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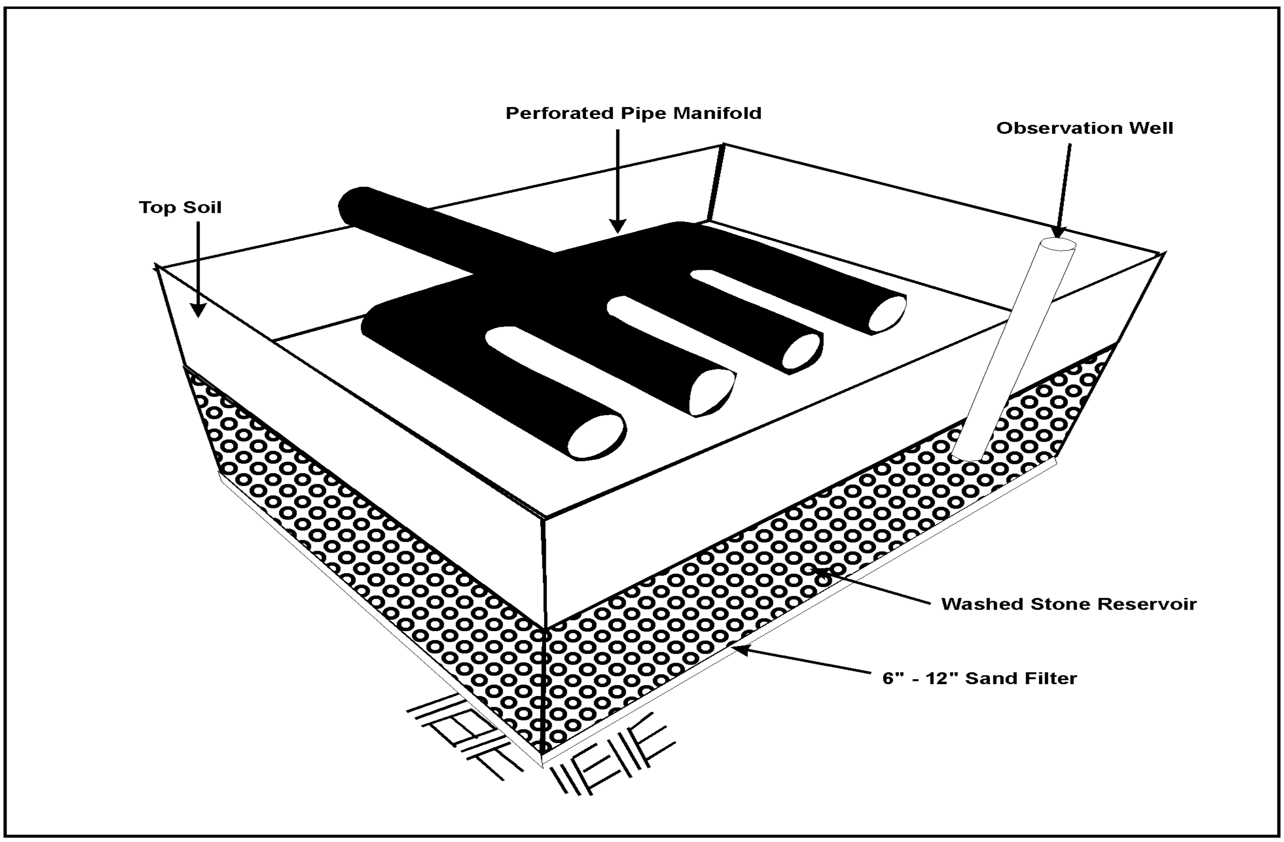
Storm Water Technology Fact Sheet
Infiltration Drainfields

DESCRIPTION

Infiltration drainfields are innovative technologies that are specially designed to promote storm water infiltration into subsoils. These drainfields help to control runoff and prevent the contamination of local watersheds. The system is usually composed of a pretreatment structure, a manifold system, and a drainfield. Runoff is first diverted into a storm sewer system that passes through a pretreatment structure such as an oil and grit separator. The oil and grit chamber effectively removes coarse sediment, oils, and grease from the runoff. The storm water runoff then continues through a manifold system into the infiltration drainfield. The manifold system consists of a perforated pipe which distributes the runoff evenly throughout the infiltration drainfield. The runoff then percolates through an underlying aggregate sand filter and filter fabric into the subsoils. An example of this system is provided in Figure 1.



Source: Metropolitan Washington Council of Governments, 1987.

FIGURE 1 TYPICAL INFILTRATION DRAINFIELD SCHEMATIC

Common design modifications to the infiltration drainfield best management practice (BMP) include the installation of porous pavement surrounded by a grass filter strip over the infiltration drainfield or the insertion of an emergency overflow pipe in the oil and grit pretreatment chamber. The overflow pipe allows runoff volumes exceeding design capacities to discharge directly to a trunk storm sewer system.

APPLICABILITY

Infiltration drainfields are most applicable on sites with a relatively small drainage area (less than 15 acres.) They can be used to control runoff from parking lots, rooftops, impervious storage areas, or other land uses. Infiltration drainfields should not be used in locations that receive a large sediment load that could clog the pretreatment system, which in turn would plug the infiltration drainfield and reduce its effectiveness.

Soils in areas where the installation of an infiltration drainfield is being considered should have field-verified permeability rates of greater than 0.5 inches per hour and should include a 4-foot minimum clearance between the bottom of the system and the bedrock or the water table.

ADVANTAGES AND DISADVANTAGES

The use of infiltration drainfields may be restricted in regions with colder climates, arid regions, regions with high wind erosion rates (because of increased windblown sediment loads), and areas of sole source aquifers. Some specific limitations of infiltration drainfields include:

- High maintenance when sediment loads to the drainfield are heavy.
- High costs of engineering design, excavation, fill material, and pretreatment systems.
- Short life span if not well maintained.
- Not suitable for use in regions with clay or silty soils.
- Not suitable for use in regions where groundwater is used locally for human consumption.
- Anaerobic conditions that could clog the soil and reduce the capacity and performance of the system may develop in underlying soils if there is not sufficient time between storm events to allow the soil to dry out.

One potential negative impact of infiltration drainfields is the risk of groundwater contamination. Studies to date do not indicate that this is a major risk if site suitability guidelines are observed. However, migration of nitrates and chlorides from the drainfield has been documented.

Additional questions regarding infiltration drainfields remain to be answered:

- Is the oil and grit separator the most effective pretreatment system to protect infiltration capacity?
- What are the pollutant removal capacities of infiltration drainfields with various pretreatment systems?
- Is the performance of infiltration drainfields better than the performance of infiltration basins and trenches during subfreezing weather and snow melt runoff conditions?
- What level of maintenance is required to ensure proper performance?

DESIGN CRITERIA

Infiltration drainfields, along with most other infiltration BMP structures (infiltration trenches, basins, etc.) have proved to have short life spans in the past. Failure of the systems has been attributed to poor design, inadequate construction techniques, low permeability soils, and a lack of pretreatment. Some design factors which could significantly increase the longevity of infiltration drainfields and other infiltration processes are shown in Table 1.

TABLE 1 INFILTRATION DRAINFIELD DESIGN CRITERIA

Design Criteria	Guidelines
Site Evaluation	Take soil borings to a depth of at least 4 feet below bottom of stone reservoir to check for soil permeability, porosity, depth to seasonally high water table, and depth to bedrock. Not recommended on slopes greater than 5 percent and best when slopes are as flat as possible. Minimum infiltration rate 3 feet below bottom of stone reservoir: 0.5 inches per hour. Minimum depth to bedrock and seasonally high water table: 4 feet. Minimum setback from building foundations: 10 feet downgradient, 100 feet upgradient. Drainage area should be less than 15 acres.
Design Storm Storage Volume	Literature values suggest this parameter is highly variable and dependent upon regulatory requirements. One typically recommended storage volume is the stormwater runoff volume produced in the tributary watershed by the 6- month, 24-hour duration storm event.
Drainage Time for Design Storm	Minimum: 12 hours. Maximum: 72 hours. Recommended: 24 hours.
Construction	Excavate and grade with light equipment with tracks or oversized tires to prevent soil compaction. As needed, divert stormwater runoff away from site before and during construction. A typical infiltration cross-section consists of the following : 1) a stone reservoir consisting of coarse 1.5 to 3-inch diameter stone (washed); 2) 6 to 12-inch sand filter at the bottom of the drainfield; and 3) filter fabric.
Pretreatment	Pretreatment is recommended to treat runoff from all contributing areas.
Dispersion Manifold	A dispersion manifold should be placed in the upper portions of the infiltration drainfield. The purpose of this manifold is to evenly distribute storm water runoff over the largest possible area. Two to four manifold extension pipes are recommended for most typical infiltration drainfield applications.

Source: Minnesota Pollution Control Agency, 1989.

PERFORMANCE

The effectiveness of infiltration drainfields depends upon their design. When runoff enters the drainfield, 100 percent of the pollutants are prevented from entering surface water. Any water that bypasses the pretreatment system and drainfield will not be treated. Pollutant removal mechanisms include absorption and adsorption, straining, microbial decomposition in the soil below the drainfield, and trapping of sediment, grit, and oil in the pretreatment chamber.

Currently there is little monitoring data on the performance of infiltration drainfields. However, some monitoring data is available on porous pavements. The design criteria for porous pavements is very similar to the design criteria of infiltration drainfields. An estimate of porous pavement pollutant removal efficiencies ranges between 82 and 95 percent for sediment, 65 percent for total phosphorus, and 80 to 85 percent for total nitrogen. Porous pavement works most effectively for about 6 months.

Some key factors to increase pollutant removal efficiencies include:

- Properly maintaining the system.
- Implementing good housekeeping practices in the tributary drainage area.
- Allowing sufficient drying time (approximately 24 hours) between storm events.

- Choosing a site with highly permeable soils and subsoils.

- Incorporating a pretreatment system.

- Ensuring that there is sufficient organic matter in subsoils.

- Using a sand layer on top of a filter fabric at the bottom of the drainfield.

OPERATION AND MAINTENANCE

Routine maintenance of infiltration drainfields is extremely important. The pretreatment grit chamber should be checked at least four times per year and after major storm events. Sediment should be cleaned out when the sediment depletes more than 10 percent of the available infiltration capacity. This can be done manually or by vacuum pump. Inlet and outlet pipes should also be inspected at this time.

The infiltration drainfield should contain an observation well that can provide information on how well the system is operating. It is recommended that the observation well be monitored daily after runoff-producing storm events. If the infiltration drainfield does not drain after three days, it usually means that the drainfield is clogged. Once the performance characteristics of the structure have been verified, the monitoring schedule can be reduced to a monthly or quarterly basis.

COSTS

There is little information on the cost of infiltration drainfields. However, the construction costs for installing an infiltration drainfield that is 30.5 meters (100 feet) long, 15 meters (50 feet) wide, 2.4 meters (8 feet) deep and with 1.2 meters (4 feet) of cover can be estimated using the general information in Table 2.

REFERENCES

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2. Minnesota Pollution Control Agency, 1989. *Protecting Water Quality in Urban Areas.*

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4. U.S. EPA, 1992. *Storm water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices*. EPA 832-R-92-006.

5. Washington State Department of Ecology, 1992. *Storm Water Management Manual for the Puget Sound Basin.*

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TABLE 2 ESTIMATED COST FOR INSTALLING AN INFILTRATION DRAINFIELD

Excavation Costs: 2,220 yd^3 @ \$5.00/yd^3	\$11,100
Stone Fill: (1,296 yd^3)(\$20.00/yd^3)	\$25,920
Sand Fill: (185 yd^3)(\$10.00/yd^3)	\$1,850
Filter Fabric: Top and Bottom= 10,000 ft^2 Sides= 1,600 + 800= 2,400 ft^2 +10%= 13,640 ft^2 (13,640 ft^2)(1 yd^2 /9 ft^2)(\$3.00/yd^2)	\$4,550
Perforated Manifold and Inlet Pipe: 75 ft + (4)(40ft)= 235 ft + 40 ft = 275 ft (275)(\$10.00/ft)	\$2,750
Observation Well: 1 at \$500 each	\$500
Pretreatment Chamber: 1 at \$10,000	\$10,000
Miscellaneous (back filling, overflow pipe, sodding, etc.):	\$1000
Subtotal:	**\$57,670**
Contingencies (engineering, administration, permits, etc.)= 25%	\$14,420
Total:	**\$72,090**
Note: Unit price will vary greatly depending upon local market conditions	

Source: SWRPC, 1992.

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