3.11 Sand Filter Basin

Type of BMP	Flow-Through Treatment
Priority Level	Priority 3 – Treatment Control BMP
Treatment Mechanisms	Filtration
Maximum Drainage Area	25 acres

Description

The Sand Filter Basin (SFB) is a basin where the entire invert is constructed as a stormwater filter, using a sand bed above an underdrain system. Stormwater enters the SFB at its forebay where trash and sediment accumulate or through overland sheet flow. Overland sheet flow into the Sand Filter Basin is biofiltered through the vegetated side slopes or other pre-treatment. Flows pass into the sand filter surcharge zone and are gradually filtered through the underlying sand bed. The underdrain gradually dewaters the sand bed and discharges the filtered runoff to a nearby channel, swale, or storm drain.

Sand Filter (no forebay) -
Photo courtesy of Colorado UDFCD

The primary advantage of the SFB is its effectiveness in removing pollutants where infiltration into the underlying soil is not practical, and where site conditions preclude the use of a Bioretention Facility . The primary disadvantage is a potential for clogging if silts and clays are allowed to flow into the SFB. In addition, this BMP's performance relies heavily on its being regularly and properly maintained.

While this BMP is not currently considered an LID BMP, when designed in accordance with this manual, a Sand Filter Basin is considered to be a highly effective Treatment Control BMP.

Siting Considerations

SFBs should be avoided where onsite configurations include a base flow and/or where this BMP would be put into operation while construction, grading or major landscaping activities are taking place in the tributary catchment. **This BMP has a flat surface area**, so it may be challenging to incorporate into steeply sloping terrain. SFBs should be set away from areas that could discharge fine sediments into the basin such as at the bottom of a slope. **See Section 1 of Riverside County Flood Control and Water Conservation District's "Basin Guidelines" (Appendix C) for additional requirements** (i.e., fencing, maintenance access, etc.) or other guidelines issued by the Engineering Authority (EA)[1].

[1] The Engineering Authority (EA) may choose to alter these guidelines and may have different/additional requirements. These entities, along with the District, will be referred to as the EA

Setbacks

The bottom of the sand filter should remain above the seasonal high groundwater level. Always consult your geotechnical engineer for additional site-specific recommendations.

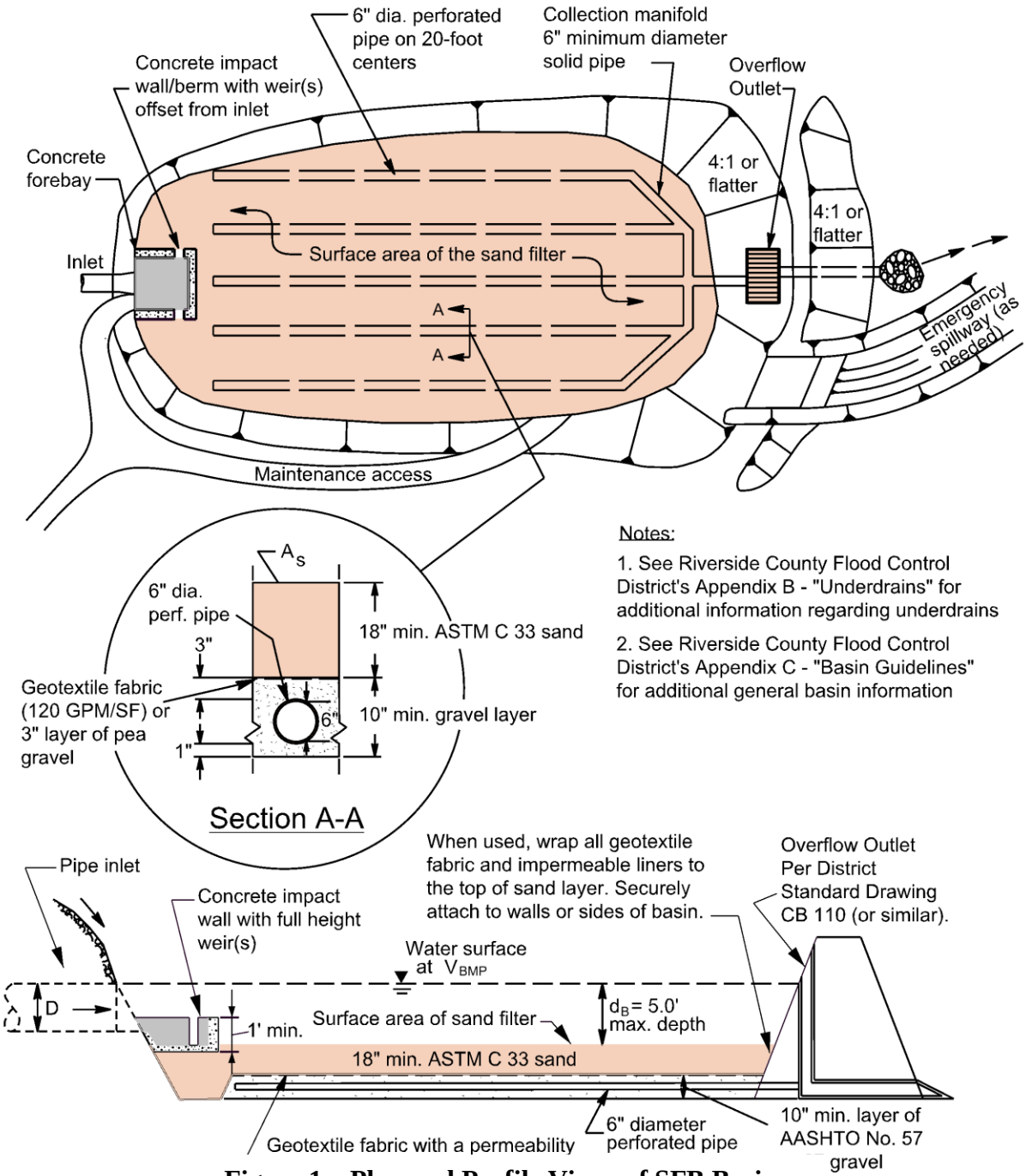


Figure 1 – Plan and Profile Views of SFB Basin

Forebay

A concrete forebay shall be provided to reduce sediment clogging and to reduce erosion. The forebay shall have a design volume of at least 0.5% V_{BMP} and a minimum 1 foot high concrete splashwall. Full height notch-type weir(s), offset from the line of flow from the basin inlet to prevent short circuiting shall be used to outlet the forebay. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 1).

Underdrains

Underdrain piping shall consist of a manifold (collector) pipe with perforated lateral branching. The lateral branching conveys the filtered water to the manifold where it is discharged into the outlet structure. See Appendix B for additional information.

Overflow Structure

An overflow must be provided to drain volume in excess of V_{BMP} or to help drain the system if clogging were to occur. Overflows shall flow to an acceptable discharge point such as a downstream conveyance system. Overflows must be placed above the water quality capture volume and near the outlet of the system. The overflow structure shall be similar to the District's Standard Drawing CB 110.

Recommended Maintenance

Table 1 - Recommended Inspection and Maintenance Activities for SFBs

Schedule	Inspection and Maintenance Activity
Semi-monthly including just before the annual storm season and following rainfall events.	• Routine maintenance and inspection. • Remove debris and litter from the entire basin to minimize filter clogging and to improve aesthetics. • Check for obvious problems especially filter clogging and signs of long term ponding. Repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in the basin bottom. There should be no long-term ponding water. • Check for erosion and sediment laden areas in the basin. Repair as needed. Clean forebay if needed. • Revegetate side slopes where needed.
Annually. If possible, schedule these inspections within 72 hours after a significant rainfall.	• Inspection of hydraulic and structural facilities. Examine the overflow outlet for clogging, the embankment and spillway integrity, and damage to any structural element. • Check side slopes and embankments for erosion, slumping and overgrowth. • Inspect the sand media at the filter drain to verify it is allowing acceptable infiltration. **Scarify the top 3 inches by raking the filter drain's sand surface annually.** • Check the filter drain underdrains for damage or clogging. Repair as needed. • Repair basin inlets, outlets, forebays, and energy dissipaters whenever damage is discovered. • No water should be present 72 hours after an event. No long term standing water should be present at all. No algae formation should be visible. Correct problem as needed.
Every 5 years or sooner depending on the observed drain times (no more than 72 hours to empty the basin).	• Remove the top 3 inches of sand from the filter drain and backfill with 3 inches of new sand to return the sand layer to its original depth. When scarification or removal of the top 3 inches of sand is no longer effective, remove and replace sand filter layer.

Table 2 - Design and Sizing Criteria for SFBs

Design Parameter	Extended Detention Basin
Maximum tributary area	25 acres [2]
Basin design volume	100% of V_{BMP}
Maximum basin depth	5 feet
Forebay volume	0.5 % of V_{BMP}
Longitudinal Slope	0%
Transverse Slope (min.)	0%
Outlet erosion control	Energy dissipaters to reduce velocities[1]

1. **Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures**
2. **CA Stormwater BMP Handbook for New Development and Significant Redevelopment**

Note: The information contained in this BMP Factsheet is intended to be a summary of design considerations and requirements. Additional information which applies to all detention basins may be found in the District's "Basin Guidelines" (Appendix C). In addition, information herein may be superseded by other guidelines issued by the EA.

Design Procedure

1. Enter the Tributary Area, A_{TRIB}
2. Enter the Design Capture Volume, V_{BMP}, determined from Section 2.1 of this Handbook
3. SFB Geometry

   Determine the minimum sand filter area required. The filtration bed surface shall be flat with the maximum depth for the reservoir design volume no greater than 5 feet*. The reservoir design volume does not include the volume of the sand filter. No credit is given for voids in the sand layer toward the reservoir volume since the sand is part of the water quality filter and not a reservoir layer. The design storage volume shall equal 100 percent of V_{BMP}. The minimum sand filter area (As) of the basin's bottom shall be determined using the equation:

$$A_s = (V_{BMP}/ d_B)$$

   Where:

   V_{BMP} = Design Volume, ft^3
   d_B = proposed basin depth (5 feet maximum), ft

   Once the basin side slopes, proposed basin depth and depth of freeboard are entered, the spreadsheet will calculate the minimum total depth required to use this BMP. This is the depth from the top of the basin (including freeboard) down to the bottom of the underdrain gravel layer. This depth can be used to determine if enough vertical separation is available between the BMP and its outlet destination.

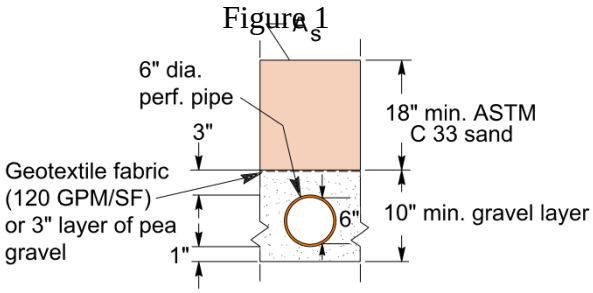
*Note: The 5 foot maximum depth equates to a minimum filter media infiltration rate of 0.83 inches per hour with a 72 hour drawdown time. Studies have shown that while initially most filter media will infiltrate at a much higher rate, it is not uncommon for that rate to decrease significantly over a very short period of time. (Urbonas, 1996)

4. Enter the proposed surface area of the basin.

5. Forebay

Provide a concrete forebay. Its volume shall be at least 0.5% V_{BMP} with a minimum 1 foot high concrete splashwall. Full-height notch-type weir(s) shall be used to outlet the forebay. The weir(s) must be offset from the line of flow from the basin inlet. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 1). Notches shall not be less than 1.5 inches in width.

Figure 1



6. Filter Media

Provide, as a minimum, an 18-inch layer of filter media (ASTM C-33 sand). Other filter media may be considered with sufficient supporting documentation. Where a medium level of removal efficiency is desired for nutrients, the depth of the sand layer must be increased to 36 inches.

5. Underdrains

Underdrains shall be provided per the guidelines outlined in Appendix B.