Pipeline

Spring 2000
Vol. 11, No. 2

National Small Flows Clearinghouse

Small Community Wastewater Issues Explained to the Public

SITE EVALUATIONS

You've decided on the perfect home design, located property, and initiated plans with a building contractor. But before you can begin any construction on a new home, you must address water and sewage disposal first.

Homes built in areas with public water and sewage merely need to hook into the water and sewage systems. However, when people choose to build in areas outside the reach of public systems, tapping into a water source and planning for onsite wastewater disposal must be arranged before dreams of a home can become a reality.

A site evaluation is the first step toward installing an appropriate wastewater disposal system. Site evaluations determine the characteristics of the building site and the soil's ability to treat and dispose of wastewater.

A good site evaluation provides enough information about the area to install the correct system from the possible options. While most or all of this work will be done by the site evaluator, the landowner benefits from understanding the process.

Ordinarily, a septic tank followed by a conventional subsurface soil absorption system is the preferred treatment and disposal method. Soil has a considerable capacity to transform and recycle wastewater. This method of treatment is reliable and the least expensive disposal option. However, if soils are found to be unsuitable (shallow depth to bedrock or a high groundwater table), then other treatment and disposal methods must be considered. *(See figure 1 on page 2.)*

The site evaluation entails gathering detailed information about the lot and the surrounding area. This information should include the physical properties of the soil, how existing water is distributed and moves in the soil, the depth to an underground limiting layer, and other conditions that describe whether wastewater treatment and disposal by the soil is possible.

More than one-fourth of Americans use some type of onsite wastewater treatment system, and thousands of new onsite permits are issued each year. With that many onsite systems in use, site evaluations continue to be the best way to make sure that wastewater leaving a house won't pollute groundwater or surface water.

This issue of *Pipeline* explains the importance of a site evaluation and how the testing determines the type of onsite system that is appropriate for a particular site. Who performs the evaluation, what steps are taken in the process (including the percolation test), and how the evaluator uses the test results are detailed in the following pages. This *Pipeline* is not intended to serve as a comprehensive guide to conducting a site and/or soil evaluation, but serves as an overview to give the public insight into the process.

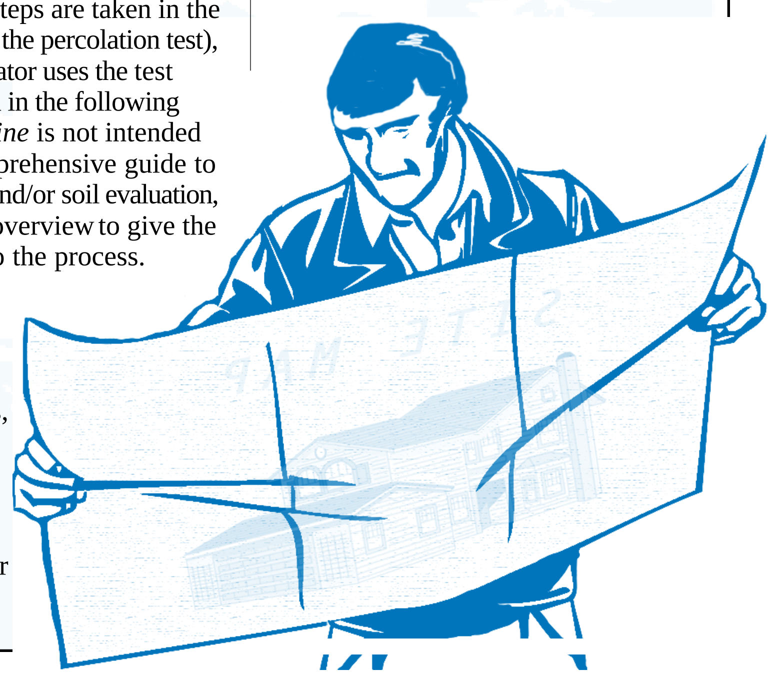
Readers are encouraged to reprint *Pipeline* articles in local newspapers, flyers, newsletters, or educational presentations. Please include the name and phone number of the National Small Flows Clearinghouse (NSFC) on your reprint and send us a copy.

If you have any questions about reprinting articles or about any of the topics discussed in the newsletter, please contact the NSFC at (800) 624-8301 or (304) 293-4191.

Helpful tips to prepare for a site evaluation:

- Remove heavy brush or plant undergrowth blocking:
  (1) the view of proposed buildings or drainfield locations and
  (2) the view of your lot's position with neighboring lots.
- Clearly mark your property lines.
- Clearly mark your proposed house location.

From the Virginia Department of Health



Planning for an Onsite System

Preliminary site evaluation

Following the application process, whereby a landowner files for an onsite system permit with the local health department or other local permitting agency, a representative of the organization begins working with the landowner to produce a preliminary evaluation.

The evaluator examines any published maps or reports that include data about soils, geology, and the topography of the area. Records of local soil tests, successful onsite system designs, and reported problems with existing onsite systems in the area are reviewed.

This local information reveals general land features and potential issues that should be investigated when planning an onsite system. Adiagram (plot plan) of the building lot and the properties adjacent to it should be drawn to a scale that is large enough to display the information gathered in this and later steps. All existing buildings and other man-made features need to be included in the drawing.

Soil surveys outline an area

The National Resource Conservation Service (formerly known as the U.S. Soil Conservation Service) and the state's geological survey office keep soil surveys. These surveys consist of aerial photographs of the mapped area (most often a county) that note the types and distribution of soils, plus the potential use of each soil, whether for farming, woodlands, recreation, engineering uses, or other nonfarm practices. Usually drawn to a scale of four inches to one mile, the surveys include a detailed description of each soil series (those with similar characteristics) found in the area.

Map symbols give the names of the soil series, slope, and degree of erosion. Atwo-letter symbol (the first upper case and the second lower case) represents the soil series name. An upper case letter, ranging from A(for flat) through F (for steep), indicates the slope of the land. Slightly eroded to severely eroded classes of soil are noted by numbers from one (the least eroded) to three (most eroded).

Tables in the text of the survey list possible uses for each soil series. How suitable the soil may be for subsurface absorption systems is shown, as are engineering properties, including depth to bedrock, seasonally high water tables, percolation rates and shrink-swell potential of the soils, and drainage potentials. Profile descriptions of each mapping unit also discuss possible flooding hazards.

These soil surveys provide good information to start the evaluation process, however they cannot be substituted for a field study of the actual property and surrounding areas. Surveys do not show enough detail to replace onsite testing.

Soil test reports and records of failed local onsite systems also may provide helpful insights. Soil tests show soil types and the differences that may exist in a particular area. This initial information indicates what to expect when the actual field evaluation takes place. Governing agencies, such as the local

BOX 1 **BOX 2** **BOX 3**

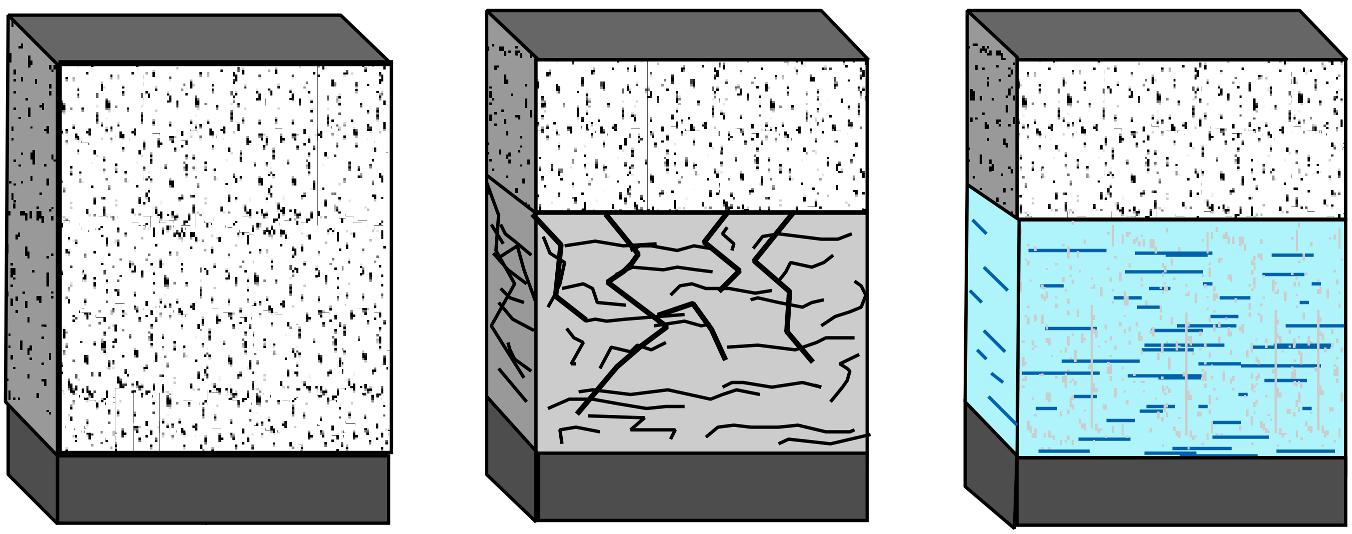


FIGURE 1

These three types of subsurface conditions show ideal to unsuitable soils for treating wastewater with a conventional onsite system. **Box 1** shows ideal conditions: adequate soil depth before a limiting layer causes lateral movement of water. **Box 2** shows fractured bedrock that could allow partially treated wastewater to mingle with groundwater. **Box 3** shows conditions where a high water table would also allow wastewater and groundwater to mix.

health department, often have records of onsite system failures that may help the evaluator determine which type of onsite system might be suitable for the area.

Field testing provides the most information

The most valuable information for siting an onsite system is gathered through testing the soil and drainage conditions on the parcel of land itself.

When evaluators first visit a site, they begin by looking around the property and determining areas that appear suitable for a subsurface soil absorption system. They consider land features like slopes, rock outcrops, watercourses, surface drainage paths, traffic areas, and the types of existing natural vegetation.

They will note low spots, gullies, steep areas, surface puddling, roads, buildings, and other visible factors. The evaluator checks for compacted areas on the property, such as places that might indicate an old road bed. Compaction renders the ground unsuitable for adequate absorption. Also, an onsite system cannot be built on any part of the lot at risk for flooding. As a preliminary indicator, soil borings using a hand auger or a soil probe help in assessing the soil's characteristics.

Size and species of vegetation growing on the land provide helpful information about soil conditions. A soil's depth and drainage affect whether certain plants will grow, so the evaluator identifies plants in the vicinity of the proposed drainfield and determines their growing conditions. Large tree roots can interfere with a conventional system's performance, and therefore some trees may need to be removed to allow for the drainfield.

Landscape contour and subsurface drainage

The slope of a lot affects how well an onsite disposal system operates. Measuring slope is important because knowing the land form and landscape contour at the site helps the evaluator estimate surface and subsurface drainage patterns. Hill tops, ridge lines, and side slopes ordinarily have good drainage above and below ground. Low spots (depressions) and foot slopes are likely to have poor drainage. *(See figure 2 for landscape contours.)*

The type and degree of slope can indicate what surface drainage problems may occur. Convex (outcurving) slopes allow for run-off of rain, and concave (incurving) slopes may catch and hold water.

Wastewater (and precipitation) flowing into the subsoil eventually leaves the absorption field. The water may travel vertically downward for a few feet ultimately reaching the water table. At this point, both existing groundwater and effluent will move laterally in the direction of the slope of the water table or the hydraulic gradient. Normally this gradient is parallel to the ground surface. Where the water table breaks the surface, typically at the bottom of a slope, it may form a spring or become the source of a pond or lake.

Groundwater moving beneath the lot also influences the performance of the onsite system. A flat lot in a flat landscape, such as in a floodplain, is perhaps not an ideal location for effluent dispersal. Little hydraulic gradient exists to move the groundwater from the site, resulting in a water table that is already near the surface, leaving little capacity for additional effluent.

A moderate grade of five to 15 percent presents the ideal situation: enough slope exists to move the effluent away at a reasonable depth below the surface; basement plumbing can readily be serviced; and a gravity flow system can

continued on page 4

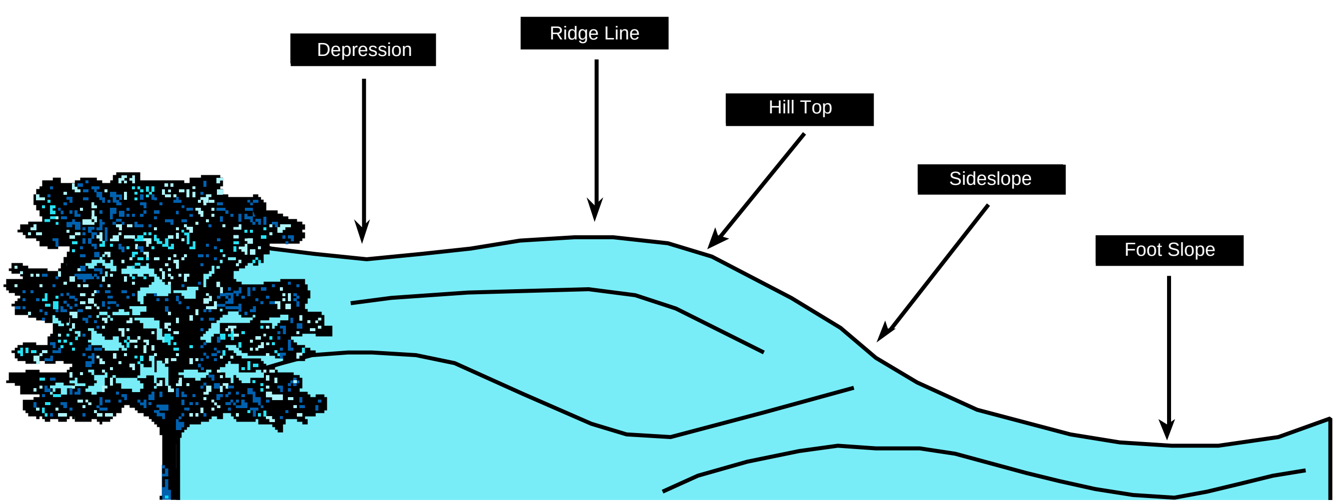


FIGURE 2 Landscape contours help estimate surface and subsurface drainage patterns. Hilltops and side slopes drain well, whereas depressions and foot slopes drain poorly.

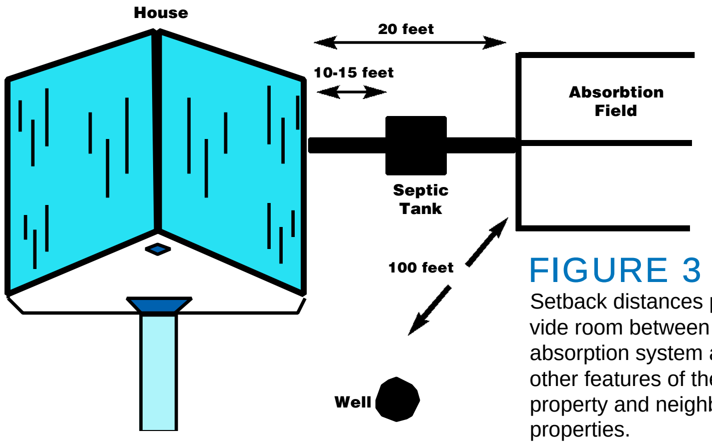


FIGURE 3
Setback distances provide room between the absorption system and other features of the property and neighbors' properties.

continued from page 3

be used so pumping won't be required.

Steeper grades of 15 to 25 percent present more of a construction challenge. These systems can be designed to prevent breakout at the surface by following natural contours and distributing effluent along and between the absorption field trenches.

Rock outcrops signal minimal soil cover over bedrock. When locating an onsite system, avoid these areas because untreated effluent entering fractured bedrock can contaminate wells located hundreds of feet away.

In addition to the previous surface features, horizontal setbacks must be considered. *(See figure 3 above for typical setback distances.)* These setbacks maintain specified distances between the soil absorption field and wells, surface waters, buildings, and property lines. Required setback distances, which differ from state to state, can usually be found in state and/or local regulatory codes.

Soil tests yield more information

Once evaluators visually determine a potential location for an onsite system, they perform a detailed assessment of soil characteristics. This process can best be accomplished by digging a pit (or pits) within the perimeter of the proposed absorption area. (*Contact local utilities before any digging to prevent cutting underground lines.*) An experienced evaluator can possibly perform the soil inspection adequately using a hand auger or probe. However, to be thorough, both methods (soil borings and test pits) are usually employed.

Each pit is excavated to a minimum depth of four feet below the estimated depth of the intended disposal system. The hole must be wide enough to allow natural sunlight to shine directly on the exposed face of the pit wall. To prevent cave-in accidents, the evaluator may take samples from the soil in the backhoe's bucket and inspect the sides of the hole from ground level instead of climbing down into the hole. (*Safety note: the wall of any pit dug four feet deep or more must be shored [supported] if people will be entering the confined space.*)

The pits must be deep enough for the evaluator to determine that enough depth of unsaturated soil (as specified in local governing regulations) exists below the proposed bottom of the absorption area. If the evaluator finds several different soil conditions, more pits may need to be dug.

What does the evaluator look for in the soil?

The evaluator will look at soil texture, soil structure, and soil color. As far as water movement within the soil is concerned, the evaluator determines any seasonal soil saturation, the soil's hydraulic conductivity (the measured rate that water moves through soil), and the soil's potential evaporation capabilities in the event that an evapotranspiration system might need to be used. (Refer to the winter 2000 *Pipeline* issue on evapotranspiration systems.)

Soil texture

Soil texture relates to pore size, pore size distribution and pore continuity. Simply put, texture indicates the various sizes of solid particles in the soil and the proportion of spaces that exist between those particles.

Soils are classified from sandy to sandy loam, loam, silt loam, clay loam, and clay. Sand has the largest particles, and clay has the smallest.

Different classes of soil have different textures. Soil with a high proportion of sand, for instance, is loose, and has single grains that feel gritty. If a dry, sandy soil ball is squeezed in the hand, the mass falls apart when the pressure is released.

Water flows between soil particles, not through them. In most cases, the larger the particles, as with sand, the more quickly water moves through the soil. Soil with a high degree of mixed particles filters out most bacteria, viruses, and other potential disease-causing organisms (pathogens) from effluent. The number of feet of soil beneath the drain bed determines how thoroughly the effluent is treated. This layer of soil acts as a hostile environment to pathogens, greatly reducing their numbers over time.

The evaluator observes the pit's sidewalls in bright, natural daylight. Sidewalls should display obvious texture changes in the different layers of soil, which are called "horizons." The evaluator marks and records depth, thickness, and texture of each horizon.

Soil structure

Structure pertains to how the soil particles group themselves into clusters called "peds." The individual peds are loosely joined but have surfaces of weakness. These weak planes, which open as pores between the peds, are often seen as cracks in the soil.

A soil's structure strongly helps absorb and move water. Well-structured soils with large spaces between peds transmit water more quickly than structureless soils of the same texture, especially if the soil is dry. Conse-

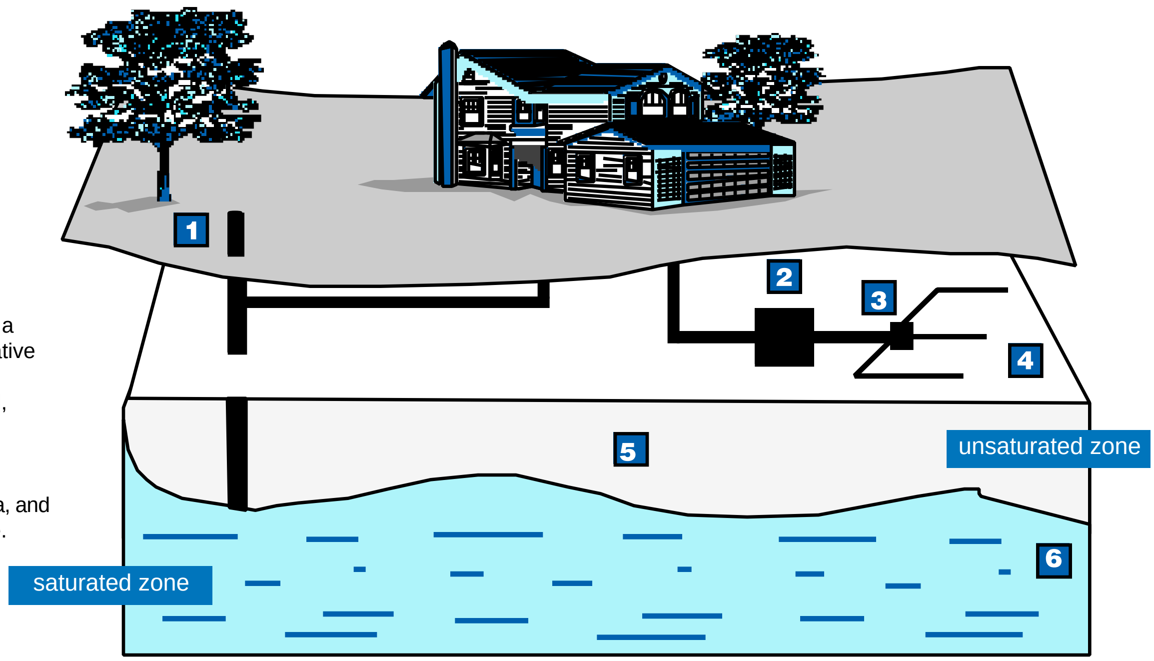


FIGURE 4
An expanded view of a property showing relative positions for the
(1) drinking water well,
(2) septic tank,
(3) distribution box,
(4) absorption field,
(5) soil absorption area, and
(6) groundwater table.

quently, water percolates very slowly through fine-textured, "massive'' soils with little structure, such as clay or clay loam.

Because structure can significantly affect water movement through soil, the evaluator may need detailed descriptions of structure.

Soil properties and water movement

A soil's physical properties, the location of a plot of ground in the landscape, and climate all influence how water moves in the soil. *(See figure 4 for positioning a conventional soil absorption system.)* Color and color patterns also reveal whether soil drains sufficiently. Interpreting color helps to identify conditions where soils drain well or where soils remain saturated, affecting that tract of land's ability to absorb and treat wastewater. Again, soil must be examined in bright daylight, not under artificial light, to show true color.

Dark colored—brown or reddish—soils indicate good drainage. Gray coloring indicates poorly drained soil. "Mottling''refers to spots of color often intermingled with gray. This characteristic may indicate seasonally saturated soils. Soil borings made during wet seasons of the year can show whether or not the ground remains saturated.

Observation wells may help determine if drainage problems exist within the proposed absorption field. The evaluator digs these wells into the soil level (horizon) with suspected drainage problems, and monitors the wells for standing water over the course of a normal wet season. If water remains in a well for several days, a conventional onsite system will not function properly in that location. Then, other locations or treatment and disposal options need to be investigated.

A soil's bulk density, or the volume of a mass of dry soil plus its air spaces, indicates porosity and water movement. Soils with high bulk density are less porous and less permeable. For instance, clay soils have high bulk density. Their minute particles are tightly packed with minimal air spaces between them. Clays that swell when they become wet seal off soil pores further and, thus, can virtually stop the flow of water.

This wet condition interferes with effluent moving from the absorption field into the natural soils. During saturated periods, water will not flow as it does when unsaturated. Instead, the water may puddle on the ground's surface above the soil absorption system or back up into the house.

What a site evaluation means to you

The goal of a site evaluation is simple even though the process may seem fairly complex. The evaluator comes to the property, observes site conditions, tests the soils, and determines from the results what onsite system may be most appropriate.

All of this investigating and testing leads to an assurance that a conventional onsite system will adequately treat and dispose of wastewater. If the testing indicates that a conventional soil absorption system won't work, proven alternative systems exist. *(The NSFC offers information about a number of alternative onsite systems that may be helpful. Check the resources on page 8.)*

Once the site evaluation is completed, a builder has the go-ahead to excavate for the onsite system and the house. These initial excavations of home building, plus locating a source of drinking water, compose the basis forthe eventual property development.

During construction, heavy equipment *must* not be parked or driven over the area where the onsite system will be located.

As a builder or property owner, the site evaluation will help you feel confident that your onsite system's location won't allow polluting substances to make their way from your home into any of the area's clean water supplies.

Percolation testing for soil drainage evaluation

You've probably heard of a percolation test, or "perc test''as it is commonly called. *(See figure 5 below.)* But what is this test, and how is it used in the process of installing an onsite system?

The theory behind the percolation test is that the rate of water absorbing into the soil of an excavated test hole relates to the amount of water flowing through an onsite system and to how rapidly the system's soil absorbs it. Results of the test are used to help determine if a site can accept an onsite system and the size that the absorption area needs to be.

The "perc" test procedure

Evaluators usually set up three percolation tests spaced uniformly within the proposed absorption area. If the results vary widely, more testing may be needed.

Under one protocol, six-inch diameter test holes are dug or bored to the depth at which the absorption system is to be placed or to the most limiting soil horizon. The sides of the hole need to be roughened to expose the natural soil surface. Loose soil is removed and two inches of one half- to three-quarter-inch gravel is placed in the bottom of the hole to prevent scouring when the water is added.

The hole is filled with at least 12 inches of clear water. This depth is maintained for at least four hours and longer if clay soil is predominant. Soaking helps to saturate the soil, causing it to swell, and leading to more accurate results.

Sandy soils with little or no clay won't need to be soaked. If after the evaluator fills the hole twice with 12 inches of water, and the water seeps away in less than 10 minutes each time, he or she will proceed immediately with the test.

Except in sandy soils, percolation rate measurements are made for at least 15 hours, but no more than 30 hours, after the soaking period begins. Any soil that falls down to the bottom of the hole needs to be removed, and the water level adjusted to six inches above the gravel (or eight inches above the bottom of the hole). The water level must not rise more than six inches above the gravel.

After these adjustments, the water level is measured from a fixed reference point to the nearest one-sixteenth inch at 30-minute intervals. The test continues until two successive water level drops do not vary by more than one-sixteenth inch. At least three measurements are taken. After each one, the water level is readjusted to the six-inch level.

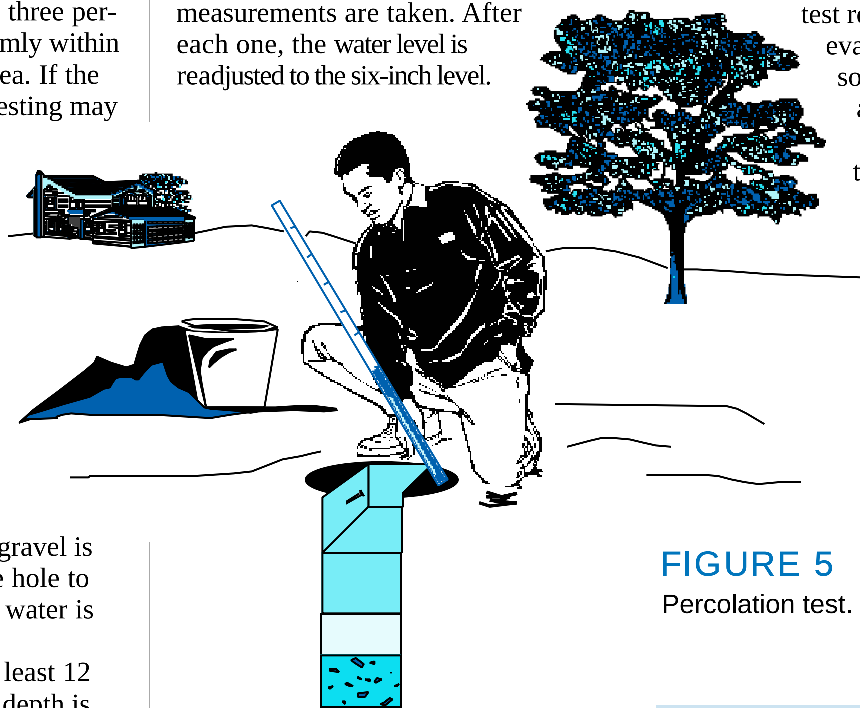


FIGURE 5
Percolation test.

The last water level drop is used to calculate the percolation rate.

The results

Water level measurements are made at 10-minute intervals for one hour in sandy soils or in soils where the first six inches of water added after the soaking period seeps away in less than 30 minutes. The last water level drop is used to calculate the percolation rate.

This calculation of minutes per inch is made for each test hole by dividing the time interval used between measurements by the magnitude of the last water level drop. To determine the percolation rate for the area, the rates obtained from each hole are averaged. If tests vary by more than 20 minutes per inch, soil types may be significantly different throughout the area. Therefore, percolation rates should not be averaged, and additional tests may be necessary.

The percolation test may produce widely varying results depending on the soil's present condition and is best used along with soil boring test results. Detailed soil evaluations and more sophisticated permeability tests are replacing percolation tests in many states because they are more accurate and reliable.

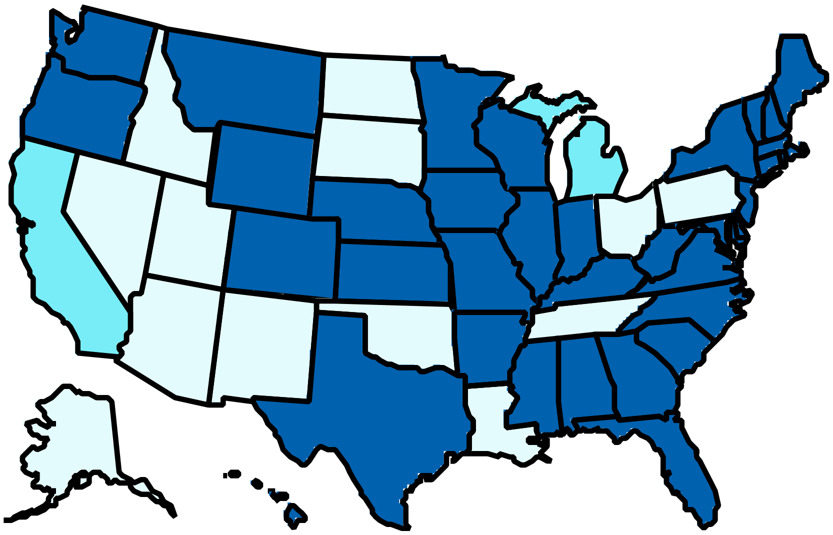
Correction

The Fall 1999 issue of *Pipeline* included a column called "Funding Expert Offers Advice'' from Donald Roecker, P.E. Roecker's consulting business'location was incorrectly listed. He operates from Plymouth, Wisconsin, rather than Sheboygan.

You may contact Roecker at (920) 893-8877 or *roecker@compuserve.com* for information about funding issues.

State Level Onsite Regulations/Codes

Many states suggest, and some require, that site evaluations be performed before installing onsite treatment and disposal systems.



site evaluations discussed within state regulations
site evaluations not discussed within state regulations
information not available

Suggested Site Evaluation Procedures

Step	Data Collected
Property owner contacts health department	• Location and description of lot • Intended land use • Volume and characteristics of wastewater
Preliminary evaluation	• Resource information (soil maps, geology, topography) • Records of onsite systems in the area
Field testing of site	• Topography and landscape features • Soil profile characteristics • Hydraulic conductivity of the soil
Other site characteristics	• Site suitability for evaporation or discharge to surface waters (if needed)
Organization of field information	• Compile all collected data

CONTACTS

National Small Flows Clearinghouse (NSFC)

The NSFC offers technical assistance and a variety of free and low-cost publications and materials about wastewater technologies for small communities. Just a few of the NSFC's many resources and services are mentioned in this newsletter. Call the NSFC at (800) 624-8301 or (304) 293-4191 or visit our Web site at *www.nsfc.wvu.edu* for more information.

Extension Service Offices

Land grant universities have U.S. Department of Agriculture (USDA) Extension Service offices on campus and in other locations that provide many services and assistance to small communities. For the number of the extension office in your area, check the government pages of your local phone directory, contact the NSFC at the number listed above, or call the USDA directly at (202) 720-3377.

State and Local Health Departments

Homeowners and residents of small communities who need to have a site evaluation or information about wastewater systems should contact their state or local health department for more information about regulations and requirements. These agencies are usually listed in the government section of local phone directories.

Free State Regulatory Contacts

A list of contacts is free from the NSFC and lists the name, department, address, and phone number of a contact for each state that has onsite wastewater regulations. To order, request item #WWBLRG34. A shipping and handling charge may apply. (Refer to page 8 for more information about ordering NSFC products, including NSFC's guides to state onsite regulations.)

RESOURCES AVAILABLE FROM NSFC

To order any of the following products, call the National Small Flows Clearinghouse (NSFC) at (800) 624-8301 or (304) 293-4191, fax (304) 293-3161, e-mail nsfc_orders@mail.estd.wvu.edu, *or write to NSFC, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Be sure to request each item by number and title. A shipping and handling charge will apply.*

New Homeowner Recordkeeping Folder

The NSFC has developed a method to help homeowners keep track of information related to their onsite systems. The "Homeowner Onsite System Recordkeeping Folder'' includes sections for recording permit and local health department information, a checklist for information about different system components and accessories, a place to record household information, and a grid for sketching the layout of the system. The price of the folder is $0.40. Item #WWBLPE37.

Site Evaluation for Onsite Treatment and Disposal Systems

This semi-technical report discusses critical site and soil characteristics, the use of soil surveys, and necessary equipment. Factors affecting the percolation test are also covered. The price of the design manual is $5.65. Item #WWBLDM12.

Site Evaluation Technology Package

This book contains several discussions about how site evaluations and soil testing can determine whether a traditional drainfield or an alternative system should be installed in a particular situation. The price of the book is $13.95. Item #WWBKGN83.

Onsite Wastewater Treatment and Disposal Systems

Published by the U.S. Environmental Protection Agency, this 432-page design manual contains important technical information about site evaluation procedures, characteristics of wastewater, different treatment and disposal methods, and management of onsite systems. The price is $45. Item #WWBKDM35.

Site Evaluations and Inspections

NSFC technical assistance specialists have compiled information about regulations governing site evaluations and onsite wastewater inspections from each state in these regionally divided documents. Southeast—Item #WWBKRG60, $11.25; Southwest—Item #WWBKRG61, $4.35; Northwest—Item #WWBKRG62, $4.50; and Northeast—Item #WWBKRG63, $13.20.

Guide to State-Level Onsite Regulations

This newly updated NSFC publication is a guide to state onsite system regulations. The guide includes a glossary, citations from state regulations, state regulatory contacts, a matrix (chart) showing which states address particular onsite issues and technologies in their state regulations, and a list of additional resources. The price is $12.50. Item #WWBKRG01.

PIPELINE

NATIONAL SMALL FLOWS CLEARINGHOUSE

Pipeline is published quarterly by the National Small Flows Clearinghouse at West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064

Pipeline is funded through a grant from the
U.S. Environmental Protection Agency
Washington D.C.
Steve Hogye—*Project Officer*
Municipal Support Division
Office of Wastewater Management

National Small Flows Clearinghouse
West Virginia University
Morgantown,WV
Peter Casey—*Program Coordinator*
Michelle Moore—*Editor*
Michelle Sanders—*Graphic Designer*
Jennifer Hause—*Technical Advisor*

Permission to quote from or reproduce articles in this publication is granted when due acknowledgement is given. Please send a copy of the publication in which information was used to the *Pipeline* editor at the address above.

West Virginia University
an equal opportunity/affirmative action institution

ISSN 1060-0043

National Small Flows Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064
ADDRESS SERVICE REQUESTED