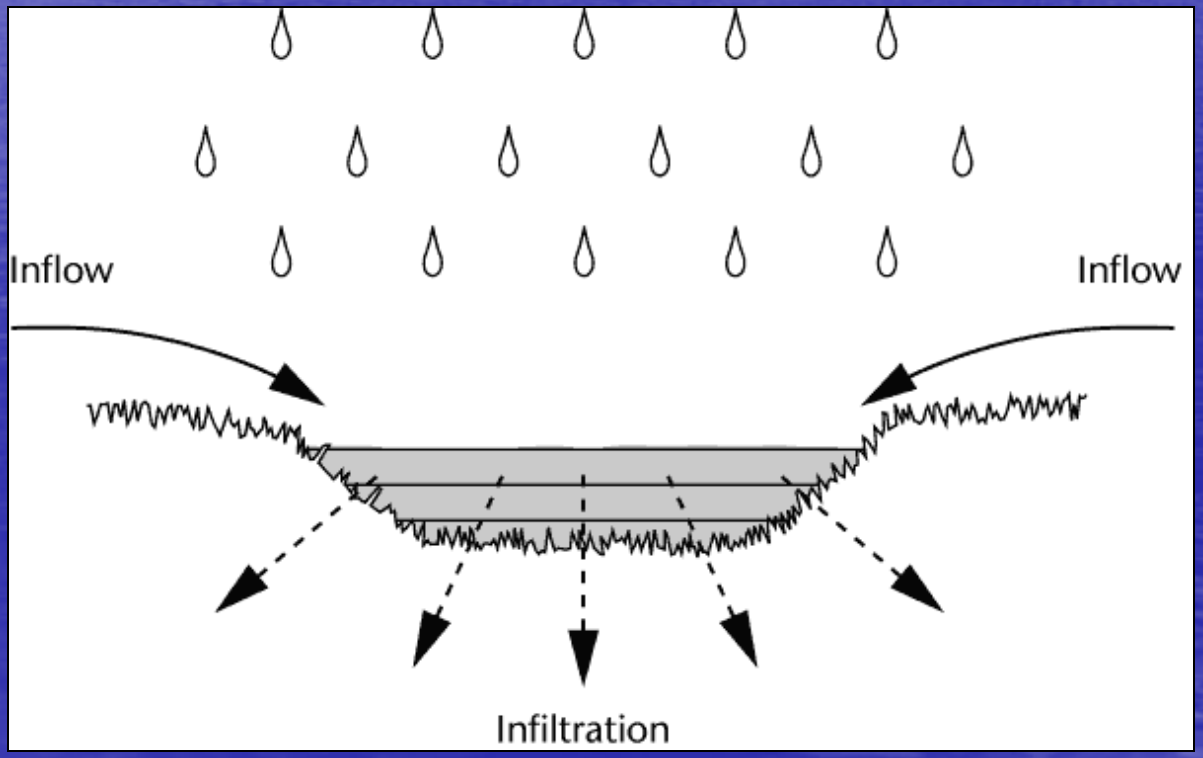
Infiltration

- "Infiltration" is the process by which water on the ground surface enters the soil.



Infiltration Basins

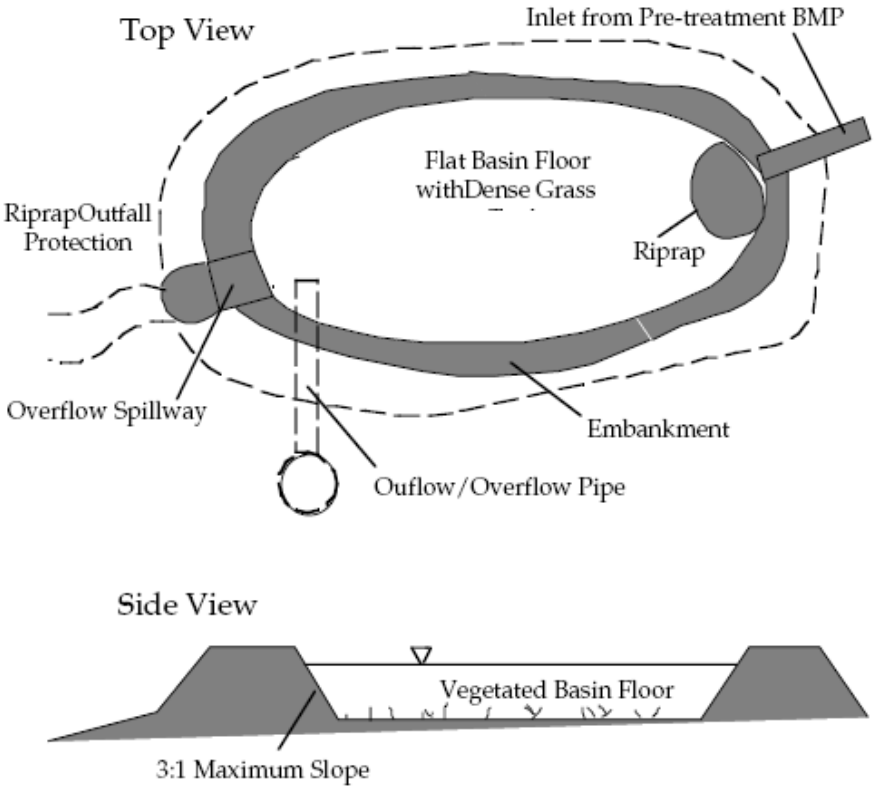
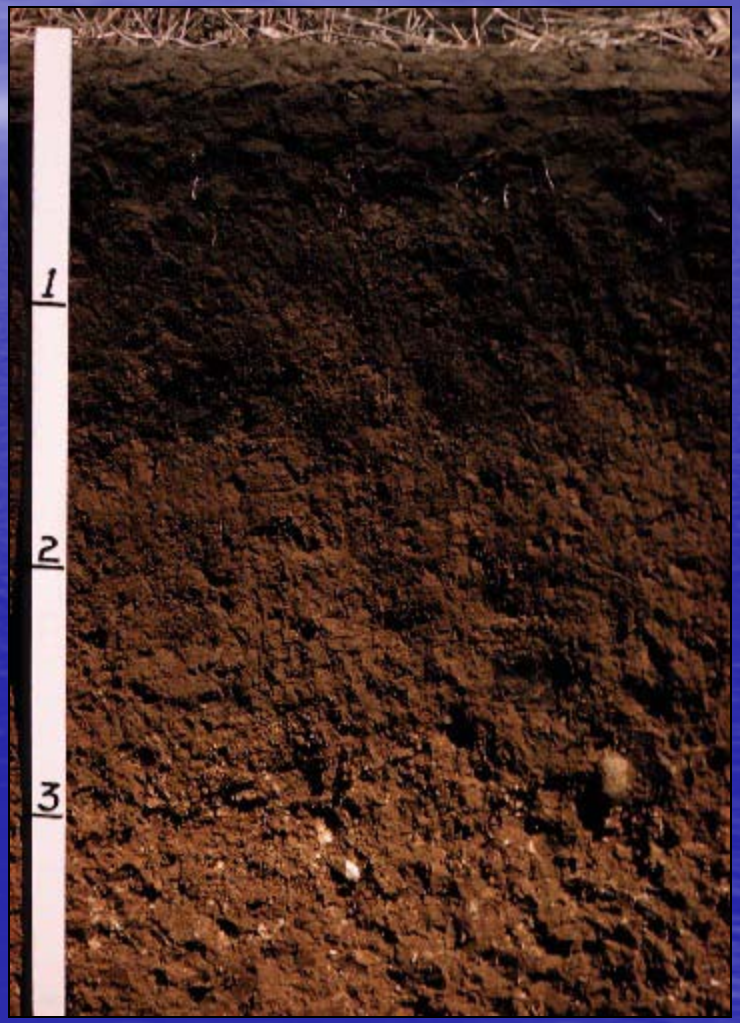


Figure 1. Layout of a Typical Infiltration Basin

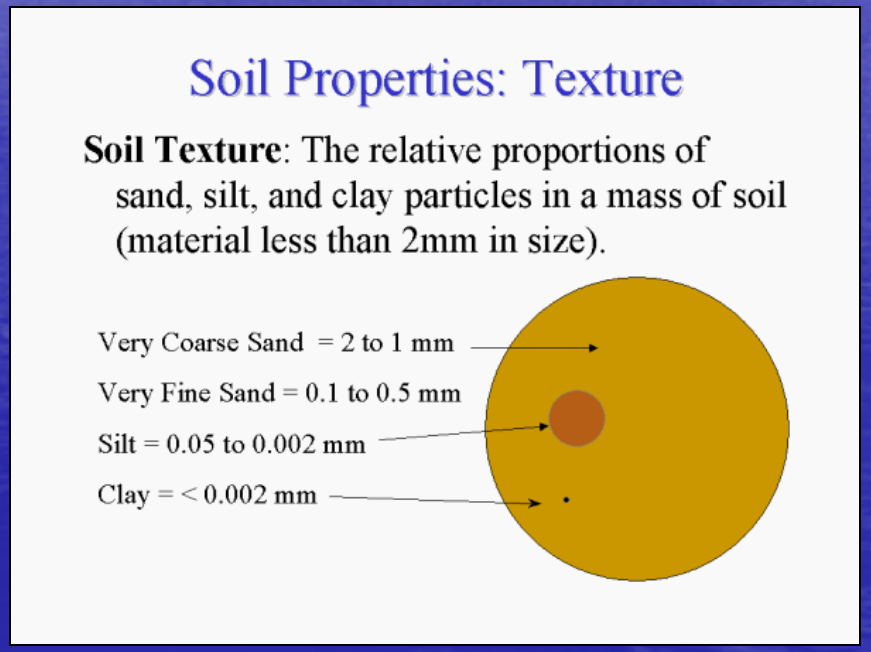
Infiltration Basins

- The fraction of soil organic carbon should exceed 0.3% to improve metals attenuation, but should not exceed 1.5% (by weight) for hydraulic effectiveness to a depth of (at least) 1 meter.



Infiltration Basins

- The silt/clay content upper limits should be reduced to 20% silt and 10% clay to improve/maintain hydraulic performance.



Infiltration Basins

- Design the basin to have a maximum drawdown time of 72-hours to prevent formation of a bio-slime layer which will clog the surface of the soil.

Infiltration Basins

- Remember; too short of a retention time can also be a problem, reducing the opportunity for absorption of pollutants in the porous media.

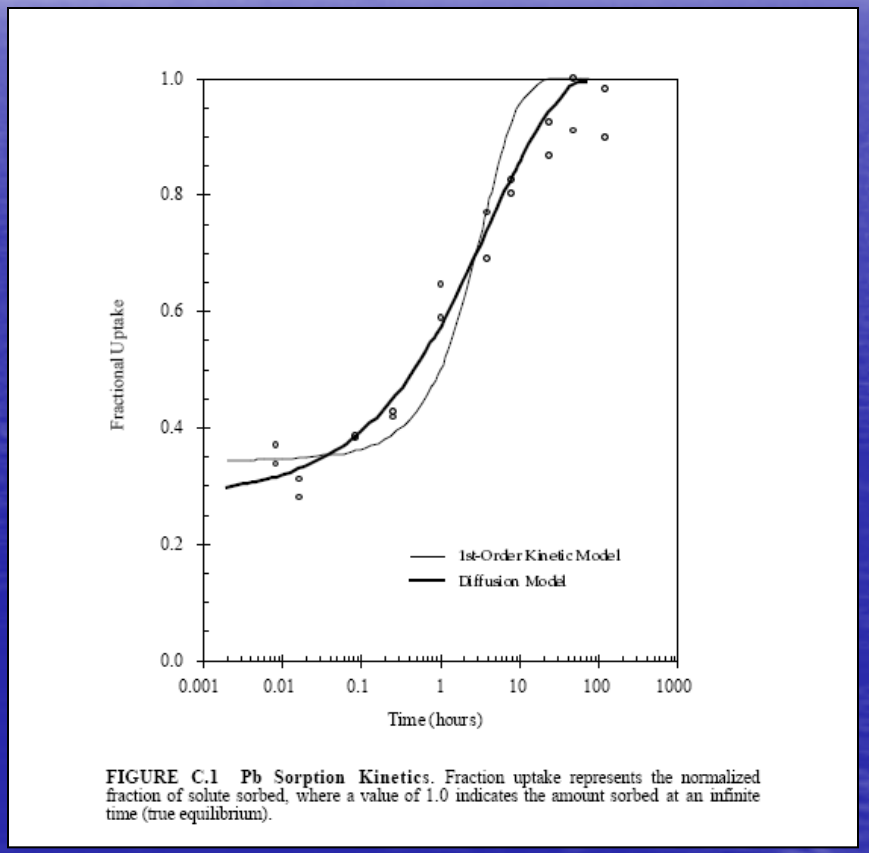
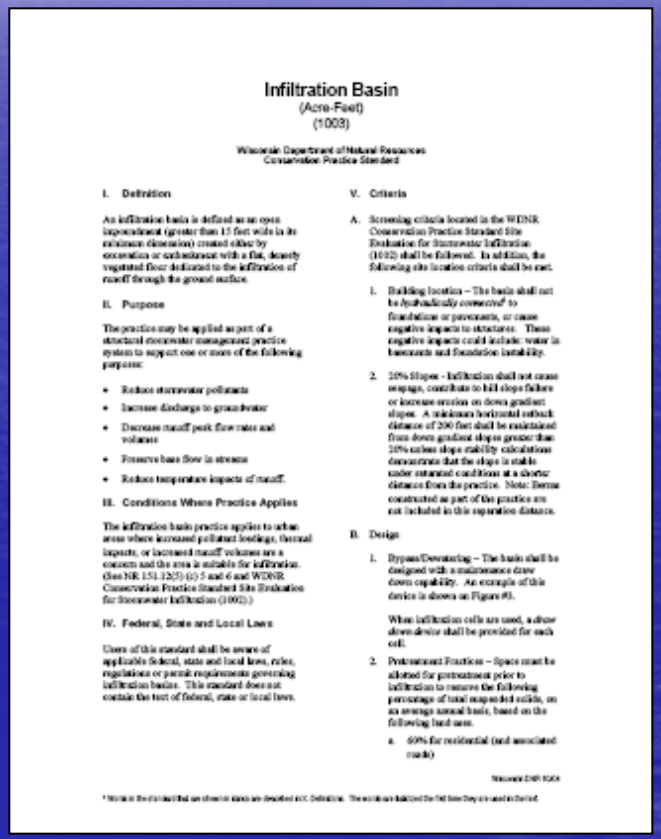


FIGURE C.1 Pb Sorption Kinetics. Fraction uptake represents the normalized fraction of solute sorbed, where a value of 1.0 indicates the amount sorbed at an infinite time (true equilibrium).

Infiltration Basins

- Construction
  - 1. Construction shall be suspended during periods of rainfall or snowmelt.
  - Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction.



Infiltration Basin
(Acre-Feet)
(1003)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

An infiltration basin is defined as an open impoundment (greater than 15 feet wide in its minimum dimension) created either by excavation or embankment with a flat, densely vegetated floor dedicated to the infiltration of runoff through the ground surface.

II. Purpose

The practice may be applied as part of a structural stormwater management practice system to support one or more of the following purposes:

- Reduce stormwater pollutants
- Increase discharge to groundwater
- Decrease runoff peak flow rates and volumes
- Preserve base flow in streams
- Reduce temperature impacts of runoff.

III. Conditions Where Practice Applies

The infiltration basin practice applies to urban areas where increased pollutant loadings, thermal impacts, or increased runoff volumes are a concern and the area is suitable for infiltration. (See NR 151.12(5) (c) 5 and 6 and WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002).)

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration basins. This standard does not contain the text of federal, state or local laws.

V. Criteria

A. Screening criteria located in the WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) shall be followed. In addition, the following site location criteria shall be met.

1. Building location – The basin shall not be hydraulically connected* to foundations or pavements, or cause negative impacts to structures. These negative impacts could include: water in basements and foundation instability.

2. 20% Slopes - Infiltration shall not cause seepage, contribute to hill slope failure or increase erosion on down gradient slopes. A minimum horizontal setback distance of 200 feet shall be maintained from down gradient slopes greater than 20% unless slope stability calculations demonstrate that the slope is stable under saturated conditions at a shorter distance from the practice. Note: Berms constructed as part of the practice are not included in this separation distance.

B. Design

1. Bypass/Dewatering – The basin shall be designed with a maintenance draw down capability. An example of this device is shown on Figure #3.

   When infiltration cells are used, a draw down device shall be provided for each cell.

2. Pretreatment Practices – Space must be allotted for pretreatment prior to infiltration to remove the following percentage of total suspended solids, on an average annual basis, based on the following land uses.

   a. 80% for residential (and associated roads)

Wisconsin DNR 1003

* Terms in the document that are shown in italics are described in V. Definitions. The word shown Additional Site Visit Notes Days is used in the text.

Infiltration Basins

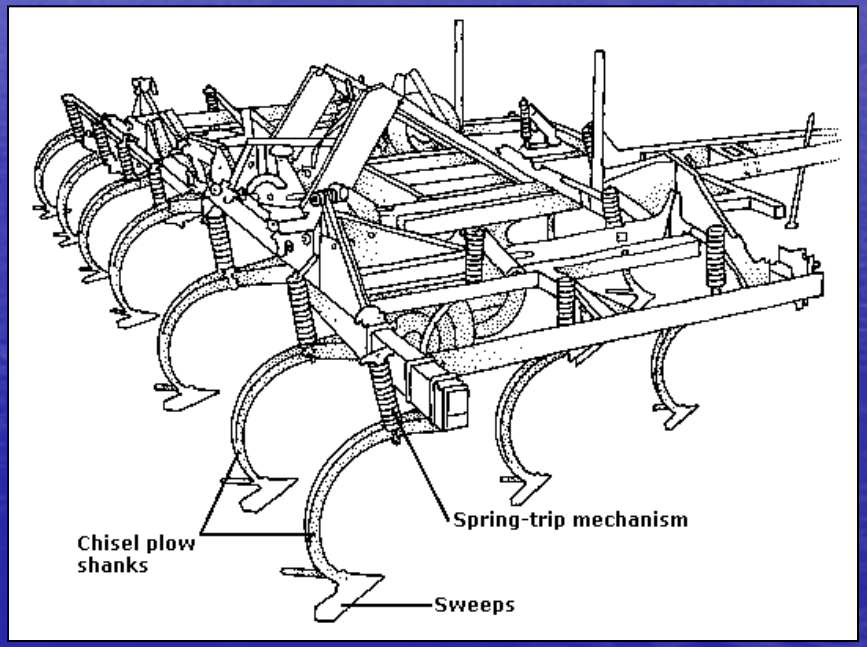
- Construction
  - 2. the system should be only brought on-line when potential erosion of the drainage area is stabilized.

Infiltration Basins

- Construction
  - During construction one of the following methods shall be used:
    a) No disturbance
    b) Compaction Mitigation

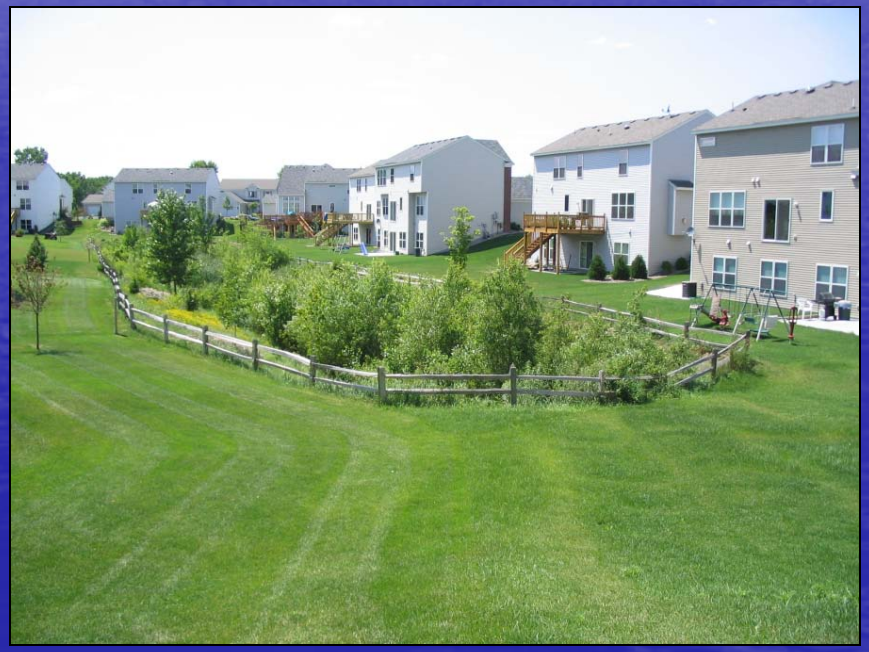
Infiltration Basins

- Compaction Mitigation – If the active infiltration area is graded…:
  - (1) Incorporate soil additives consisting of two inches of compost mixed into two inches of topsoil.
  - (2) The soil mix (V.C.3.b.1) shall be incorporated into the existing soil using a chisel plow or rotary device with the capability of reaching to 12 inches below the existing surface.
  - (3) The compost component shall meet the following WDNR Specification S100 Compost.



Infiltration Basins

- Other Construction Thoughts:
  - The infiltration basin should not be used for erosion control during construction.
  - Seed vegetation shortly after construction (USDA-SCS Technical Guide Practice 342)
  - Sediment that has accumulated in the basin must be removed after construction.



Infiltration Basins

- Operation and Maintenance (Min. Requirements 1003):
  - Inspections
  - Plant Maintenance
    - Establishment
    - Mowing
    - Burning
  - Restoration Procedures
  - Trash Removal
  - Pretreatment
  - Winter Maintenance

Infiltration Basins

- Other Items that Should be in a O&M Plan:
  - The party/parties responsible for operation, maintenance, and documentation of the plan
  - Details on inspecting the topsoil layer for clogging
  - Details on inspecting the vegetation of the basin

Infiltration Basins

- Plan for deep tilling, regarding and replanting to restore design infiltration rate once clogging has occurred
- Frequency of sediment removal
- Disposal locations for sediment
- Inlet and outlet maintenance
- Access plan for performing the operation and maintenance activities

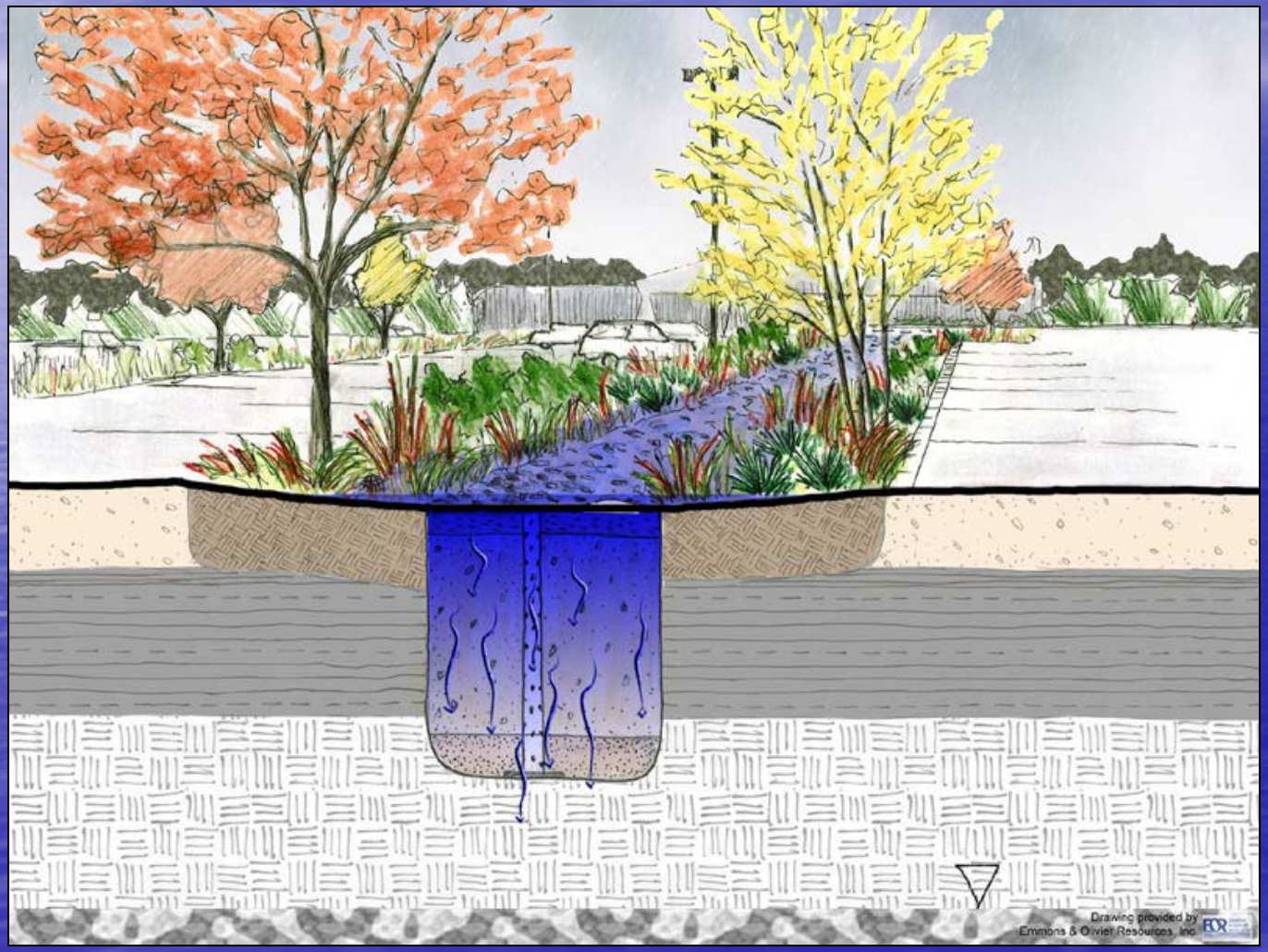
Infiltration Basins

- Following construction, the Owner shall inspect the basin monthly to see if the basin is draining within the design time limits.
- The Owner shall inspect annually for settling, cracking, erosion, leakage, tree growth on the embankment, the condition of the inlet and outlet channels, sediment accumulation in the basin, and the health and density of the grass turf.

Infiltration Basins

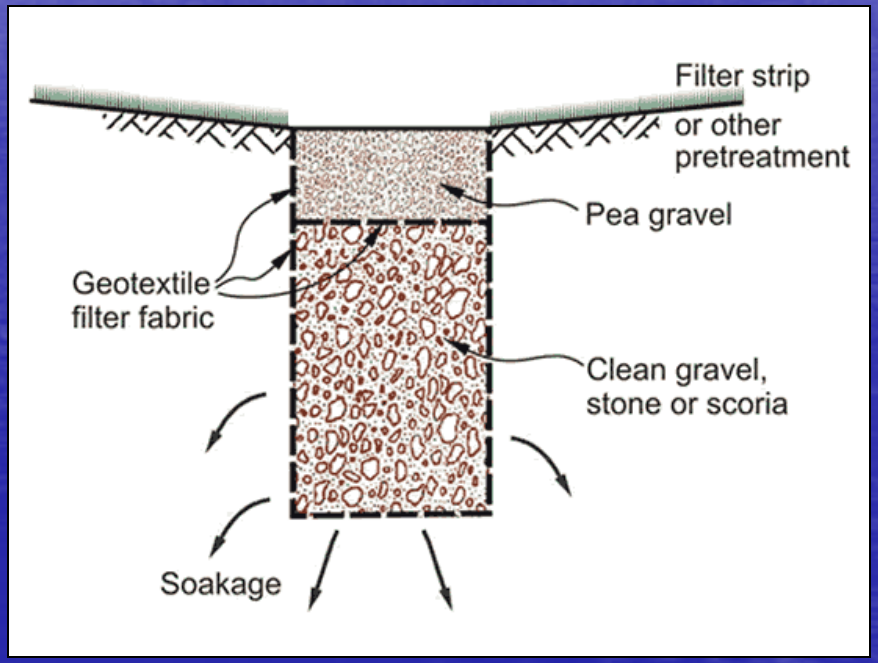
- Maintain basin floor and side slopes to promote dense turf with extensive root growth. Bare spots are to be immediately stabilized and re-vegetated.
- Vegetation growth should not be allowed to exceed 18 inches in height. The basin should be mowed twice a year to prevent woody growth, stimulate grass growth and enhance nutrient removal.

Infiltration Trench



Infiltration Trench

- A well-designed infiltration trench consists of an excavated shallow trench backfilled with sand, coarse stone, and pea gravel, and lined with a filter fabric; appropriate pretreatment measures; and one or more observation wells to show how quickly the trench dewaters or to determine if the device is clogged.

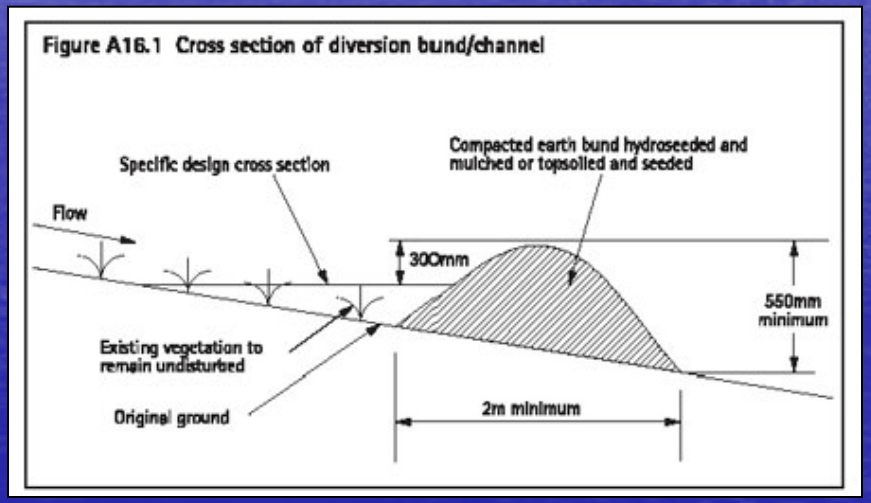


Infiltration Trench

- Used in small drainage areas less than 15 acres.

Infiltration Trench

- Before any construction begins, divert stormwater runoff and construction traffic away from the site of the trench.
- Trench construction should not begin until the upland site is stabilized or runoff diverted and should not be used as part of the construction site erosion control plan.

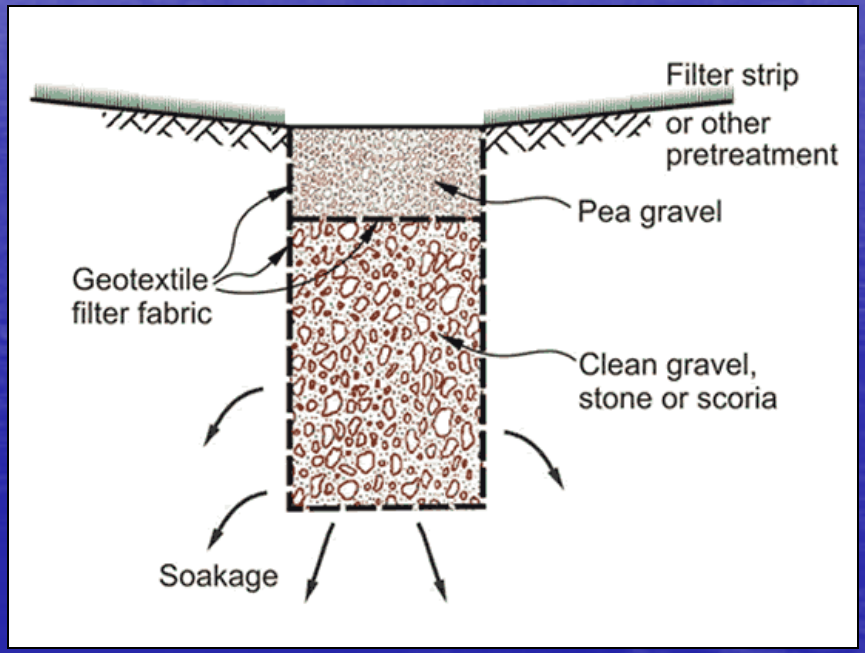


Infiltration Trench

- Excavate the trench using a backhoe or trencher with oversized tires to prevent compaction. Do not use bulldozers or front-end loaders. Each trench section should be dug, filled with rock and covered before a new section is dug.

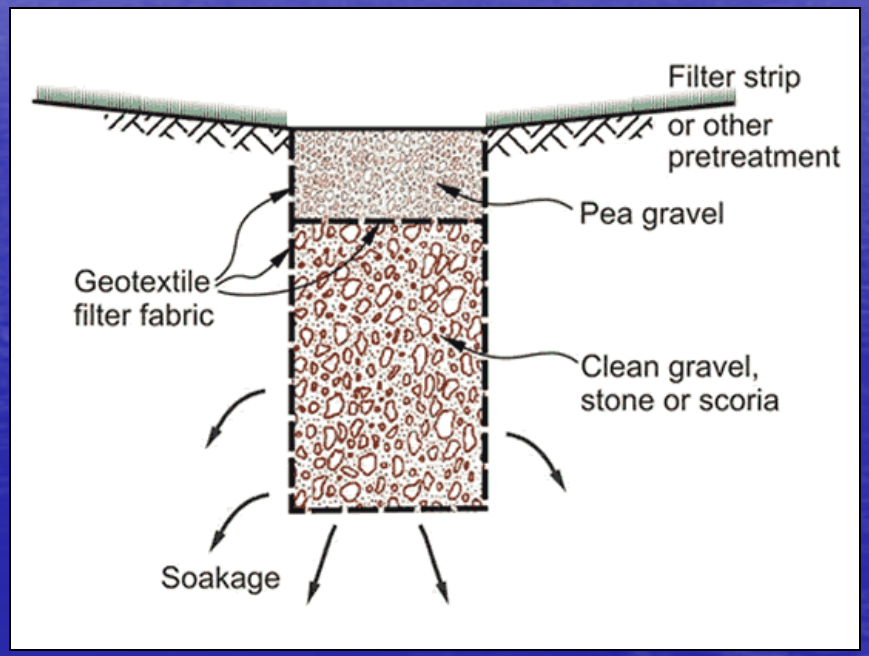
Infiltration Trench

- After the trench is dug, roughen or scarify the bottom and sides to restore infiltration capacity that may have been compromised by rainfall or smearing of the soil surface during digging.



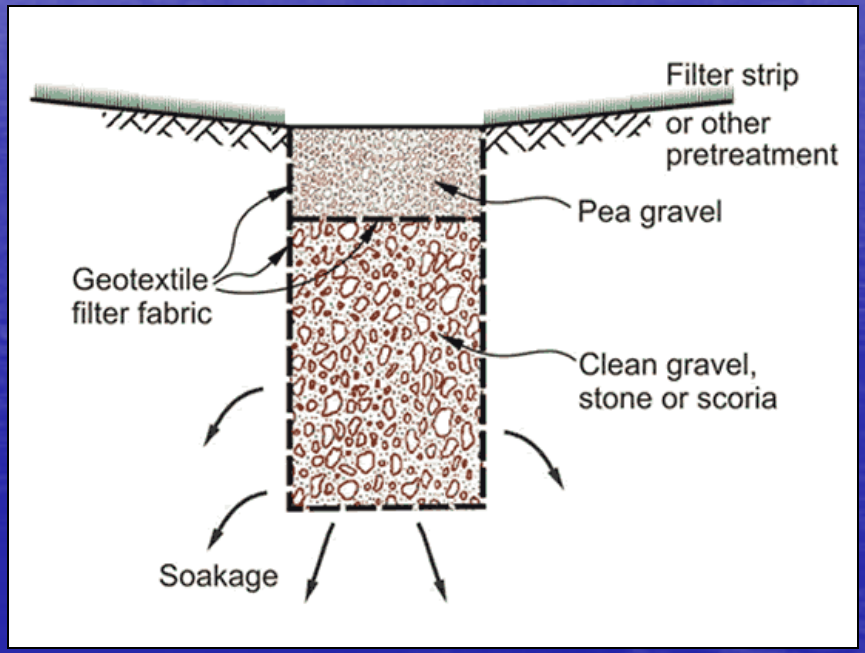
Infiltration Trench

- Cover the trench bottom with 6 inches of clean sand. Place a geotextile filter fabric on the sides and one foot below the top of the trench, overlapping it at the seams to prevent soil fines from entering the stone aggregate. The fabric should be flush with the walls.



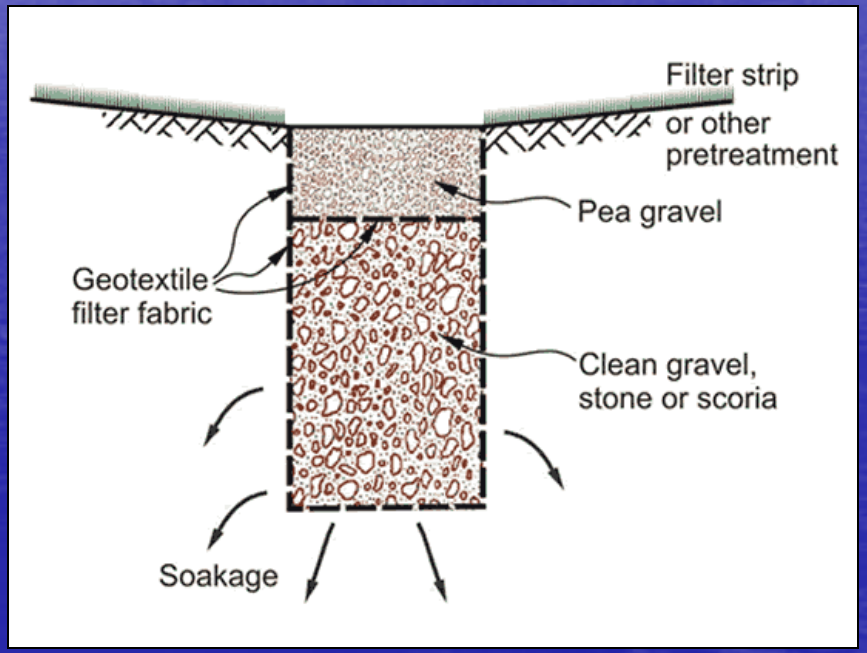
Infiltration Trench

- Clean, washed, 1.5- to 3.0-inch stone aggregate should be placed in the trench in lifts and lightly compacted with a plate compactor. Using unwashed stone will result in premature clogging from the stone's heavy sediment load.



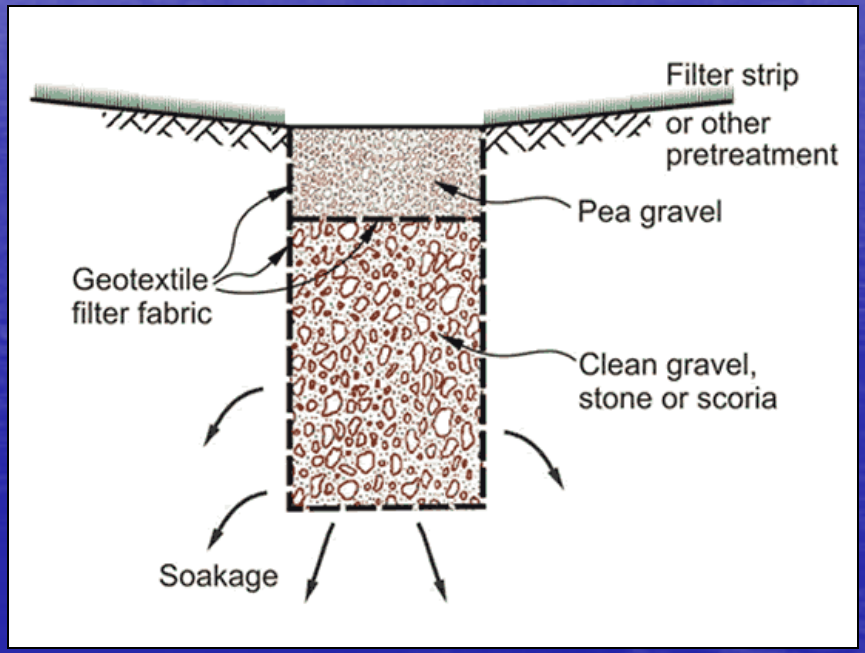
Infiltration Trench

- Place filter fabric horizontally over the aggregate approximately 1 foot below the surface, and then cover it with permeable topsoils or with larger aggregate.



Infiltration Trench

- Sediment control after construction is critical. Sodding the upland areas and the vegetative buffer will speed up the stabilization of the area. If upland areas are seeded, the area must be inspected regularly until it is well established.



Infiltration Trench

- If the trench drains more than 72 hours after a significant storm, remedial measures will be required.
- The Owner should monitor the trench frequently in the first year to determine how well the system is performing.
- Pretreatment facilities must be monitored by for sediment build-up and cleaned as appropriate.

Infiltration Trench

- Maintain the buffer and surface vegetation by reseeding bare spots and mowing as often as dictated by the aesthetic needs of the area. The grass should not be cut shorter than 3 inches to maintain filter performance.

Infiltration Trench

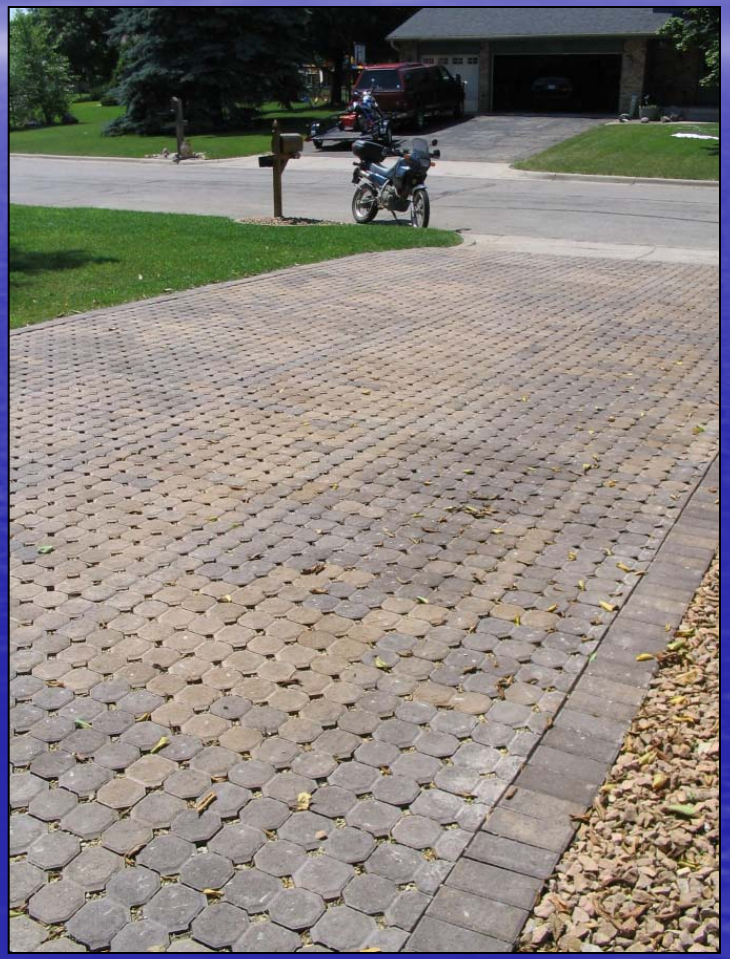
- If the trench clogs at the top, the top layer should be stripped off and the clogged filter fabric and top foot of the aggregate or soil shall be replaced.
- If the bottom of the trench is clogged, the trench media and clogged layer must be removed and the trench drain reinstalled in accordance with the original plan.

Infiltration Trench

- When Planting Trees

Exfiltration Pipes

Porous Pavement



Category	Potential Pollutant	Abundance in Stormwater	Potential for Groundwater Contamination Without Pretreatment
Nutrients	Nitrate	Low/moderate	Low/moderate
Pesticides	Lindane	Moderate	Moderate
	Chlordane	Moderate	Moderate
Other Organics	1,3dichlorobenzene	High	Low
	Pyrene	High	High/moderate
	Floranthene	High	Moderate
	Benzo(a)anthracene	Moderate	Low/moderate
	Bis (2-ethylexyl) phthalate	Moderate	Low/moderate
	Pentachlorophenol	Moderate	Low/moderate
	phenanthrene	Moderate	Low/moderate
	VOC's	Low	Low
Pathogens	Entroviruses	Present	High
	Shigella	Present	High
	Pseudomonas aeruginosa	High	High/moderate
	Protozoa	Present	High/moderate
Heavy metals	Nickel	High	High
	Zinc	High	High
	Chromium	Moderate	Moderate
	Lead	Moderate	Moderate
Salts	Chloride	Seasonally high	High

Source: Pitt, 1996

Questions