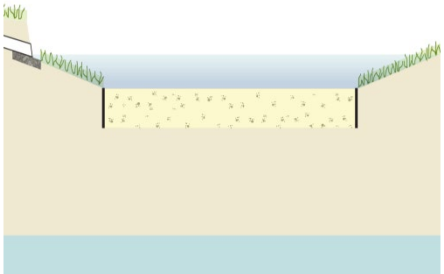
10.2 INFILTRATION BASINS (LARGE-SCALE)



Infiltration basins are stormwater management systems constructed with highly permeable components designed to both maximize the removal of pollutants from stormwater, promote groundwater recharge and address the quantity impacts of land development. Pollutants are treated through settling, filtration of the runoff through, and biological and chemical activity within, the components. 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
GR	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 Removal

Stormwater Runoff Quality Mechanisms and Corresponding Criteria	
Settling	
Storage Volume	Entire Water Quality Design Storm (WQDS) Volume
Infiltration	
Maximum Design Storm Drain Time	72 hours, Using Slowest Design Permeability Rate
Permeability Rate Factor of Safety	2
Minimum Subsoil Design Permeability Rate	0.5 inches/hour
Maximum Design Permeability Rate	10 inches/hour
Soil Testing Consistent with *Chapter 12: Soil Testing Criteria*	Required
Minimum Distance between Basin Bottom and Seasonal High Water Table	2 feet
Biological and Chemical Activity	
Minimum Sand Layer Thickness	6 inches
Minimum Sand Layer Permeability Rate	20 inches/hour, tested per *Chapter 12*
Maximum % Fines in Sand Layer	15%

Introduction

Infiltration basins are stormwater management systems constructed in areas of highly permeable soil that provide temporary storage of stormwater runoff and can help to reduce increases in both the peak rate and total volume of runoff caused by land development. Pollutants in runoff are treated through the processes of filtration through and biological and chemical activity within the soil.

In these systems, the rate of infiltration is affected by the hydraulic conductivity of the underlying soil, the distance separating the lowest basin elevation from the seasonal high water table (SHWT) and the area of the basin bottom. While loss of hydraulic conductivity through soil compaction is a concern, transport of dissolved pollutants by highly permeable subsoil is of equal concern; therefore, care must be taken when using fertilizers and herbicides upgradient of an infiltration basin.

Additionally, due to the potential for groundwater contamination, the use of infiltration basins, and all stormwater infiltration best management practices (BMPs), is prohibited in areas where high pollutant or sediment loading is anticipated. For more information regarding stormwater runoff that may not be infiltrated, refer to N.J.A.C. 7:8-5.4(b)3. However, this prohibition is limited only to areas onsite where this type of loading is expected. Additionally, infiltration basins may only be used on these types of sites provided the location of the infiltration basin is not inconsistent with a remedial action work plan or landfill closure plan.

Discharge from infiltration basins of the smaller storm events occurs through the subsoil; therefore, they may not be used where their installation would create a significant risk of adverse hydraulic impacts. These impacts may include exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of a subsurface sewage disposal system or other subsurface structure, or where their construction will compact the subsoil. Hydraulic impacts on the groundwater table must be assessed. For more information on groundwater mounding analysis, refer to *Chapter 13: Groundwater Table Hydraulic Impact Assessments for Infiltration BMPs* and the *USGS Paper on Assessment of Impacts* link on the *Additional Guidance Documents* page at https://dep.nj.gov/stormwater/additional-guidance-documents/.

Infiltration basins designed in accordance with 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.

Finally, an infiltration basin 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

The use of infiltration basins is applicable only where the soils have the required permeability rate identified in the Design Criteria section found below.

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.

Infiltration basins may be designed to reduce peak runoff rates when designed as an on-line system in combination with a detention option; however, regardless of the design storm chosen, all infiltration basins must be designed for stability and 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 infiltration basins 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 infiltration basins that exceed the contributory drainage area limit of 5.3(b) be used to meet the stormwater runoff quality requirement.

Design Criteria

Basic Requirements

An infiltration basin may be designed as a surface or subsurface system. The following criteria apply to both configurations. Design criteria specific to surface infiltration basins may be found beginning on Page 9; design criteria specific to subsurface infiltration basins may be found beginning on Page 11. Additional requirements for the detention option may be found beginning on Page 8.

Inflow

- All inflow must be stable and non-erosive and must be consistent with the *Standards for Soil Erosion and Sediment Control in New Jersey*.

Storage Volume

- Infiltration basins may be constructed as either off-line or on-line systems. In off-line systems, most, or all, of the runoff from storms larger than the Water Quality Design Storm (WQDS) bypass the infiltration basin through an upgradient diversion; this reduces the size of the required basin storage volume, the system's long-term pollutant loading and associated maintenance. On-line systems receive runoff from all storms 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 the water surface elevation of the WQDS. Further details are provided beginning on Page 9 under the sub-heading *Requirements for the Detention Option.*

- The system must have sufficient storage volume to contain the WQDS runoff volume without overflow.
- Under no circumstances may exfiltration be used in the routing calculations.
- Infiltration basins 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 basin bottom or in the overflow structure must not exceed 72 hours after any rain event. Storage times in excess of 72 hours may render an infiltration basin ineffective and may result in anaerobic conditions, odor, and both stormwater quality and mosquito breeding issues.

Geometry

- Infiltration basins may not be constructed in areas where the surrounding slopes are 15% or greater.
- The infiltration area must be as level as possible in order to uniformly distribute runoff infiltration over the footprint and into subsoil.
- The basin must have a sufficient surface area to prevent the accumulated volume of stormwater runoff from exceeding the maximum depth requirement, which is specific to the type of system. More information is found on Page 9 for surface type infiltration basins.
- The seasonal high water table (SHWT) or bedrock must be at least 2 feet below the lowest extent of the basin bottom. In surface basins, this distance is measured from the bottom of the sand layer.

Soil Testing

- Soil testing must be consistent with *Chapter 12: Soil Testing Criteria* in this manual.

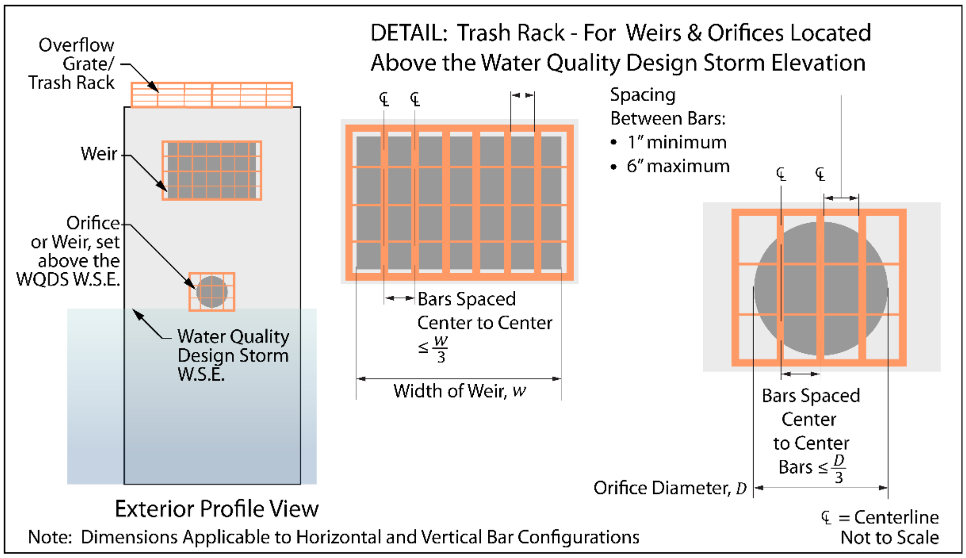
Safety

- All infiltration basins must be designed to safely convey overflows to down-gradient drainage systems. The design of any overflow structure must be sufficient to provide safe, stable discharge of stormwater in the event of an overflow. Safe and stable discharge minimizes the possibility of adverse impacts, including erosion and flooding in down-gradient areas. Therefore, discharge in the event of an overflow must be consistent with the Standards for Off-Site Stability found in the *Standards for Soil Erosion and Sediment Control in New Jersey*.
- Infiltration basins 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.

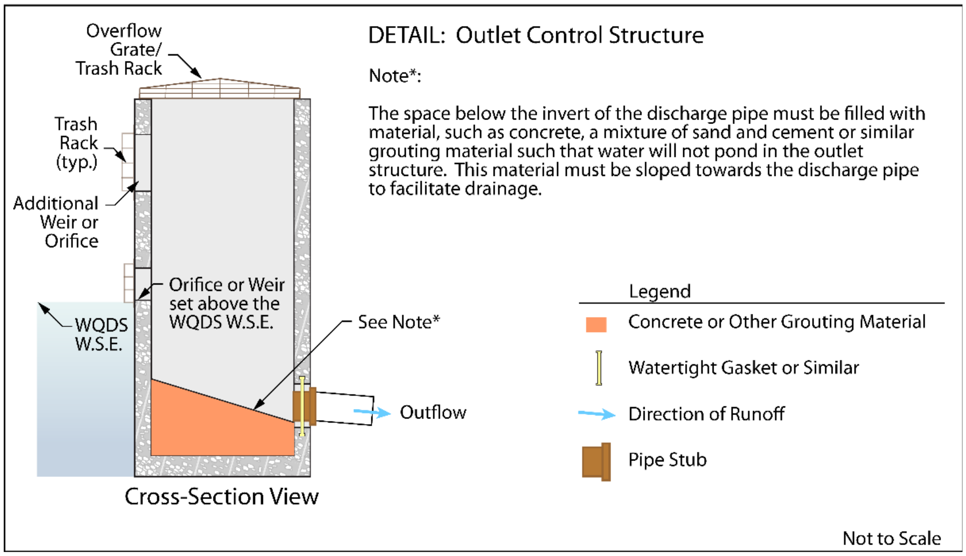
Outlet Structure

- Trash racks must be installed at the intake to the outlet structure. They must meet the following criteria and the detail below illustrates these requirements:
  - □ Parallel bars with 1-inch spacing between the bars up to the elevation of the WQDS;
  - □ Parallel bars higher than the elevation of the WQDS must be spaced no greater than one-third the width of the diameter of the orifice or one-third the width of the weir, with minimum spacing between bars of 1 inch and a maximum spacing between the bars of six inches;
  - □ The trash rack must be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure;
  - □ 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.



- Any flow control device, such as an orifice, weir, grate or perforated pipe, at the outlet of the stormwater management measures shall be designed to prevent the clogging of the flow control device while achieving the design and performance standards at N.J.A.C. 7:8-5.4, 5.5 and 5.6.

- 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 system, 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

- During clearing and grading of the site, measures must be taken to eliminate soil compaction at the location of a proposed infiltration basin.
- The location of the proposed infiltration basin must be cordoned off during construction to prevent compaction of the subsoil by construction equipment or stockpiles.
- The use of the location proposed for an infiltration basin to provide sediment control during construction is discouraged; however, when unavoidable, excavation for the sediment control basin must be at least 2 feet above the final design elevation of the basin bottom.
- Excavation and construction of an infiltration basin must be performed using equipment placed outside the limits of the basin.
- The excavation to the final design elevation of the infiltration basin bottom may only occur after all construction within its drainage area is completed and the drainage area is stabilized. If construction of the infiltration basin cannot be delayed, berms must be placed around the perimeter of the basin during all phases of construction to divert all flows away from the basin. The berms may not be removed until all construction within the drainage area is completed, and the area is stabilized.
- The contributing drainage area must be completely stabilized prior to infiltration basin use.
- Post-construction testing must be performed on the as-built infiltration basin in accordance with the Construction and Post-Construction Oversight and Soil Permeability Testing section in *Chapter 12* of this manual. Where as-built testing shows a longer drain time than designed, corrective action must be taken. The drain time is defined as the time it takes to fully infiltrate the maximum design storm runoff volume through the most hydraulically restrictive layer.

Access Requirements

- An access roadway must be included in the design to facilitate monitoring and maintenance. If the access roadway is constructed of impervious material, take note that it may be subject to the stormwater runoff quality, quantity, and/or groundwater recharge requirements at N.J.A.C. 7:8-5.4, 5.5 and 5.6.
- Additional steps may be necessary to eliminate vehicular intrusion into the basin, such as from all-terrain vehicles and utility trucks.

Requirements for the Detention Option

An infiltration basin may be constructed as part of an on-line, combination system to provide 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 of an infiltration zone is likely to experience groundwater mounding impacts, as discussed in *Chapter 13*.

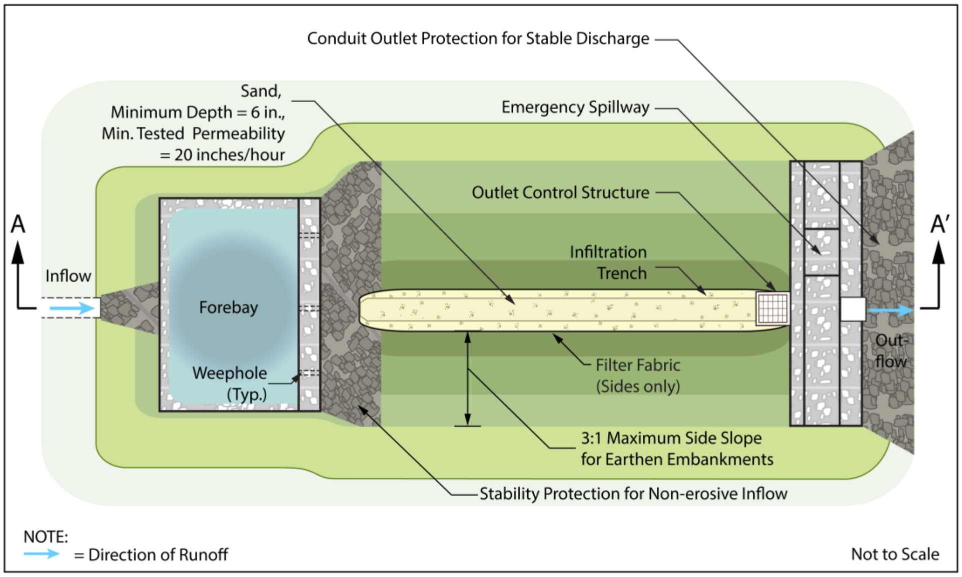
Storage Volume

- Infiltration basins with the detention option may be designed to treat and temporarily store runoff generated by both small storms, such as the WQDS, and larger storms such as the 2-, 10- and 100-year design storms.

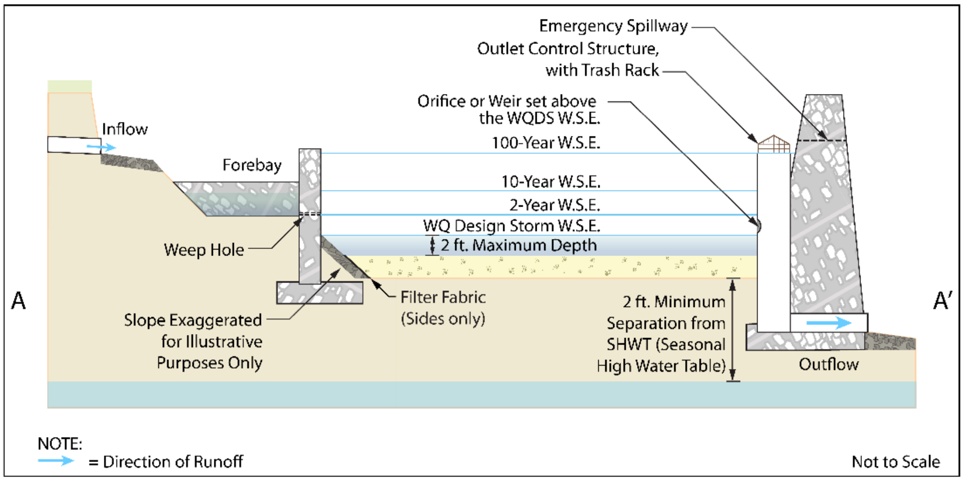
- Under no circumstances may exfiltration be used in the routing calculations.

The following illustrations depict a surface infiltration basin with the detention option in both plan and profile views; a concrete forebay was selected to provide pretreatment. Although not shown, stormwater quantity control outlets are provided at the water surface elevation of the 2-, 10-, and 100-year storm events. To prevent the accumulation of runoff from exceeding the 2 foot maximum depth limit, an orifice is set at the water surface elevation of the WQDS.

Infiltration Basin with the Detention Option: Plan View



Infiltration Basin with the Detention Option: Profile View



Types of Infiltration Basins

There are two types of infiltration basins:

1. Surface Infiltration Basins
2. Subsurface Infiltration Basins

Individual Types of Infiltration Basins

The following section provides detailed design criteria for each type of infiltration basin. The illustrations depict possible configurations and flow paths and are not intended to limit the design.

Surface Infiltration Basins

Geometry

- The maximum interior slope for an earthen dam, embankment or berm is 3:1.
- The vertical distance between the upper surface of the basin bottom and the WQDS water surface elevation must be no greater than 2 feet. This distance is also referred to as the maximum depth of stormwater runoff to be infiltrated.

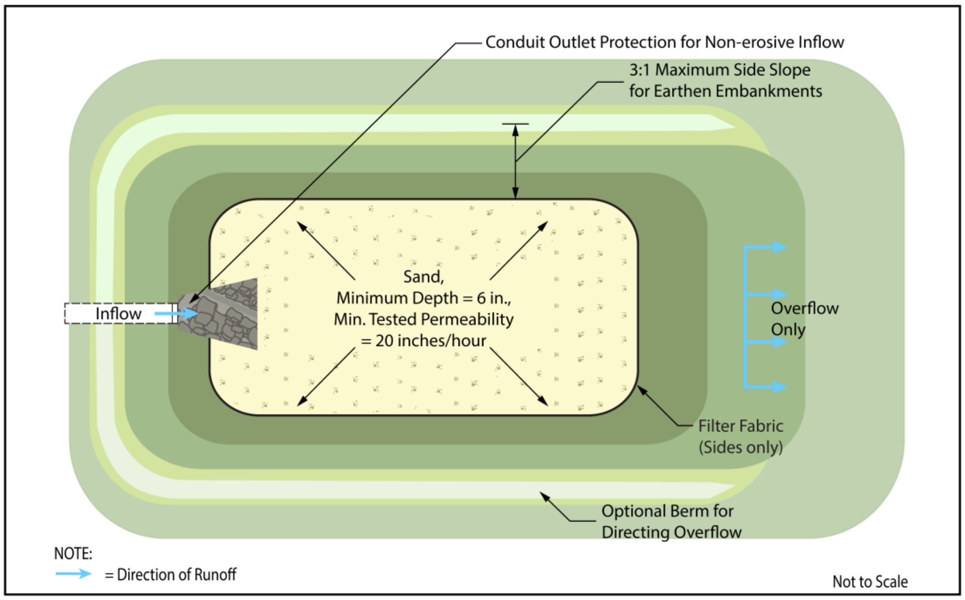
Sand Layer

- To ensure that the design permeability rate is maintained over time, a sand layer is required at the bottom of every surface type infiltration basin.
- The minimum depth is 6 inches.
- The sand must meet all 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.

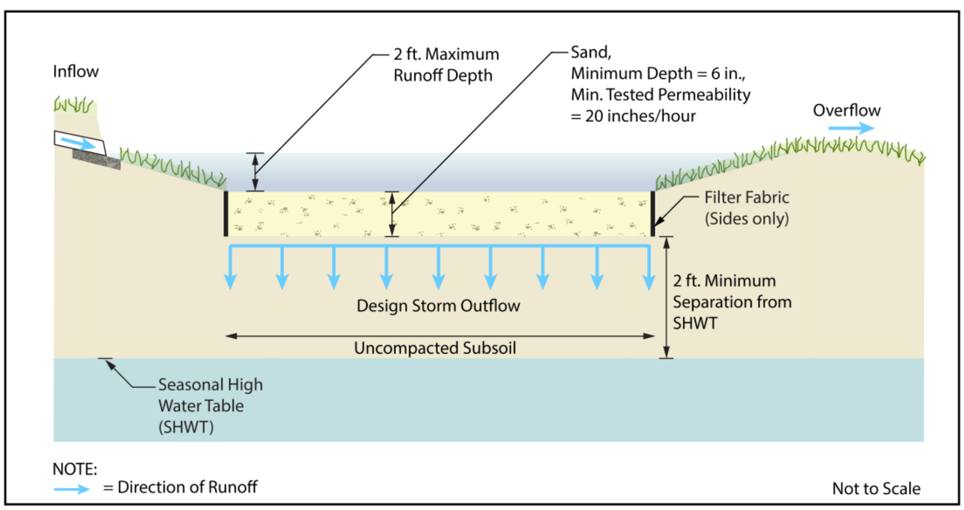
- The maximum percentage of fines is 15%.
- The minimum tested permeability rate is 20 inches/hour.
- The use of topsoil and vegetation is prohibited. If a vegetated BMP is desired, refer to *Chapter 10.1: Bioretention Systems (Large-scale)* or *Chapter 9.7: Small-scale Bioretention Systems*.
- Filter fabric is required along the sides of the infiltration basin to prevent the migration of fine particles from the surrounding soil; filter fabric may not be used along the bottom of the basin because it may result in a loss of permeability.

The following graphics depict a surface infiltration basin in both plan and profile view. These illustrations show possible configurations and flow paths and are not intended to limit the design.

Surface Infiltration Basin – Plan View



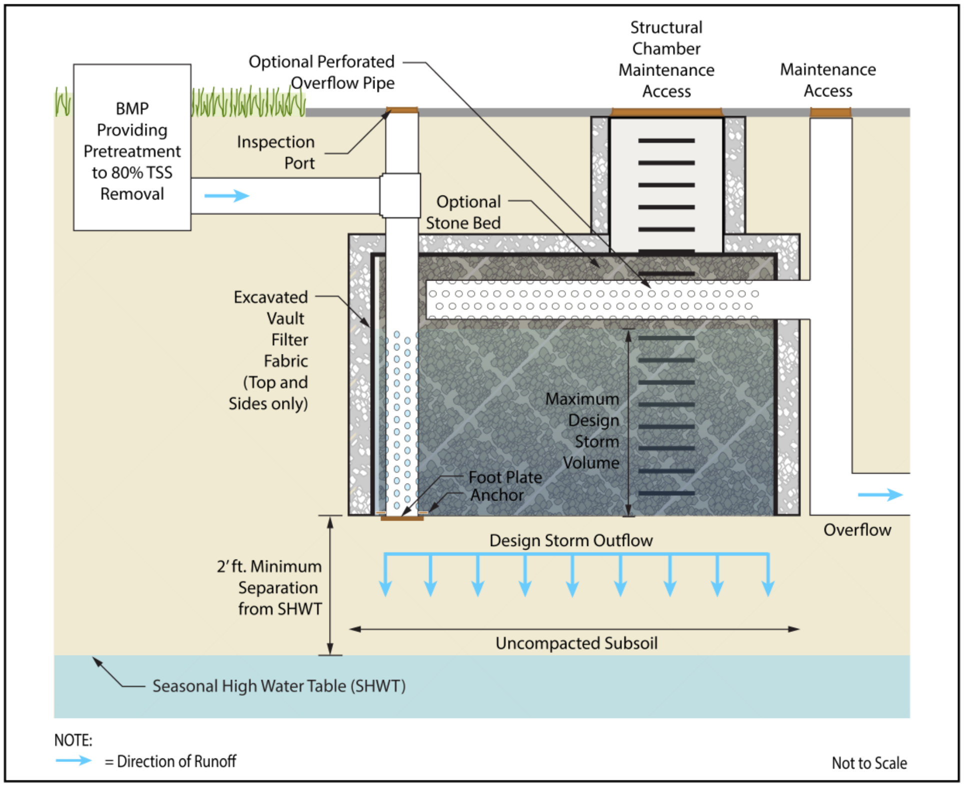
Surface Infiltration Basin – Profile View



Subsurface Infiltration Basins

A subsurface infiltration basin may consist of a vault, or a network of one or more perforated pipes, either of which may include a stone bed. A typical subsurface infiltration basin constructed as a vault is depicted in the following illustration as an example, but it is not intended to limit the design configuration. Design criteria specific to this type of infiltration basin immediately follows.

Subsurface Infiltration Basin – Profile View



Pretreatment for Subsurface Infiltration Basins

- Pretreatment is required on all subsurface infiltration basins.
- Roof runoff that directly discharges into the subsurface infiltration basin can 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 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 for non-roof runoff, or roof runoff comingled with stormwater from other surfaces, must remove 80% of the total suspended solids (TSS) in the runoff generated by the WQDS.

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

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

Component Requirements for Subsurface Infiltration Basins

- Filter fabric is required along the top and sides of a subsurface infiltration basin to prevent the migration of fine particles from the surrounding soil, unless the basin is enclosed in an impermeable structural housing. Filter fabric may not be used along the bottom of the basin because it may result in a loss of permeability.

- Any aggregate used in a subsurface infiltration basin must be free from debris, silt or other material that could contribute to clogging.

Access Requirements

- At least one inspection port that extends into the subsoil must be provided in the area of the infiltration basin to monitor the functionality of the basin. The location of the inspection port must be shown in the maintenance plan. Additionally, the maximum design storm depth of runoff must be marked on the structure and its level included in the design report and maintenance plan.

- All points of access must also be covered in such a way as to prevent sediment or other material from entering the system and to prevent the accumulation of standing water, which could lead to mosquito breeding.

Designing an Infiltration Basin

The following examples show how to design various infiltration basins to treat the runoff generated by the WQDS. The examples below are two of many possible ways to configure these basins and are not intended to limit the design.

Example 1 - Surface Infiltration Basin: For one acre of impervious pavement, design an infiltration basin to infiltrate the runoff generated by the WQDS. Runoff will receive pretreatment by a forebay designed in accordance with the criteria established in this chapter. Runoff volumes in excess of the WQDS generated volume will discharge via an emergency spillway. The following parameters apply:

Inflow Drainage Area =	5 acre (motor vehicle surface)
Pavement NRCS Curve Number (CN) =	98
Tested Sand Permeability Rate =	40 inches/hour
Tested Subsoil Permeability Rate =	8 inches/hour
Maximum Design Storm Water Depth =	2 ft
Sand Layer Depth =	6 in

Step 1: Runoff Calculations

Using the NRCS method described in *National Engineering Handbook, Part 630 (NEH)* and discussed in *Chapter 5*, the runoff volume for the WQDS was calculated to be 18,777 cf.

Step 2: Forebay Sizing

The forebay must be sized to hold 10% of the WQDS volume. Assuming the depth of water in the forebay is equal to 1 ft, a square forebay with a width of 41 ft and a length of 46 ft will provide adequate storage volume. In order to facilitate drainage, the bottom of the forebay must be elevated above the sand layer in the infiltration basin; in addition, the perforations in the riser pipe must be designed to ensure that the forebay will drain within 9 hours.

Step 3: Infiltration Basin Sizing

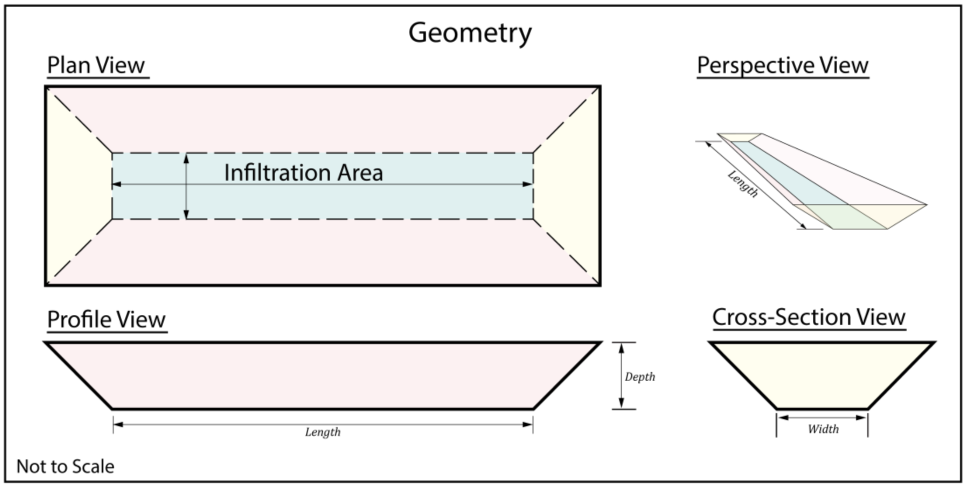
When designing an infiltration basin, the permeability rate of the subsoil is usually the limiting factor in the design of the system, as is demonstrated in the following analysis. The tested permeability rate of the sand layer is reduced by a safety factor of 2; however, the resulting 20 inches/hour design permeability rate cannot be used in calculations because the maximum design permeability rate allowed is 10 inches/hour. As stated, the subsoil has a tested permeability rate of 8 inches/hour, which is reduced by the same safety factor to yield the design permeability rate of 4 inches/hour; therefore, the design permeability rate of the subsoil will be used in sizing calculations for the bottom of the basin, also known as the infiltration area.

The storage volume of the infiltration basin must be equal to the volume of runoff generated by the with a maximum runoff depth of 2 feet. Therefore, the required infiltration area for the runoff volume is as follows:

$$Infiltration\ Area = \frac{WQDS\ Volume}{Runoff\ Depth} = \frac{18{,}777\ cf}{2\ ft} = 9{,}388.5\text{ sf}$$

Because the maximum slope of the earthen embankments may not be steeper than 3:1, the infiltration basin 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 infiltration area is shown in blue, the side slopes in pink and the end slopes in yellow. The dimensions of this assumed shape can be calculated by computer programs based on the depth and side slopes. A 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.

Example 1 - Geometry



Step 4: 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 infiltration basin 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 5: Check Separation from SHWT

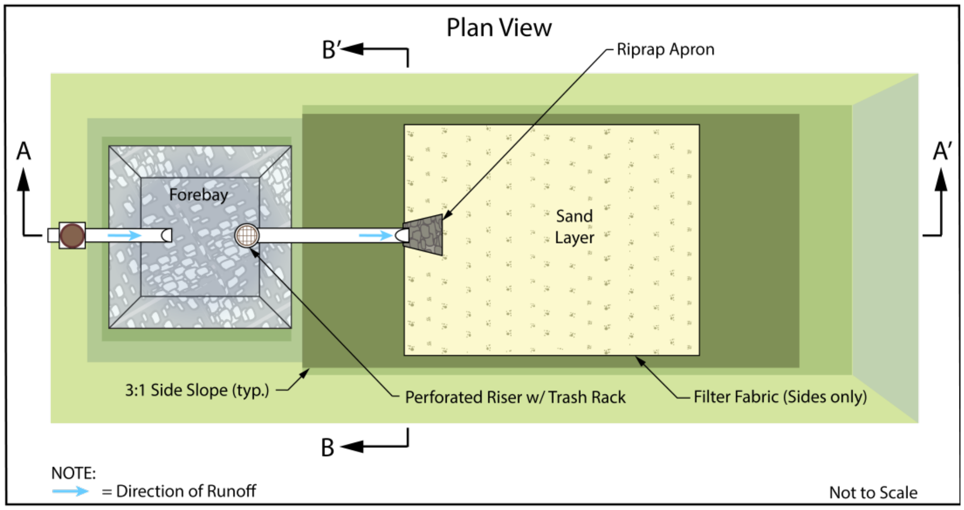
The vertical distance between the lowest elevation of the sand layer and the SHWT must be checked to ensure it meets the minimum requirements. By inspection, the required 2 foot separation from the SHWT is provided.

Step 6: Groundwater Mounding Analysis

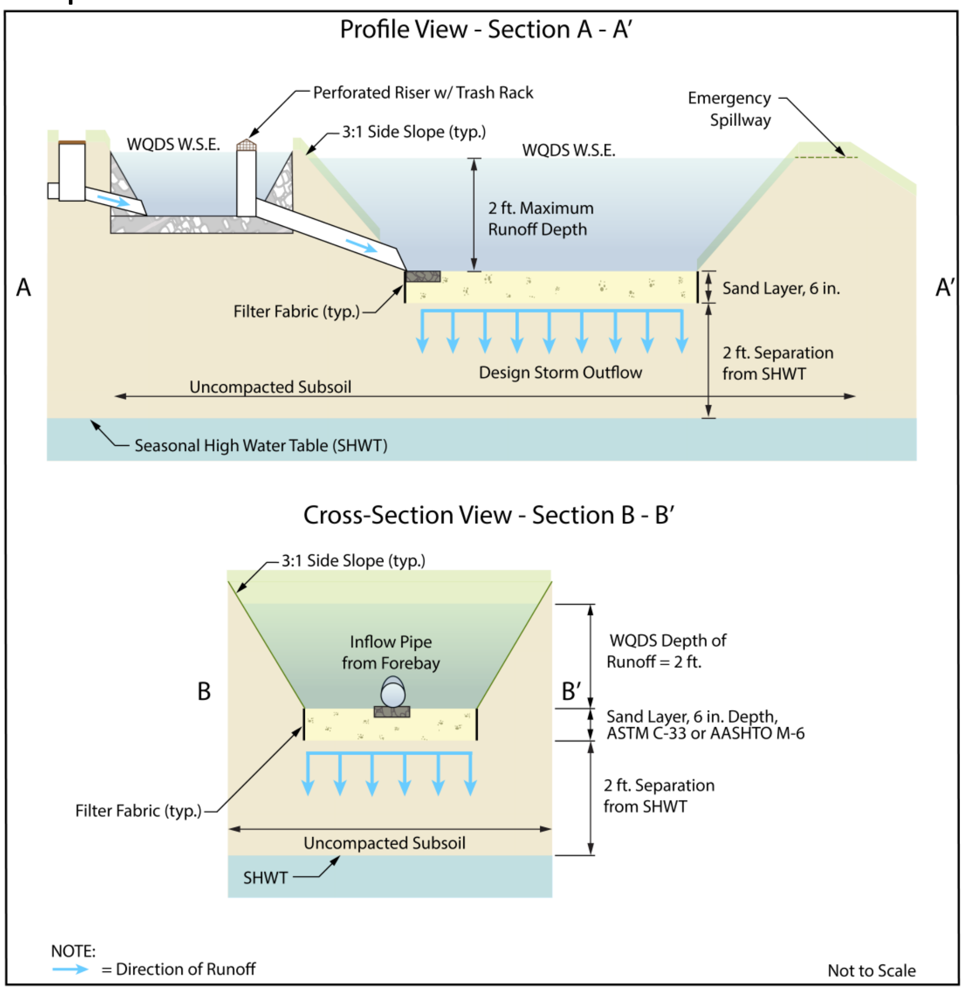
Calculate the height of the groundwater mound caused by infiltration to ensure that it will neither prevent infiltration nor damage nearby structures. For information on conducting a groundwater mounding analysis, please see *Chapter 13: Groundwater Table Hydraulic Impact Assessments for Infiltration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

Illustrations for this example, exclusive of any refinements, are shown below and on the following page.

Example 1 – Plan View



Example 1 – Profile and Cross-Section View



Considerations

When planning an infiltration basin, 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 infiltration basins 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 infiltration basin 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 infiltration basins 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 infiltration basin from other facilities or systems shall also comply with all applicable laws and rules adopted by Federal, State and local government entities.

Pretreatment

As with all other best management practices, pretreatment may extend the functional life and increase the pollutant removal capability of an infiltration basin by reducing incoming velocities and capturing coarser sediments. Note that pretreatment is one requirement in the design criteria for subsurface infiltration basins. Pretreatment requirements specific to this type of infiltration basin can be found in the above section entitled *"Pretreatment for Subsurface Infiltration Basins."*

- Pretreatment may consist of a forebay or any of the structural 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 may 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 WQDS and be sized to hold the sediment volume expected between clean-outs.
    - The forebay 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.

- When using another BMP for pretreatment, it must be designed in accordance with the design requirements outlined in its respective chapter. For additional information on the design requirements of each BMP, refer to the appropriate chapter in this manual.
- Any roof runoff that discharges to the small-scale infiltration basin 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.*
    - The 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

Soil Characteristics

Soils are perhaps the most important consideration for site suitability. In general, County Soil Surveys may be used to obtain necessary soil data for planning and preliminary design of infiltration basins. However, as previously mentioned, for final design and construction, soil tests are required at the exact location of the proposed basin in order to confirm its ability to function properly without failure. In order to confirm reasonable data consistency, the results of soil testing should be compared with the County Soil Survey data that was used in the computation of runoff rates and volumes and the design of on-site BMPs. If significant differences exist between the soil test results and the County Soil Survey data, additional soil tests are recommended to determine and evaluate the extent of the data inconsistency and whether there is a need for revised site runoff and BMP design computations. All significant inconsistencies should be discussed with the local Soil Conservation District prior to proceeding with such a redesign to help ensure that the final site soil data is accurate.

Geology

The presence or absence of Karst topography is an important consideration when designing an infiltration basin; in areas of the State with this type of geology, the bedrock is composed of highly soluble rock. If Karst topography is present, infiltration of runoff may lead to subsidence and sinkholes; therefore, careful consideration must be taken in these areas. For more information on design and remediation in areas of Karst topography, refer to the *Standards for Soil Erosion and Sediment Control in New Jersey: Investigation, Design and Remedial Measures for Areas Underlain by Cavernous Limestone.*

Maintenance

Regular and effective maintenance is crucial to ensure effective infiltration basin performance; in addition, maintenance plans are required for all stormwater management facilities on 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 infiltration basins are presented below; these requirements must be included in the basin's maintenance plan.

General Maintenance

- Proper and timely maintenance is essential to continuous, effective operation; therefore, an access route must be incorporated into the design, and it must be properly maintained.
- 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 four times annually, as well as after every storm exceeding 1 inch of rainfall.
- Sediment removal should take place when all runoff has drained and the basin 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.
- Access points for maintenance are required on all enclosed areas within an infiltration basin; these access points must be clearly identified in the maintenance plan. In addition, any special training required for maintenance personnel to perform specific tasks, such as 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.

Drain Time

- The basin must be inspected at least twice annually to determine if the permeability of the basin has decreased.
- The design drain time for the maximum design storm runoff volume must be indicated in the maintenance manual.
- If the actual drain time is longer than the design drain time, the components must be evaluated and appropriate measures taken to return the infiltration basin to the original tested as-built condition.
- If the infiltration basin fails to drain the WQDS within 72 hours, corrective action must be taken and the maintenance manual revised accordingly to prevent similar failures in the future. Note that annual tilling of the sand layer, using lightweight equipment, may assist in maintaining the infiltration capacity of a surface type system by breaking up clogged surfaces.

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