Pierce County

Department of Planning and Land Services
Development Engineering

SINGLE FAMILY RESIDENTIAL
INFILTRATION SYSTEM
DESIGN GUIDE
2008 Pierce County Stormwater Management and Site Development Manual

Introduction

This guide is designed to aid you in designing a single family residence infiltration system. A number of the most commonly asked questions are included. Volume 1, Table A.2 of the *2008 Pierce County Stormwater Management and Site Development Manual* has been simplified in this design guide to make the calculations easier. See Ordinance 2008-59s, *2008 Pierce County Stormwater Management and Site Development Manual* for a complete reference.

What is an infiltration system? Infiltration is the soaking or percolation of surface water into the ground. An infiltration system is similar to the septic tanks and drainfields that are used to dispose of wastewater from your house. The system is composed of several elements that convey runoff (gutters and downspouts) to a sediment control structure (similar to a septic tank, but much smaller) which filters out debris and finally to a gravel-filled infiltration trench where the runoff percolates into the soil.

Why is an infiltration system required? Single family residential construction often has a negative effect on the environment. Typical construction practice consists of stripping the building site of all vegetation, and in many cases, the topsoil. This practice reduces the amount of vegetation and topsoil that is available on a site to absorb rainfall. The construction project adds impervious surfaces, such as roofs and driveways, which prevents natural infiltration.

It is necessary to control this extra runoff to prevent flooding, erosion, and recharge groundwaters that supply water to wetlands, streams and wells. A properly designed, constructed and maintained infiltration system is one of the most effective ways of managing runoff from single family construction projects.

Who can design an infiltration system? A homeowner or contractor may use this design packet to design an infiltration system with help from a Soils Professional. The Soils Professional is required to verify the soil type and determine the appropriate infiltration rate. For sites with proposed on-site sewage disposal systems, the same Soils Professional designing that system can provide the on-site soil type(s) and design the infiltration system. Systems infiltrating runoff from areas greater than 5,000 square feet must be designed by a Professional Engineer. A professional Engineer must also design any system placed in fill material or under pavement.

What is a Soils Professional? A person (civil engineer, geotechnical engineer, septic designer) who demonstrates proficiency in the practice of the science of soils, including their origin, character, and utilization for stormwater treatment and disposal. This

proficiency shall be demonstrated through the soils professional's ability to complete the Soils Evaluation Report form in a precise and accurate manner.

How do I apply for a permit? An application for a single family residence is not considered complete if an infiltration system is required and its application is not submitted along with the building permit application. Incomplete applications cannot be accepted. Complete the attached Single Family Infiltration Design Worksheets. Make sure you attach the site plan and soil logs. Bring two (2) copies of the completed worksheets along with your building permit package to the Development Center located in the Pierce County Annex, located at 2401 South 35th Street, Tacoma. Infiltration system reviews are typically completed within two weeks. This time may vary based on current workload.

I cannot design a system per the regulations. What do I do? Contact a professional Civil engineer licensed in the State of Washington. They can design alternative systems that meet the requirements of the *2008 Pierce County Stormwater Management and Site Development Manual*.

Requesting County Inspections. From a touch tone telephone you may schedule or cancel an inspection. Contact Pierce County's Permit and Application Status System (PASS) by calling 253-798-4900 or 253-798-7290. The Site Development permit number for storm drainage inspection is needed to schedule inspections.

When To Call For Inspection: The drainage system must be completely constructed but not yet backfilled at the time of inspection. All pipe connections must be in place, properly coupled or glued, and exposed. A clean, smooth stake (preferably PVC) shall be placed in every trench prior to filling with washed rock. The inspector will remove this stake to check the depth of washed rock. All accessory structures such as driveway basins, residential sump structures, clean outs and/or inspection wells depicted on the approved plan must be in place.

What is required to get a final inspection on my building permit? Prior to final inspection approval of construction, the contractor or applicant needs to have the infiltration system inspected by the County or your retained engineer.

Design Procedure and Tips

1. The first step in designing an infiltration trench is to determine what you are trying to fit on your site. If you have a small lot and are trying to squeeze a house, driveway, septic system with reserve area and an infiltration trench(s), you might be in for a challenge. Reducing the footprint of the house and driveway can reduce infiltration trench system sizes.

2. Start by preparing an accurate, to scale site plan and/or abbreviated plan (see Figure 1). Draw the site plan at a scale of 1" = 20'. Show all easements, buffer areas and/or other areas where building activity is restricted. Show contours lines at 2-foot intervals. Draw a line offset 10 feet inside the property line. Use the easement line if your lot fronts a private road. If you have a slope on or adjacent to your lot that is steeper than 20% and greater than 10 feet high draw another line located 50 feet from the top of the slope. NOTE: A reduced setback may only be granted upon submission of geotechnical data but in no case shall be less than the vertical height of the slope. Infiltration systems cannot be located within 10 feet of any property line.

3. Draw a preliminary location of the house foot print on the site plan. Draw a line offset 10 feet from the house outline. Infiltration systems cannot be located within 10 feet of any structure.

4. The remaining area is available, minus the area needed for on-site septic systems and reserve areas, for the infiltration system. If you are utilizing an on-site sewage system (septic system) you will have to coordinate the location of both systems**.** Infiltration systems must be located at least 50 feet from a septic drainfield, reserve area, septic tank or pump chamber. This setback requirement may be waved and shall be reviewed on a case by case basis. Contact Development Engineering Technical Support for more information

5. Locate an area for the infiltration system on the site plan. It needs to be located down slope from the driveway and house so the water drains to it. The trench needs to be oriented parallel to the site's contour lines. Have a Soils Professional determine the soil type and infiltration rate in inches per hour. See the following section on soil evaluation reports. The soils determination must be consistent with the Sizing Table, see page 7.

6. Size the infiltration trench per the attached worksheet pages 5 and 6.

   Step 1. Determine the number of square feet of the roof and driveway. You do not have to worry about the pitch of the roof. Use the roof area and not the floor area. They will be different on a multi-story house. Be sure to include the roof overhang in your calculations. Note the soil type that is consistent with the Sizing Table.

   Step 2. Select a trench depth between 2 and 5 feet. A deeper trench will result in a shorter trench. This could be an issue in a design where space is limited. A deep trench may not be possible in soils with a high ground water elevation. The bottom of the trench must be located at least 18 inches above the seasonal high groundwater or impermeable layer. You will also need at least 6 inches of topsoil over the top of the trench. As an example, if your site has an impermeable layer at 5 feet below the surface, the maximum trench depth possible is 3 feet. (6" cover + 3 feet of trench + 18" separation = 5 feet). Your Soils Professional can help with the trench depth selection.

   Step 3. Determine the required trench bottom area by using the information shown on the Sizing Table, see page 15. The table is divided into 5 infiltration rates ranging from 60 inches per hour to 1 inch per hour. After you have selected the correct portion of the table, locate the multiplier that applies to your site (from Step 2). As an example, if your site has a 4 inches per hour infiltration rate and a trench depth of 3 feet, the correct multiplier is 0.080.

   Step 4. Select a trench width. A wider trench will allow the trench length to be shorter. Selection of the trench width is one of personal choice. The amount of room available and ease of construction may be used in determining the best width for your site. The width of the trench should be between 2 feet and 4 feet.

Step 5. Calculate the length of the trench by multiplying the area (Step 1) by the multiplier (Step 3) and dividing by the trench width (Step 4). The resulting number is the length of the trench in feet. To complete our example, if we used a 2,000 square foot roof times a 0.080 multiplier divided by a 4-foot wide trench, the length would be 40 feet. Note: The trench length cannot exceed 100 feet from the inlet sump i.e. sediment control structure.

Step 6. Summarize the trench dimensions from steps 2, 4 and 5.

Step 7. If you are combining the roof runoff and the driveway runoff into a single trench, summarize dimensions from step 6. Add the trench lengths. In our example the lengths would be added, 40 feet for the roof and 18 feet for the driveway for a total combined trench length of 48 feet. The combined length must be less than 100 feet. See the section **The Trench** below, for more information.

Complete the final site plan (Figure 1) incorporating the final location of the infiltration system, house, driveway and septic/reserve area.

Driveway Runoff. The designer must consider runoff from the proposed driveway. The designer may choose to grade the proposed driveway towards a natural and/or landscape area in lieu of a separate infiltration trench. A fairly flat area (sloped at less than two percent) and good soils (infiltration rate 12 - 60 inches per hour) are required. Sufficient detail must be shown to demonstrate to the satisfaction of Pierce County that no runoff will leave the site. The County must pre approve discharge of driveway runoff to an off-site system. Driveway runoff and roof runoff can be collected into one system if necessary.

Sediment Control Structures. (See Figure 2) Sediment control structures are important for keeping debris out of the infiltration trench. The “T” with its screens keeps leaves, needles, twigs, roofing gravel, etc., from clogging the perforated pipe and/or the washed rock. Several different types of structures can be used. Generally, a concrete catch basin that has a depth of at least 4 feet is used. Some installations utilize a plastic structure. When choosing a concrete structure, consider using a Type 1, Type 30, Type 40 or a 24” diameter Type 45 catch basin. Plastic equivalents are acceptable. The inlet pipe (the one from the house) should be set at the same elevation as the outlet pipe. If the inlet is set above the outlet pipe the in-flowing water will splash and cause turbulence. This may suspend sediment and cause the suspended sediment to be deposited in the perforated pipe or washed rock.

The Trench. (See Figures 3, 4 and 5) Infiltration systems may be placed in fill material if the fill is placed and compacted under the direct supervision of geotechnical professional or professional engineer and if the measured infiltration rate is at least 8 inches per hour. Infiltration systems shall be a minimum of 50 feet from any slope steeper than 20% and greater than 10 feet high. Note: Slope setback distance may be reduced upon submission of geotechnical data but in no case less than the vertical height of the slope. Trench bottoms shall be a minimum of 18 inches above seasonal high groundwater or impermeable layer (hard pan). The end of the trench must be located within 100 feet of the sediment control structure. If your calculations show a trench longer than 100 feet, you will need to split it into two separate trenches. The elevation of both trenches must be the same to ensure equal distribution of flows. All infiltration trenches must be located downstream of the sediment control structure.

Soil Evaluation Reports. A soils professional (engineer, soil scientist, or septic designer) must be utilized to verify if on-site soils are adequate. A minimum of one soil log shall be obtained for each proposed infiltration system location. It shall extend a minimum of 18 inches below the bottom of the trench. Each soil log shall be show on a separate Soil Log Evaluation Form. A soils professional (engineer, soil scientist, or septic designer) must sign, date, and stamp the Soil Log Evaluation Report. Soil log locations need to be shown on the site plan. You must hire a civil engineer to design systems in areas with an infiltration rate slower than 1 inch per hour.

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INFILTRATION TRENCH DESIGN WORKSHEET

DESCRIPTION OF PROJECT:

The owner proposes to construct a 1,656 square foot house with a 900 square foot concrete driveway on a 14,000 square foot lot.

DESIGN:

Step 1. Determine the roof and driveway areas and check the soil group/infiltration rate design is based on. Check the soil group that applies to your site.

Building Area: 1,656 sq. ft. Roof Overhang: 2 feet

Roof Area: 2,000 sq. ft. (5,000 square foot maximum)

Driveway: 900 sq. ft. (5,000 square foot maximum)

Saturated Percolation Rate:

Γ 60 inches/hour

Γ 12 inches/hour

X 4 inches/hour

Γ 2 inches/hour

Γ 1 inches/hour

Step 2. Select a trench depth between 2 and 5 feet.

Roof trench depth = 3 ft.

Driveway trench depth = 3 ft.

Step 3. Select the correct trench bottom multiplier using the Sizing Table.

Roof multiplier = 0.080

Driveway multiplier = 0.080

Step 4. Select a trench width, the wider the trench (4 ft. max), the shorter the trench length.

Roof trench width = _____4_____ ft. (2' min. - 4' max.)

Driveway trench width = _____4_____ ft. (2' min. – 4' max.)

Step 5. Calculate the required trench length.

Trench length of the roof = roof area (Step 1) times the trench bottom multiplier (Step 3) divided by the trench width (Step 4).

___2,000___ sq. ft. x ___0.080___ (multiplier) / _____4____ ft. = ___40_____ ft.

Trench length of the driveway = driveway area (Step 1) times the trench bottom multiplier (Step 3) divided by the trench width (Step 4).

____900____ sq. ft. x ___0.080___ (multiplier) / _____4___ ft. = _____18____ ft.

Step 6. Summarize the trench dimensions:

Roof: _____3_____ ft. deep x _____4_____ ft. wide x _____40_____ ft. long

Driveway: ____3_____ ft. deep x _____4_____ ft. wide x ____18_____ ft. long

Step 7 (Optional). For a combined roof and driveway trench (5,000 square foot maximum), summarize the trench dimensions:

Roof & Driveway: _____ ft. deep x _____ ft. wide x _____ ft. long

The above design meets the minimum requirements for stormwater control in accordance with Ordinance 2008-59s, *2008 Pierce County Stormwater Management and Site Development Manual*.

_____ _____

Designer Name (print name) Date

_____ _____

Signature Registration No. (if applicable)

Sign, date, and stamp

SIZING TABLE

Saturated Infiltration Rate	Depth	Trench Bottom Multiplier
60 inches/hour	2’	0.024
	2.5’	0.022
	3’	0.019
	3.5’	0.018
	4’	0.017
	4.5’	0.016
	5’	0.015
12 inches/hour	2’	0.058
	2.5’	0.052
	3’	0.046
	3.5’	0.044
	4’	0.040
	4.5’	0.038
	5’	0.036
4 inches/hour	2’	0.101
	2.5’	0.090
	3’	0.080
	3.5’	0.076
	4’	0.072
	4.5’	0.066
	5’	0.063
2 inches/hour	2’	0.144
	2.5’	0.130
	3’	0.114
	3.5’	0.108
	4’	0.102
	4.5’	0.094
	5’	0.090
1 inch/hour	2’	0.206
	2.5’	0.184
	3’	0.163
	3.5’	0.153
	4’	0.146
	4.5’	0.135
	5’	0.129

SFR INFILTRATION SYSTEM
SOIL LOG EVALUATION REPORT

SOIL LOG NUMBER: Sheet ___ of ___
(Number shall match site plan)

1. SITE ADDRESS:

2. PARCEL NUMBER:
___ ___ ___ ___ ___ ___ - ___ ___ ___ ___

3. SITE DESCRIPTION:

4. LIST METHODS USED TO EXPOSE, SAMPLE AND TEST SOILS:

5. NUMBER OF TEST HOLES LOGGED:_____

6. SATURATED INFILTRATION RATE:
Inches / Hour

7. HAS FILL MATERIAL BEEN PLACED OVER THE PROPOSED INFILTRATION TRENCH AREA? NO YES

8. DEPTH TO SEASONAL HIGH WATER:

9. CURRENT WATER DEPTH:

10. DEPTH TO IMPERVIOUS LAYER:

11. PROFILE DESCRIPTION:

HORIZON (See Note 1)	DEPTH	TEXTURAL CLASS	MOTTLING	INDURATION

Note 1: Identify limits of any outwash type soils (i.e. those meeting USDA soil texture classes ranging from coarse sand and cobbles to medium sand.

I hereby state that I prepared this report, and conducted or supervised the performance of related work. I state that I am qualified to do this work. I represent my work to be complete and accurate within the bounds of uncertainty inherent to the practice of soil science, and to be suitable for its intended use.

SIGNED: _____

DATE: _____ LICENSED STAMP: _____
(Sign & Date)

SOIL EVALUATION REPORT INSTRUCTIONS

The following instructions should give you the guidance needed to complete the form:

1. Provide site address, include house number and street name.

2. Note 10-digit parcel number.

3. Describe site topography and natural cover.

4. List methods used to expose, sample, and test soils.

5. Note number of test holes logged.

6. Describe the saturated percolation rate for the infiltration trench.

7. Indicate whether fill material has been placed over the infiltration trench area. Circle the correct response. Designs placed in fill material must be prepared by a Professional Engineer.

8. Indicate seasonal high water table depth based upon the presence of mottling, or other evidence. If information available is inadequate, state value to be "greater than" the bottom of the hole depth.

9. Indicate current water table depth based upon observation. If saturated conditions are not observed, state value to be "greater than" bottom of hole depth.

10. Indicate depth to impervious layer (e.g., basal till). If information is inadequate, state value to be "greater than" bottom of hole depth.

11. The profile description provides the minimum information on the physical attributes of the soil. All information provided for the profile shall utilize standard SCS nomenclature and abbreviations. The following are the factors to be addressed, with brief examples of acceptable responses. Further information on most of these is provided in the SCS *Soil Survey of Pierce County.* Use additional sheets if necessary. Identify limits of any outwash type soils (i.e. those meeting USDA soil texture classes ranging from coarse sand and cobbles to medium sand.

    a. Horizon: A layer of soil with distinct characteristics, labeled A, AB, B, C, Ccw, etc.
    b. Depth: Starting at 0" (surface), depth and interval of horizon.
    c. Textural class: Class that best describes relative percentages of sand, silt, and clay in horizon, such as sandy loam (SL).
    d. Mottling: Where present, describe using three-letter abbreviation to indicate abundance, size, and contrast, such as CFD (common, fine, distinct).
    g. Induration: Physical compaction of a layer such as a glacial till. Where present, describe as weak, mod(erate), or str(ong).

Sign and date the form and affix any relevant professional seal (e.g., P.E., ARCPACS).

HOW TO TELL IF YOUR SYSTEM IS WORKING PROPERLY

The simple answer is that if you put water in, and it goes away, it's probably working. For the most part, the first statement is correct. Here are several things to check to get a better idea of if the system is working:

- Is water bubbling out of the connection where the downspout connects to the drain line? If it is, the screens may be clogged, the infiltration trench may be clogged or a pipe may be plugged or broken. Check and clean the screens if necessary. If the screens are clean, check to see that the pipes from the downspout to the sediment control structure are clear. A plumber's "snake" or garden hose may be helpful to check and/or clean out the pipe.

- If you have a catch basin located in the driveway, is it backed up? Check to make sure the catch basin outlet is not clogged. Also check to make sure that the pipe from the catch basin to the sediment control structure is clear.

- Are the screens and pipe leading to the sediment control structure clean and clear? Check the perforated pipe in the infiltration trench. Is it clogged?

- So far nothing is clogged, but the system will not drain. Try digging a hole about 1 or 2 feet away from the edge of the trench, at about the midpoint. Dig it as deep as the infiltration trench. If it is full of water as you dig, you may have a high groundwater problem. Contact an engineer for further advice.

THE CARE AND FEEDING OF AN INFILTRATION SYSTEM

If an infiltration system is not properly maintained, it can fail after a few short years. When properly maintained, they can function for 20 to 50 years. The most important thing is to prevent anything other than clean water from entering the trench portion of the system. Leaves, fir needles, grass clippings, plastic bags, toys, oil/grease, mud, roofing gravel, etc., can clog a system and necessitate costly repairs or replacement of the system. The following is a list of hints to keep your system in good working order:

- Inspect the sediment control structure several times a year. The most important time is in the fall before the heavy rains of winter begin. If there is less than 6 inches of clearance between the debris and the bottom of the outlet tee, clean the sump. A wet/dry shop vacuum may be useful as a cleaning device. See Figure 6.

- Clean and inspect both screens. Replace corroded and/or damaged screens as necessary.

- Clean gutters several times a year. Do not flush debris into the system with a hose. Clean out gutters with a plastic scoop or shop vacuum.

- Sweep driveways with a broom several times a year. Do not flush debris into the system with a hose.