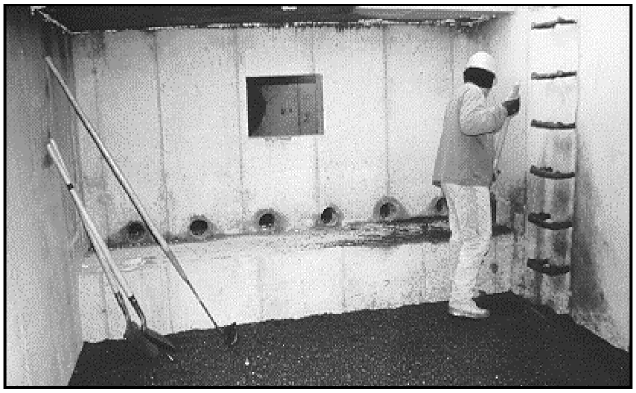
Underground Sand Filter



Description: Design variant of the sand filter, located in an underground vault.

Variations: Surface Sand filter (PTP-04), Perimeter Sand filter (PTP-16)

Components:

Underground vault with three chambers

(1) Sedimentation chamber
(2) Filter chamber with protective screen and perforated drain system to third chamber
(3) Overflow/outlet chamber

Advantages/Benefits:

- High sediment trapping capability
- Additional pollutant removal as a result of sediment removal
- Precast concrete shells available, which decrease construction costs

Disadvantages/Limitations:

- Intended for space-limited applications
- High maintenance requirements

Design considerations:

- Drains highly impervious areas, usually 1 acre or less
- Provide maintenance access to chambers
- Underground chamber must be water tight. Openings must be 1/16th inch or smaller to prevent mosquito intrusion

Selection Criteria:

- [✓] **Water Quality 80 % TSS Removal**
- [✓] **Accepts Hotspot Runoff**
- [ ] **Residential Subdivision**
- [✓] **High Density / Ultra Urban Use**

Maintenance:

- Monitor water level in sand filter chamber.
- Sedimentation chamber should be cleaned out when the sediment depth reaches 12 inches.
- Remove accumulated oil and floatables in sedimentation chamber.

Maintenance Burden: **H**

L = Low M = Moderate H = High

General Description

The underground sand filter is a variant of the sand filter located in an underground vault designed for high-density land use or ultra-urban applications where there is not enough space for a surface sand filter or other structural stormwater controls.

The underground sand filter is a three-chamber system (See Figure 10.1). The initial chamber is a sedimentation chamber that temporarily stores runoff and utilizes a wet pool to capture sediment. The sedimentation chamber is connected to the sand filter chamber by a submerged wall that protects the filter bed from floating oil and trash. The filter bed is 18 to 24 inches deep and may have a protective screen of gravel or permeable geotextile to limit clogging. The sand filter chamber also includes an underdrain system with capped inspection and clean out wells. Perforated drain pipes under the sand filter bed extend into a third chamber that collects filtered runoff. The WQ_v displaces part of the permanent pool as it flows into the facility and creates a temporary pool above the permanent pool. Flows beyond the filter capacity are diverted through an overflow weir.

Due to its location below the surface, underground sand filters have a high maintenance burden and should only be used where adequate inspection and maintenance can be ensured.

Site and Design Considerations

1. Underground sand filters are typically used on highly impervious sites of 1 acre or less. The maximum drainage area that should be treated by an underground sand filter is 5 acres.
2. Underground sand filters are typically constructed on-line, but can be constructed off-line. For off-line construction, the overflow between the second and third chambers is not included.
3. The underground vault should be tested for water tightness prior to placement of filter layers.
4. Adequate maintenance access must be provided to the sedimentation and filter bed chambers.
5. Compute the minimum permanent pool volume required in the sedimentation chamber as:

   $V_w = A_s$ * 3 feet minimum

   Where: $A_s =$ Surface Area, from PTP-04

6. Consult the design criteria for the perimeter sand filter (see PTP-16 for the underground filter sizing and design steps.)

As-Built Certification Considerations

An as-built certification conducted by a registered Professional Engineer must be performed and submitted to Metro. The as-built certification verifies that the BMP was installed as designed and approved.

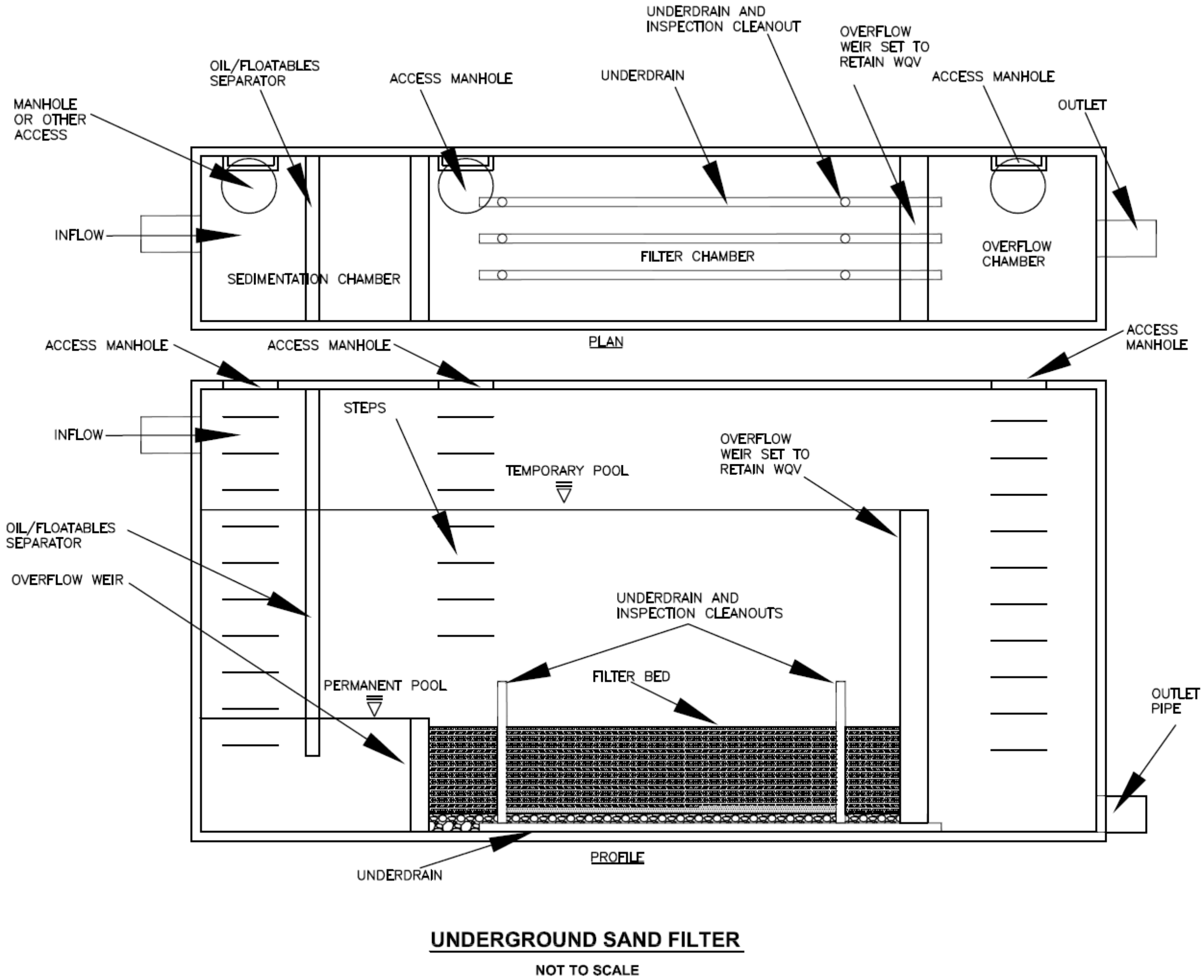
Maintenance

Each BMP must have an Operations and Maintenance (O&M) Agreement that is submitted to Metro for approval and is maintained and updated by the BMP owner. Refer to Volume 1 Appendix C for the Operation and Maintenance Agreement for sand filters, as well as an inspection checklist. The O&M Agreement must be completed and submitted to Metro with site plans. The developer/owner is responsible for the cost of maintenance and annual inspections. The BMP owner must maintain and update the BMP operations and maintenance plan. At a minimum, the operations and maintenance plan must address:

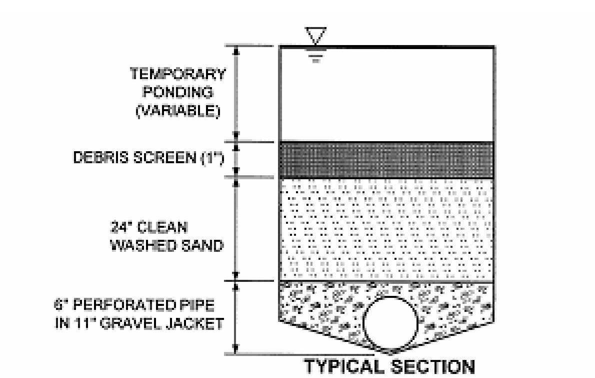
1. Monitor water level in sand filter chamber.
2. Sedimentation chamber should be cleaned out when the sediment depth reaches 12 inches.
3. Remove accumulated oil and floatables in sedimentation chamber.
4. Replace filter media when temporary pool is maintained for 40 hours following design storm (FHWA).

Design Procedures

Consult design criteria for perimeter sand filter (PTP-16) for sizing and design steps.



(Adapted from the Minnesota Stormwater Manual)



(Source: Center for Watershed Protection)

Figure 10.1 Schematic of Underground Sand Filter

References

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Center for Watershed Protection, Accessed July 2005. Stormwater Manager's Resource Center. Manual Builder. *www.stormwatercenter.net*.

Minnesota Pollution Control Agency, Accessed January 2006. Minnesota Stormwater Manual. http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html

Suggested Reading

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Claytor, R.A., and T.R. Schueler. 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection, Silver Spring, MD.

US EPA, 1999. Storm Water Technology Fact Sheet: Sand Filters. EPA 832-F-99-007. Office of Water.

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Schueler, T.R. 1994. Developments in Sand Filter Technology to Improve Stormwater Runoff Quality. Watershed Protection Techniques 1(2):47-54.

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