10.3 SAND FILTERS (LARGE-SCALE GI)

A sand filter designed to infiltrate into the subsoil is a stormwater management system designed to both maximize the removal of pollutants from stormwater and to promote groundwater recharge as well as address the quantity impacts of land development. It consists of a pre-treatment zone and a treatment zone, which includes the sand bed and its underlying materials. Pollutants are treated through settling, filtration and adsorption by the sand bed prior to discharging stormwater runoff by infiltration into the subsoil. The total suspended solids (TSS) removal rate is 80%.

N.J.A.C. 7:8 Stormwater Management Rules – Applicable Design and Performance Standards		
	Green Infrastructure	Yes
	Stormwater Runoff Quantity	Yes, when designed as an on-line system
	Groundwater Recharge	Only with a waiver or variance from N.J.A.C. 7:8-5.3
	Stormwater Runoff Quality	Only with a waiver or variance from N.J.A.C. 7:8-5.3, 80% TSS

Stormwater Runoff Quality Mechanisms and Corresponding Criteria	
Settling	
Storage Volume	Entire Water Quality Design Storm Volume
Filtration	
Sand bed minimum thickness	18 inches
Maximum storage above sand bed	24 inches
Maximum design permeability rate of sand bed	2 inches/hour
Minimum topsoil permeability rate, if using optional vegetative cover	2x the permeability of the subsoil

Introduction

A sand filter designed to infiltrate into the subsoil is a stormwater management facility that uses sand to filter particles and particle-bound constituents from runoff. Pollutant removal occurs in the sand bed. Although there are two types of sand filter systems: infiltration sand filters and underdrained sand filters, **the underdrained type does not meet the definition of green infrastructure, i.e., treating stormwater runoff through infiltration into the subsoil, treating stormwater runoff through filtration by vegetation or soil or storing stormwater runoff for reuse, and is not included in this chapter**. Stormwater runoff entering the sand filter is first conveyed through the pretreatment zone where trash, debris and coarse sediment are removed. It then passes through the treatment zone and out of the system through the subsoil via infiltration. Pollutants in runoff are treated in sand filters through the processes of settling, filtration and adsorption.

Due to the potential for groundwater contamination, the use of sand filters designed to infiltrate into the subsoil, and all stormwater infiltration best management practices (BMP), is prohibited in areas where high pollutant or sediment loading is anticipated. For more information regarding areas where stormwater runoff infiltration is prohibited, refer to N.J.A.C. 7:8-5.4(b)3.

Sand filters are better suited for impervious drainage areas with high TSS, heavy metals and hydrocarbon loadings like roads, driveways, drive-up lanes, parking lots and urban areas. They are not recommended for use in pervious drainage areas where high sediment loads and organic material can clog the sand bed; where such loadings cannot be avoided, pretreatment is recommended.

Sand filters designed to infiltrate into the subsoil as described in this chapter can only be used to satisfy the standards for stormwater runoff quantity, unless a waiver from the green infrastructure requirements of N.J.A.C. 7:8-5.3 is obtained.

Sand filters must have a maintenance plan and must be reflected in a deed notice recorded in the county clerk's office to prevent alteration or removal.

Applications

Pursuant to N.J.A.C. 7:8-5.2(a)(2), the minimum design and performance standards for groundwater recharge, stormwater runoff quality and stormwater runoff quantity at N.J.A.C. 7:8- 5.4, 5.5 and 5.6 shall be met by incorporating green infrastructure in accordance with N.J.A.C. 7:8-5.3. Pursuant to N.J.A.C. 7:8-5.3(c), large-scale green infrastructure BMPs - i.e., those that exceed the contributory drainage area limits at N.J.A.C. 7:8-5.3(b) - may only be used to satisfy the stormwater runoff quantity standards.

Sand filters designed to infiltrate into the subsoil may be designed to convey storm events larger than the Water Quality Design Storm (WQDS); however, regardless of the design storm chosen, all sand filters designed to infiltrate into the subsoil must be designed for stability and capacity in accordance with the *Standards for Soil Erosion and Sediment Control in New Jersey*.

Only if a waiver or variance from the green infrastructure requirements of N.J.A.C. 7:8-5.3 is obtained may sand filters designed to infiltrate into the subsoil that exceed the contributory drainage area limit of 5.3(b) be used to meet the groundwater recharge requirements.

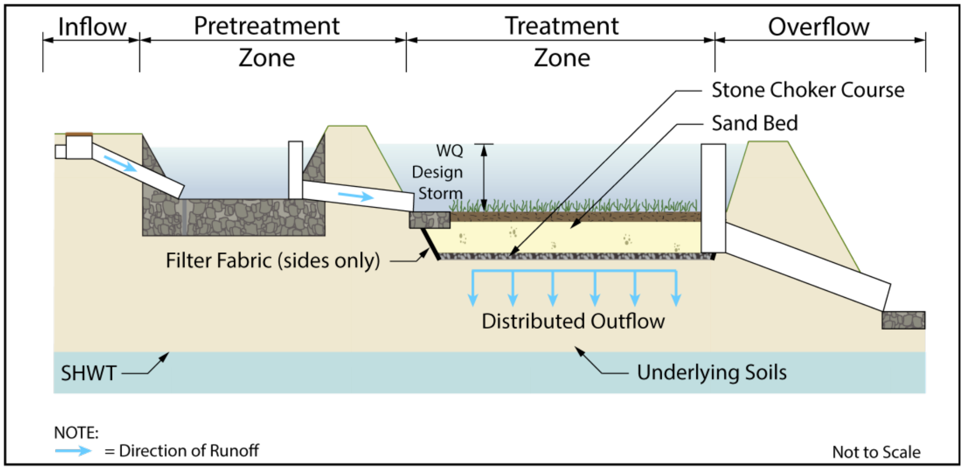
Only if a waiver or variance from the green infrastructure requirements of N.J.A.C. 7:8-5.3 is obtained may sand filters designed to infiltrate into the subsoil that exceed the contributory drainage area limit of 5.3(b) be used to meet the stormwater runoff quality requirement.

Design Criteria

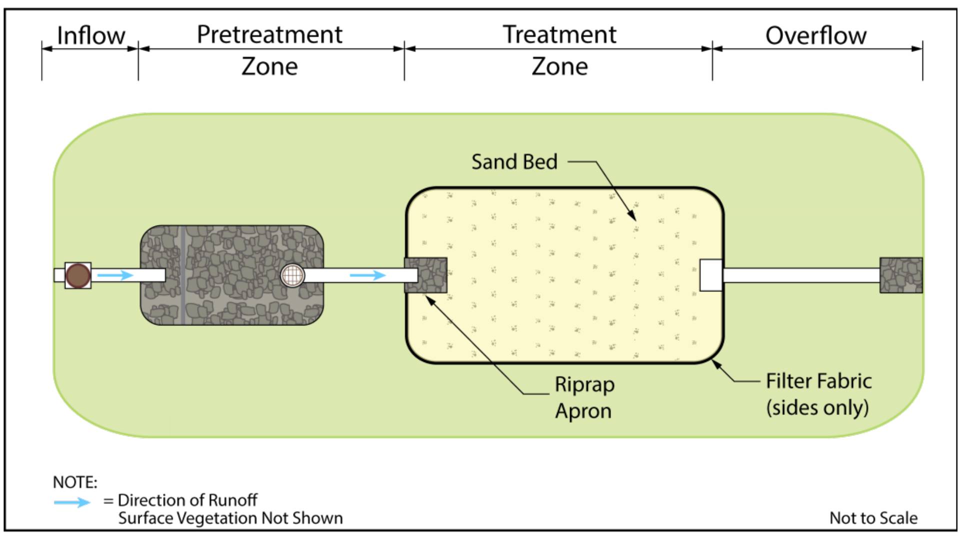
Basic Requirements

The following two illustrations show the basic components of a sand filter system designed to infiltrate into the subsoil and the various zones through which stormwater runoff travels.

Profile View – Sand Filter Designed to Infiltrate into the Subsoil



Plan View – Sand Filter Designed to Infiltrate into the Subsoil



In addition to obtaining a waiver or variance from N.J.A.C. 7:8-5.3, the following design criteria must also be met in order to receive the 80% TSS removal rate for this BMP. It is critical that all sand filters designed to infiltrate into the subsoil are designed in accordance with these criteria in order to ensure proper operation, to maximize the functional life of the system, and to ensure public safety.

Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of a sand filter designed to infiltrate into the subsoil by reducing incoming velocities and capturing coarser sediments.

- Pretreatment is a requirement for all sand filters.

- Any roof runoff may be pretreated by leaf screens, first flush diverters or roof washers. For details of these pretreatment measures, see Pages 5 and 6 of *Chapter 9.1: Cisterns.*

    - This pretreatment requirement for roof runoff can be waived by the review agency if the building in question has no potential for debris and other vegetative material to be present in the roof runoff. For example, a building that is significantly taller than any surrounding trees and does not have vegetative roof should not need the pretreatment. However, in making this determination, the review agency must consider the mature height of any surrounding trees.

- Pretreatment may consist of a forebay or any of the BMPs found in *Chapters 9 or 11.*

- There is no adopted TSS removal rate associated with forebays; therefore, their inclusion in any design should be solely for the purpose of facilitating maintenance. Forebays can be earthen, constructed of riprap, or made of concrete, and must comply with the following requirements:

    - The forebay must be designed to prevent scour of the receiving basin by outflow from the forebay.
    - The forebay should provide a minimum storage volume of 10% of the Water Quality Design Storm (WQDS) and be sized to hold the sediment volume expected between clean-outs.
    - It should fully drain within nine hours in order to facilitate maintenance and to prevent mosquito issues. Under no circumstances should there be any standing water in the forebay 72 hours after a precipitation event.
    - Surface forebays must meet or exceed the sizing for preformed scour holes in the *Standard for Conduit Outlet Protection* in the *Standards for Soil Erosion and Sediment Control in New Jersey* for a surface forebay.
    - If a concrete forebay is utilized, it must have at least two weep holes to facilitate low level drainage.
    - The recommended Minimum surface area (sf) = 59 X Inflow (cfs).

- When using another BMP for pretreatment, it must be designed in accordance with the design requirements outlined in the respective chapter. For additional information on the design requirements of each BMP, refer to the appropriate chapter in this manual.

Inflow

- All inflow must be stable and non-erosive and must be consistent with the applicable subchapters of the *Standards for Soil Erosion and Sediment Control in New Jersey,* such as the *Standard for Conduit Outlet Protection*.

Geometry

- Sand filters designed to infiltrate may not be constructed in areas where the surrounding slopes are 15% or greater.
- The area of the sand filter intended for infiltration must be as level as possible in order to uniformly distribute runoff infiltration over the subsoil.
- The system must have a sufficient surface area to prevent the accumulated volume of stormwater runoff exceeding the maximum depth requirement.
- The seasonal high water table (SHWT) or bedrock must be at least 2 feet below the bottom of the sand layer.

Placement of Riprap

- The use of riprap in these systems should be limited to the area directly under the inflow. The use of riprap is to dissipate energy from the inflow of stormwater and thereby prevent scouring of the receiving sand.

Sand Bed

The thickness and character of the bed must provide adequate pollutant removal.

- Minimum thickness: 18 inches.
- Maximum depth of runoff generated by the WQDS above the sand bed: 24 inches.
- The sand must meet the specifications for clean, medium-aggregate concrete sand in accordance with AASHTO M-6 or ASTM C-33, as certified by a professional engineer licensed in the State of New Jersey.
- Filter fabric is required along the sides of the sand bed to prevent the migration of fines from the surrounding soil into the sand bed. However, filter fabric may not be used between the sand bed and the stone choker course, described below, because it may cause a layer of fines to collect resulting in a loss of permeability.
- The maximum design permeability rate of sand bed is 2 inches/hour and must be verified prior to installation.
- When using the 2 in/hr design permeability rate, a design drain time of 36 hours must be used.

Stone Choker Course

- This layer must be between 1 and 2 inches.

- The stone in this layer must meet the specifications for clean, coarse aggregate in accordance with AASHTO No. 57.

Storage Volume

- The system must have sufficient storage volume to contain the WQDS runoff volume without overflow.

- Sand filters designed to infiltrate into the subsoils are generally constructed as off-line systems. In off-line sand filters, most or all of the runoff from storms larger than the WQDS bypass the filter through an upstream diversion; this reduces the size of the required storage volume, the sand's long-term pollutant loading, associated maintenance and the threat of erosion and scour caused by larger storm inflows.. Sand filters designed to infiltrate, however, may also be constructed as on-line systems. On-line sand filters receive upstream runoff from all storm events; they provide treatment for the WQDS, and they convey the runoff from larger storms through an overflow. These on-line systems store and attenuate the larger storm events and provide stormwater runoff quantity control; in such systems, the invert of the lowest quantity control outlet is set at or above the maximum water surface of the WQDS.

- Sand filters designed to infiltrate into the subsoils must contain only the WQDS or smaller storm events below the first outlet control structure.

- Under no circumstances may exfiltration be used in the routing calculations.

- Sand filters designed to infiltrate into the subsoils are intended to be free of standing water between storm events in order to allow for sufficient storage for the next rain event; therefore, the drain time for standing water present on the surface of the bottom or in the overflow structure must not exceed 72 hours after any rain event. Storage times in excess of 72 hours may render a sand filter ineffective and may result in anaerobic conditions, odor, and both water quality and mosquito breeding issues.

Permeability

The following specifications apply to the permeability rates of the sand bed, the stone choker course, the subsoil and the topsoil in systems designed with the optional vegetative cover.

- The testing of all permeability rates must be consistent with *Chapter 12: Soil Testing Criteria* in this manual.

- Since the actual permeability rate may vary from soil testing results and may decrease over time, a factor of safety of 2 must be applied to the tested permeability rate to determine the design permeability rate. For example, if the tested permeability rate is 4 inches/hour, then the design rate would be 2 inches/hour. The design rate would then be used to compute the system's WQDS drain time.

- The permeability rate of the topsoil, if using the optional vegetated surface, must be twice the design permeability rate of the subsoil.

Groundwater Mounding Impacts

- As with any infiltration BMP, groundwater mounding impacts must be assessed, as required by N.J.A.C. 7:8-5.2(h). This includes an analysis of the reduction in permeability rate when groundwater mounding is present.
  - Additional trials may be required, including using a reduced recharge rate in accordance with the method published in *Chapter 5: Stormwater Management Quantity and Quality Standards and Computations*, should the calculations demonstrate an adverse impact is produced. Refer to the information labeled "*Steps to Follow When an Adverse Impact is Encountered*" found on Page 53 of *Chapter 5*.
  - Where the mounding analysis identifies adverse impacts, the sand filter must be redesigned, the routing run again and another groundwater mounding analysis performed for the redesign. The mounding analysis must provide details and supporting documentation on the methods used and assumptions made, including values used in calculations. For further information on the required groundwater mounding assessment, *see Chapter 13: Groundwater Table Hydraulic Impact Assessments for Infiltration BMPs.*

Drain Time

- The drain time is determined by the permeability of the sand bed, the permeability of any additional materials above it and the hydraulic conductivity of the most restrictive layer in the subsoil.

- However, when sizing a sand filter designed to infiltrate, both the permeability of the subsoil and the permeability of the sand bed must be considered, and the more restrictive permeability rate of the two layers must be used in sizing calculations.

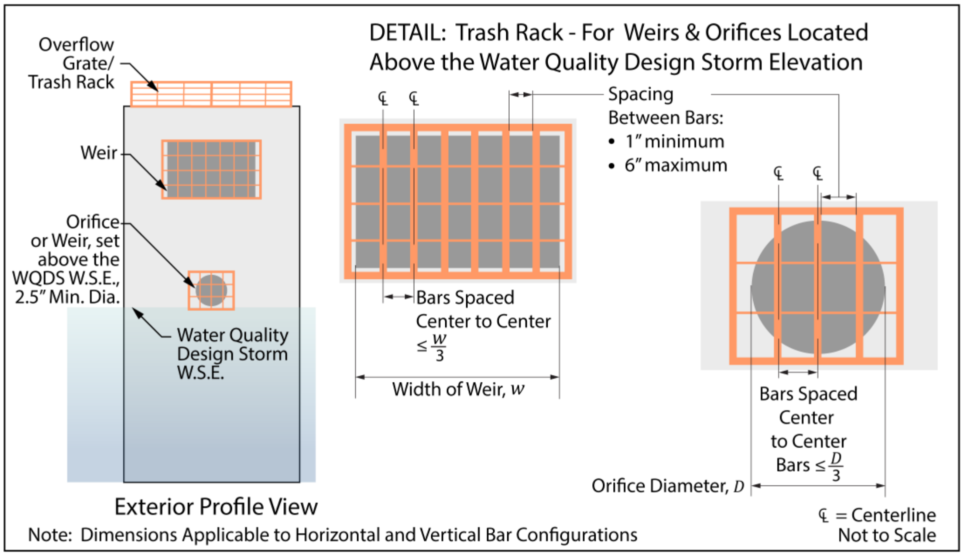
Safety

- All sand filters designed to infiltrate must be designed to safely convey overflows to down-gradient drainage systems. The design of the overflow structure must be sufficient to provide safe, stable discharge of stormwater runoff in the event of an overflow. Safe and stable discharge minimizes the possibility of erosion and flooding in down-gradient areas. Therefore, discharge in the event of an overflow must be consistent with the current version of *Standards for Off-Site Stability* found in the *Standards for Soil Erosion and Sediment Control in New Jersey,* as required by N.J.A.C. 7:8. Small scale sand filters that are classified as dams under the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must meet the overflow requirements under these regulations. Overflow capacity can be provided by a hydraulic structure, such as a weir or orifice, or a surface feature, such as a swale or open channel as site conditions allow.

Outlet Structure

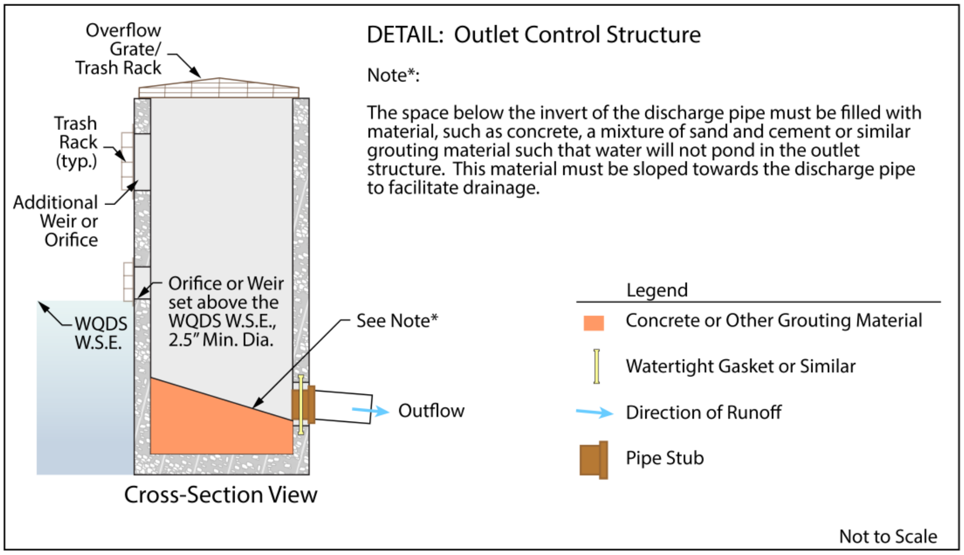
- For systems designed with an outlet structure, trash racks must be installed at the intake to the outlet structure. They must also be designed to avoid acting as the hydraulic control for the system. They must meet the following criteria, as required by N.J.A.C. 7:8-5.2(i)2 and 6.2(a), and the detail on the following page illustrates these requirements:
  - Parallel bars spaced at 1-inch intervals, up to the elevation of the WQDS;

- □ Minimum bar spacing: 1 inch, for elevations in excess of the WQDS;
- □ Maximum bar spacing: 1/3 the diameter of the orifice or 1/3 the width of weir, with a maximum spacing of 6 inches, for elevations in excess of the WQDS;
- □ Maximum average velocity of flow through clean rack: 2.5 feet/second, under full range of stage and discharge, computed on the basis of the net area of opening through rack;
- □ Constructed of rigid, durable and corrosion-resistant material; and
- □ Designed to withstand a perpendicular live loading of 300 lbs./sf.



- An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, the grate must comply with the following requirements:
  - □ The overflow grate must be secured to the outlet structure but removable for emergencies and maintenance;
  - □ The overflow grate spacing must be no greater than 2 inches across the smallest dimension; and
  - □ The overflow grate must be constructed of rigid, durable and corrosion resistant material and designed to withstand a perpendicular live loading of 300 lbs./sf.

- The space below the invert of the discharge pipe must be filled with material, such as concrete, a mixture of sand and cement, or similar grouting material, such that water will not pond in the outlet structure. This material must be sloped towards the discharge pipe to facilitate drainage, as shown in the detail on the following page.



- The minimum diameter of any overflow orifice is 2.5 inches.

- Blind connections to down-gradient facilities are prohibited. Any connection to down-gradient stormwater management facilities must include access points such as inspections ports and manholes, for visual inspection and maintenance, as appropriate, to prevent blockage of flow and ensure operation as intended. All entrance points must adhere to all State, County and municipal safety standards such as those for confined space entry.

- In instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood or tide elevation in a down-gradient waterway or stormwater collection system, the effects of tailwater on the hydraulic design of the overflow systems, as well as any stormwater quantity control outlets must be analyzed. Two methods to analyze tailwater are:

  - A simple method entails inputting flood elevations for the 2-, 10- and 100-year events as static tailwater during routing calculations for each storm event. These flood elevations are either obtained from a Department flood hazard area delineation or a FEMA flood hazard area delineation that includes the 100-year flood elevation or derived using a combination of NRCS hydrologic methodology and a standard step backwater analysis or level pool routing, where applicable. In areas where the 2-year or 10-year flood elevation does not exist in a FEMA or Department delineation, it may be interpolated or extrapolated from the existing data. If this method demonstrates that the requirements of the regulations are met with the tailwater effect, then the design is acceptable. If the analysis shows that the requirements are not met with the tailwater effects, the detailed method below can be used or the BMP must be redesigned.
  - A detailed method entails the calculation of hydrographs for the watercourse during the 2-, 10-, and 100-year events using NRCS hydrologic methodology. These hydrographs are input into a computer program to calculate rating curves for each event. Those rating curves are then input as a dynamic tailwater during the routing calculations for each of the 2-, 10- and 100-year events. This method may be used in all circumstances; however, it may require more advanced computer programs. If this method demonstrates that the requirements of

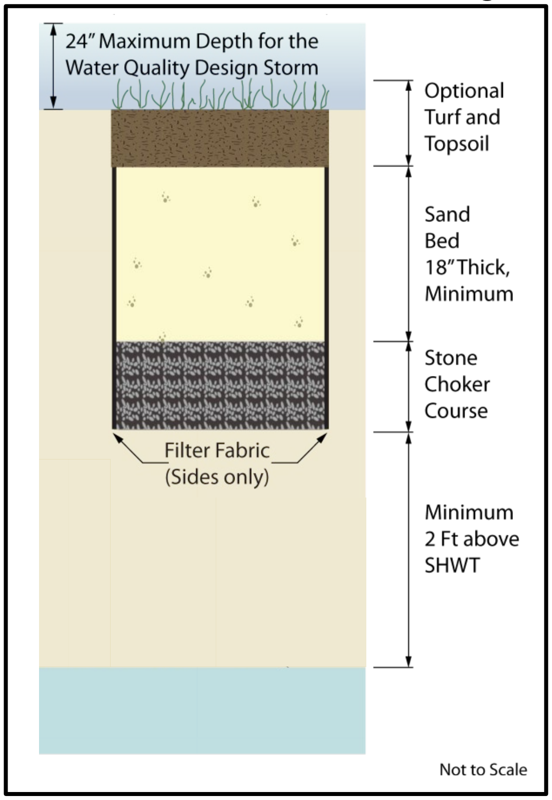
the regulations are met with the tailwater effect, then the design is acceptable. If the analysis shows that the requirements are not met with the tailwater effects, the BMP must be redesigned.

Construction Requirements

- The use of the sand filter system for sediment control during construction is discouraged; however, when unavoidable, excavation for the sediment basin should be at least 2 feet above the final design elevation of the basin bottom.
- Excavation and sand placement should be performed with equipment placed outside of the basin bottom whenever possible. However, in circumstances where this is unavoidable, light earth moving equipment with oversized tires or tracks should be utilized.
- The excavation for the sand filter bottom should only occur after all construction within its drainage area is completed and the drainage area is stabilized. If construction of the sand filter cannot be delayed, berms should be placed around the perimeter of the sand filter during all phases of construction, diverting all flows away from the filter. The berms should not be removed until all construction within the drainage area is completed and the area is stabilized.
- Once the excavation is completed, the floor of the sand filter designed to infiltrate must be deeply tilled with a rotary tiller or disc harrow and smoothed over with a leveling drag, or equivalent grading equipment.
- Once both the sand filter and its drainage area are stabilized, the infiltration rate of the sand bed must be retested to ensure that the design permeability rate is the same as the as-built permeability rate.
- Post-construction testing of the system must be performed on the as-built sand filter in accordance with the *Construction and Post-Construction Oversight and Soil Permeability Testing* section in *Chapter 12 of this manual.*
- Once construction is complete, the permeability rate of the subsoil below the sand filter must be retested to ensure that the subsoil was not compacted during construction.

The following cross-section view provides another view of a sand filter designed to infiltrate into the subsoil.

Cross Section View –Sand Filter Designed to Infiltrate



Requirements for Extended Detention Option

A sand filter designed to infiltrate into the subsoil may be constructed as part of an on-line, combination system to provide extended detention for larger storms. Such a system could include a level-graded infiltration zone such as that defined by a smaller contour, oval or other discrete area within the basin bottom. Runoff up to the WQDS water surface elevation is temporarily stored and exits the system through infiltration into the subsoil. Runoff in excess of this elevation exits the system through various quantity control devices in the outlet structure. Keep in mind that too small an infiltration zone is likely to experience groundwater mounding impacts, as discussed in *Chapter 13*.

Storage Volume

- Sand filters designed to infiltrate with the extended detention option may be designed to treat and temporarily store stormwater runoff produced by both small storms, such as the WQDS, and larger storms such as the 2-, 10- and 100-year design storms.

- For additional information on the design, operation and maintenance of the extended detention components, refer to *Chapter 11.2*: *Extended Detention Basins.*

Designing A Sand Filter

The example below illustrates how to design a sand filter designed to infiltrate to treat the stormwater runoff generated by the WQDS. The following parameters apply:

Area =	5 acre
CN Value =	98 (100% Impervious)
Calculated Time to Peak =	1.54 hours
Calculated WQDS Runoff Volume =	18,777 cf
Forebay Primary Outflow:	Perforated Riser Pipe
Forebay Secondary Outflow:	Broad-crested Weir
Tested Subsoil Permeability Rate =	8 inches/hour
Forebay Surface Elevation =	1.10 ft
Sand Bed Surface Elevation =	0.00 ft
Assumed Depth of WQDS Runoff to be infiltrated =	2 ft above the sand filter surface

Step 1: Forebay Sizing

The forebay must be sized to hold 10% of the WQDS volume. Assuming the depth of stormwater runoff in the forebay is equal to the depth of the WQDS in the surface of the sand filter system, which is assumed to be 1 ft, a rectangular forebay with a width of 42.4 ft and a length of 42.4 ft will provide adequate storage volume. However, in order to facilitate drainage, the water surface elevation in the forebay must be greater than the water surface elevation in the sand filter; in addition, the perforations in the riser pipe must be designed to ensure that the forebay will drain within 9 hours.

In this example, the WQDS water surface elevation (W.S.E.) in the forebay is 2.15 ft; this translates to a depth of 1.05 ft, with the additional 0.05 ft of depth resulting from head loss in the riser pipe. Based on the above elevations, the top of the riser pipe is set at an elevation of 2.20 ft. A grate or trash rack must be installed on the top of the riser to keep floatables from entering the riser pipe during large storm events.

Step 2: Sand Filter Sizing

When designing a sand filter designed to infiltrate, the permeability of the subsoil can affect the design permeability of the entire system; as previously stated, the maximum design permeability of any sand filter system is 10 inches/hour. As stated, the subsoil has a tested permeability rate of 8 in/hr, which is reduced by the same safety factor to yield the design permeability rate of 4 in/hr; therefore, the design permeability rate of the subsoil will be used in sizing calculations for the bottom of the sand filter, also known as the sand bed area. The storage volume of the sand filter must be equal to the volume of runoff generated by the WQDS with a maximum runoff depth of 2 ft. Therefore, the required sand bed area for the runoff volume is as follows:

$$Sand\ Bed\ Area = \frac{WQDS\ Volume}{(Runoff\ Depth)}$$

$$= \frac{18{,}777\ cf}{2\ ft} = 9{,}388.5\ \text{sf}$$

Because the maximum slope of the earthen embankments may not be steeper than 3:1, the sand filter shape cannot be a simple rectangular prism. Therefore, the shape of the basin will initially be set as a trapezoidal prism, as shown below. The dimensions of this assumed shape can be calculated by computer programs based on the depth and side slopes. A 3,601.8 sf footprint of 45 ft wide and 80.04 ft long is designed. A side slope 3:1 (horizontal to vertical) is configured, which results in 92.04 ft long and 57 ft wide at the height of 2 ft.

Step 3: Estimated Drain Time Calculation

As previously stated, the drain time of the basin is determined by the design permeability rate of the subsoil. Note that only the infiltration area, i.e. the footprint, can be credited for infiltration, meaning infiltration may not be applied to the side slopes. The drain time calculation is based on the area of the footprint, which is 3,601.8 sf.

$$Drain\ Time = \frac{WQ\ Design\ Storm\ Volume}{Infiltration\ Area\ x\ Design\ Permeability\ Rate}$$

$$= \frac{18{,}777\ cf\ x\ (12\ inches/ft)}{(3{,}601.8\ sf\ \ x\ 4\ inches/hour)} = 15.6 \text{ hours}$$

Since this is less than the allowable maximum drain time of 72 hours, the sand filter has been sized correctly, on an initial basis, to ensure the surface and sand layer are fully drained within the maximum allowable time frame.

Step 4: Check Separation from SHWT

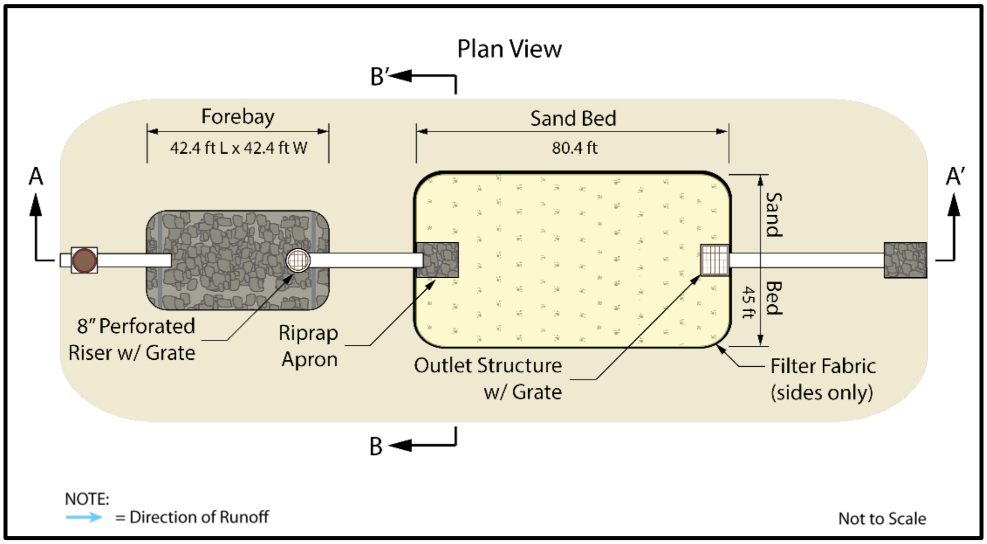
The vertical distance between the lowest elevation of the sand layer and the SHWT must be checked to ensure it meets the minimum requirements. By inspection, the required 2 ft separation from the SHWT is provided.

Step 5: Groundwater Mounding Analysis

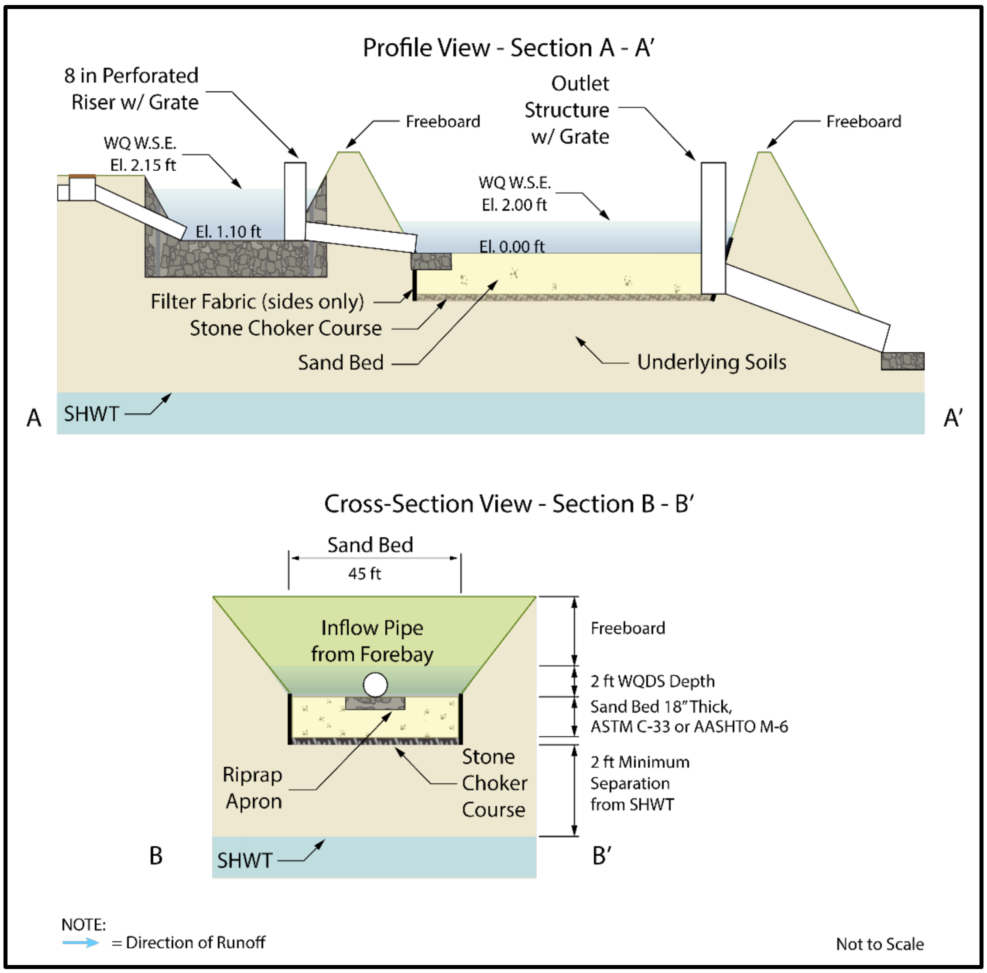
Calculate the height of the groundwater mound caused by infiltration to ensure that it will neither prevent infiltration nor damage nearby structures. For information on conducting a groundwater mounding analysis, please see *Chapter 13: Groundwater Table Hydraulic Impact Assessments for Infiltration BMPs*. For this example, it is assumed the design meets the necessary groundwater mound requirements.

Illustrations for this example are shown below.

Example - Sand Filter System Designed to Infiltrate into the Subsoil
Plan View



Example - Sand Filter System Designed to Infiltrate into the Subsoil
Profile and Cross-Section Views



Considerations

When planning a sand filter designed to infiltrate into the subsoil, consideration should be given to soil characteristics, depth to the groundwater table, sensitivity of the region and inflow water quality. It is also important to note that the use of sand filters designed to infiltrate into the subsoil is recommended in this manual only where the WQDS or smaller storm events are contained below the first outlet control structure. Use of these basins to store larger volumes below the first outlet control structure should only be considered when another applicable rule or regulation requires the infiltration of a larger storm event. In such a case, the sand filter designed to infiltrate into the subsoil should be designed to store the minimum storm event required to address that rule or regulation, below the first outlet control structure.

In addition to the prohibition of recharge in the areas with high pollutant loading or with runoff exposed to source material as defined in N.J.A.C. 7:8-5.4(b)3, the utilization of sand filters designed to infiltrate into the subsoil should consider the impact of infiltration on subsurface sewage disposal systems, water supply wells, groundwater recharge areas protected under the Ground Water Quality Standards rules at N.J.A.C 7:9C, streams under antidegradation protection by the Surface Water Quality Standards rules at N.J.A.C. 7:9B, or similar facilities or areas geologically and ecologically sensitive to pollutants or hydrological changes. Furthermore, the location and minimum distance of the sand filter designed to infiltrate into the subsoil from other facilities or systems shall also comply with all applicable laws and rules adopted by Federal, State and local government entities.

Optional Vegetative Cover

- Vegetation may only be turf grass.
- The permeability rate of the topsoil, if using the optional vegetated surface, must be twice the design permeability rate of the subsoil.

Maintenance

Regular and effective maintenance is crucial to ensure effective sand filter performance; in addition, maintenance plans are required for all stormwater management facilities associated with a major development. There are a number of required elements in all maintenance plans, pursuant to N.J.A.C. 7:8-5.8; these are discussed in more detail in *Chapter 8: Maintenance of Stormwater Management Measures*. Furthermore, maintenance activities are required through various regulations, including the New Jersey Pollutant Discharge Elimination System (NJPDES) Rules, N.J.A.C. 7:14A. Specific maintenance requirements for sand filter systems are presented below; these requirements must be included in the sand filter's maintenance plan.

General Maintenance

- All structural components must be inspected, at least once annually, for cracking, subsidence, spalling, erosion and deterioration.
- Components expected to receive and/or trap debris and sediment must be inspected for clogging at least twice annually, as well as after every storm exceeding 1 inch of rainfall.

- Sediment removal should take place when all runoff has drained from the sand bed and the sand bed is dry.

- Disposal of debris, trash, sediment and other waste material must be done at suitable disposal/recycling sites and in compliance with all applicable local, state and federal waste regulations.

- A detailed, written log of all preventative and corrective maintenance performed on the sand filter, including a record of all inspections and copies of maintenance-related work orders. Additional maintenance guidance can be found online at

  https://www.njstormwater.org/maintenance_guidance.htm.

- Access points for maintenance are required on all enclosed areas within a sand filter; these access points must be clearly identified in the maintenance plan. In addition, any special training required for maintenance personnel to perform specific tasks, e.g., confined space entry, must be included in the plan.

- Stormwater BMPs may not be used for stockpiling of plowed snow and ice, compost, or any other material.

Vegetated Areas

- In sand filter systems with vegetated surfaces, bi-weekly inspections are required when establishing/restoring vegetation.

- A minimum of one inspection during the growing season and one inspection during the non-growing season is required to ensure the health, density and diversity of the vegetation.

- Mowing/trimming of vegetation must be performed on a regular schedule based on specific site conditions; perimeter grass should be mowed at least once a month during growing season.

- Vegetative cover must be maintained at 85%; damage must be addressed through replanting in accordance with the original specifications.

- Vegetated areas must be inspected at least once annually for erosion, scour and unwanted growth; any unwanted growth should be removed with minimum disruption to the remaining vegetation.

- All use of fertilizers, pesticides, mechanical treatments and other means to ensure optimum vegetation health must not compromise the intended purpose of the sand filter.

Drain Time

- The sand bed must be inspected at least twice annually to determine if the permeability of the bed has decreased.

- The approximate drain time for the maximum design storm runoff volume below the top of the sand bed must be indicated in the maintenance manual.

- If the actual drain time is significantly different from the design drain time, the components that could provide hydraulic control must be evaluated and appropriate measures taken to return the sand filter to minimum and maximum drain time requirements.

- If the sand filter fails to drain the WQDS within 72 hours, corrective action must be taken, up to and including the replacement of the upper layers of the sand bed. In addition, the anticipated frequency of this replacement must be indicated in the maintenance manual.

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