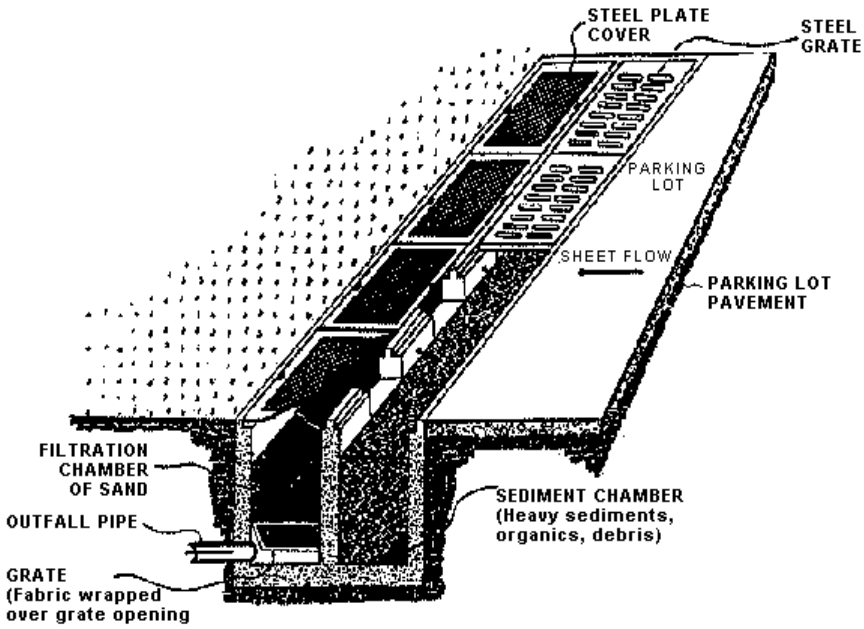
Sand and Organic Filters

Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment

Subcategory: Filtration

Description

Sand filters are usually designed as two-chambered stormwater practices; the first is a settling chamber, and the second is a filter bed filled with sand or another filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering medium. There are several modifications of the basic sand filter design, including the surface sand filter, underground sand filter, perimeter sand filter, organic media filter, and Multi-Chamber Treatment Train. All of these filtering practices operate on the same basic principle. Modifications to the traditional surface sand filter were made primarily to fit sand filters into more challenging design sites (e.g., underground and perimeter filters) or to improve pollutant removal (e.g., organic media filter).



Applicability

A stormwater retrofit is a stormwater management practice (usually structural) put into place after development has occurred, or during a redevelopment, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Sand filters are a good option to achieve water quality goals in retrofit situations where space is limited because they consume very little surface space and have few site restrictions. It is important to note, however, that sand filters cannot treat a very large drainage area. Using small-site BMPs may be the only option for a retrofit study in a highly urbanized area, but it is expensive to treat the drainage from an entire watershed using many small-site practices, as opposed to one larger facility such as a pond.

Design Considerations

Drainage Area - Sand filters are best applied on relatively small sites (up to 10 acres for surface sand filters and closer to 2 acres for perimeter or underground filters).

Slope - Sand filters can be used on sites with slopes up to about 6 percent. It is challenging to use most sand filters in very flat terrain because they require a significant amount of elevation drop, or head (about 5 to 8 feet), to allow flow through the system. One exception is the perimeter sand filter, which can be applied with as little as 2 feet of head.

Pretreatment - Pretreatment is a critical component of any stormwater management practice. In sand filters, pretreatment is achieved in the sedimentation chamber that precedes the filter bed. In this chamber, the coarsest particles settle out and thus do not reach the filter bed. Pretreatment reduces the maintenance burden of sand filters by reducing the

potential of these sediments to clog the filter. Designers should provide at least 25 percent of the water quality volume in a dry or wet sedimentation chamber as pretreatment to the filter system. The water quality volume is the amount of runoff that will be treated for pollutant removal in the practice. Typical water quality volumes are the runoff from a 1-inch storm or ½ inch of runoff over the entire drainage area to the practice.

Treatment - Treatment design features help enhance the ability of a stormwater management practice to remove pollutants. In filtering systems, designers should provide at least 75 percent of the water quality volume in the practice including both the sand chamber and the sediment chamber.
Maintenance -

Typical annual maintenance requirements are:

- Check to see that the filter bed is clean of sediments, and the sediment chamber is no more than one-half full of sediment; remove sediment if necessary
- Make sure that there is no evidence of deterioration, or cracking of concrete
- Inspect grates (if used)
- Inspect inlets, outlets, and overflow spillway to ensure good condition and no evidence of erosion
- Repair or replace any damaged structural parts
- Stabilize any eroded areas
- Ensure that flow is not bypassing the facility

The sorbent pillows used in Multi-Chamber Treatment Trains should be replaced twice per year. Routine (monthly) maintenance typically includes:

- Ensure that contributing area, filtering practice, inlets, and outlets are clear of debris
- Ensure that the contributing area is stabilized and mowed, with clippings removed
- Check to ensure that the filter surface is not clogging (also after moderate and major storms)
- Ensure that activities in the drainage area minimize oil/grease and sediment entry to the system
- If a permanent pool is present, ensure that the chamber does not leak and that normal pool level is retained
- Ensure that no noticeable odors are detected outside the facility

In addition to regular maintenance activities needed to ensure the proper function of most stormwater practices, some design features can be incorporated to ease the maintenance burden of each practice. Designers should provide maintenance access to filtering systems.

Limitations

Sand filters can be used in unique conditions where many other stormwater management practices are inappropriate, such as in limestone topography or in highly urbanized settings. There are several limitations to these practices, however. Sand filters cannot control floods and generally are not designed to protect stream channels from erosion or to recharge the ground water. In addition, sand filters require frequent maintenance, and underground and perimeter versions of these practices are easily forgotten because they are out of sight. Perhaps one of the greatest limitations to sand filters is that they cannot be used to treat large drainage areas. Surface sand filters are generally not aesthetically pleasing practices but underground and perimeter sand filters are not visible, and thus do not add or detract from the aesthetic value of a site.

Effectiveness

Filtering practices are for the most part adapted only to provide pollutant removal, although in exfilter designs, some ground water recharge can be provided. Sand filters are effective for pollutant removal with the exception of nitrates, which appear to be exported from filtering systems. The export of nitrates from filters may be caused by mineralization of organic nitrogen in the filter bed.

Reference: USEPA, Post-Construction Stormwater Management in New Development and Redevelopment, http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=5