Pipeline

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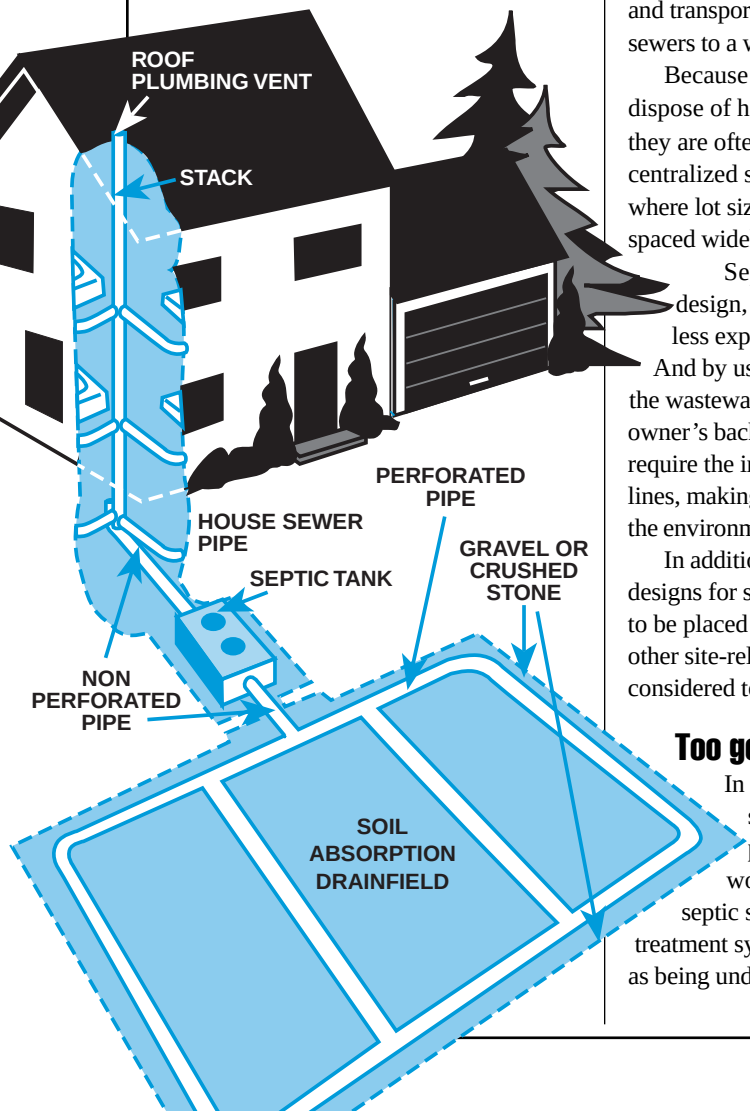
NATIONAL SMALL FLOWS CLEARINGHOUSE

Small Community Wastewater Issues Explained to the Public

Septic Systems—a practical alternative for small communities

Are you the proud owner of a septic system? If so, you're in good company. Nearly one out of every four homes in the U.S. relies on some form of septic system to treat and dispose of household wastewater. When properly designed, installed, and maintained, septic systems can be the most cost-effective and efficient method of wastewater treatment a homeowner can choose.



A septic system is an especially good alternative for homeowners in many small and rural communities. In these communities, the cost per household of installing, maintaining, and operating a conventional sewer system is usually higher because the population is smaller. (A conventional sewer system is the type of centralized wastewater collection and treatment system used by most U.S. communities. Wastewater is collected from individual households and transported through a network of sewers to a wastewater treatment plant.)

Because septic systems treat and dispose of household wastewater onsite, they are often more economical than centralized sewer systems in rural areas where lot sizes are larger and houses are spaced widely apart.

Septic systems are also simple in design, which make them generally less expensive to install and maintain. And by using natural processes to treat the wastewater onsite, usually in a homeowner's backyard, septic systems don't require the installation of miles of sewer lines, making them less disruptive to the environment.

In addition, there are many innovative designs for septic systems that allow them to be placed in areas with shallow soils or other site-related conditions previously considered to be unsuitable.

Too good to be true?

In spite of these facts, septic systems suffer from an image problem. Many people who would be better served by a septic system than a centralized treatment system still think of septic tanks as being undependable, old-fashioned, or as a temporary solution until a conventional sewer system can be built.

Part of the blame for the poor reputation of septic systems can be traced to the popularity of conventional sewer systems in the 1960s and early 1970s, when more government funding was available to install and maintain large, complex systems. Many communities weren't informed about possible alternatives and, therefore, didn't consider more cost-effective or appropriate technologies like septic systems. And engineers, local officials, and community residents sometimes may be easily impressed by more high-tech solutions to problems. Septic systems may be overlooked as a solution in some cases because they are such a simple technology.

Pollution of local groundwater, lakes, and streams due to septic system failures is also responsible for their unpopularity in some communities. The U.S. Environmental Protection Agency (EPA) has identified failing septic systems as a major source of groundwater pollution in some areas. However, most of these failures can be attributed to old systems with poor design,

ADVANTAGES OF SEPTIC SYSTEMS

- Simple and effective wastewater treatment
- Less disruptive to the environment to install and maintain
- Less expensive to operate than centralized treatment facilities
- Provide wastewater treatment in areas where it would not be available otherwise
- When functioning properly, can help replenish groundwater

Continued on page 2

Are septic systems right for my community?

When planning cost-effective wastewater treatment, homeowners and community leaders should work together to identify the needs of residents and other potential users of a system, such as schools, businesses, and industry. It is also important to evaluate factors such as the amount of money available for financing, regulations, and the performance of existing wastewater facilities and any needed repairs, expansion, or replacement.

Communities may decide that using a combination of technologies is the most effective way to fulfill the needs and goals of the entire community. Many small and rural communities use septic systems in less densely populated areas and cluster or community treatment systems where there are more users or smaller lot sizes.

The National Small Flows Clearinghouse (NSFC) offers information and technical assistance for small communities and homeowners planning or installing individual or commmunity wastewater treatment systems. Some of the resources available are listed throughout this newsletter and on page 8. *To order products or to request further assistance, call the NSFC at (800) 624-8301.*

Approximately one out of every four homes in the U.S. uses an onsite system to treat household wastewater.

HOW COMMON ARE SEPTIC TANKS?

According to the 1990 U.S. Census, there are approximately 24.7 million households across the U.S. that use septic tank systems or cesspools (holes or pits for receiving sewage) for wastewater treatment. This figure represents roughly 24 percent of the total households included in the census. Roughly half of the households in Vermont, Maine, New Hampshire, and North Carolina use septic systems or cesspools.

According to a review of local health department information by the National Small Flows Clearinghouse, 94 percent of participating health departments allow or permit the use of septic tank and soil absorption systems. Those that do not allow septic systems have sewer lines available to all residents.

The total volume of waste disposed of through septic systems is over one trillion gallons per year, according to a study conducted by the U.S. Environmental Protection Agency's Office of Technology Assessment, and virtually all of that waste is discharged directly to the subsurface, which affects groundwater quality.

Septic Systems — *continued from page 1*

poor maintenance, poor installation, or inadequate site evaluations before installation.

In the past, a lack of adequate regulations for septic system design, construction, and installation also contributed to septic system failures. With education, most problems with septic systems can be avoided. Education can lead to the proper operation and maintenance of septic systems or the possible rehabilitation of failing systems.

This issue of *Pipeline* presents some basic information about septic tank systems, how they work, and where homeowners and community leaders can find further information and assistance.

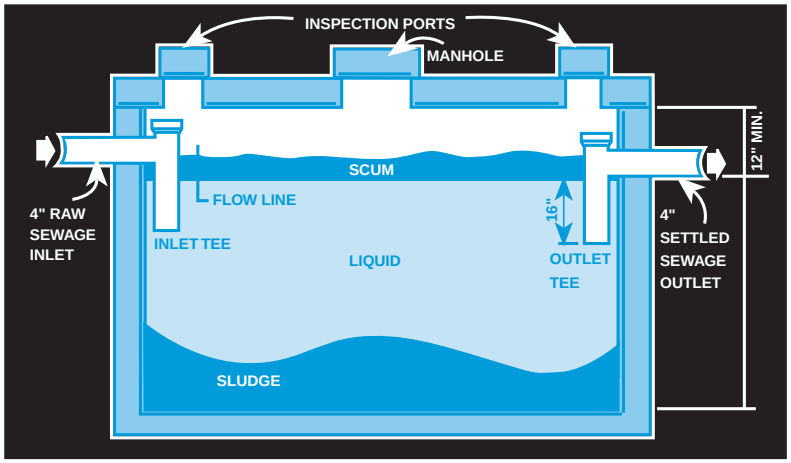
The fall issue of *Pipeline* will cover the care and maintenance of septic systems in detail, including important tips for homeowners who want to ensure the success and longevity of their systems.

You are encouraged to share, copy, or distribute any information in *Pipeline* with others in your community. The articles can also be reprinted in local newspapers or included in flyers and newsletters. We only ask that you send us a copy of the reprinted article for our files. *If you have any questions or require further information about any of the topics in this newsletter, please contact the National Small Flows Clearinghouse at (800) 624-8301.*

IN THIS ISSUE

How Septic Systems Work

Septic systems are wastewater treatment systems that collect, treat, and dispose of wastewater generated by homes or businesses. The wastewater is treated onsite, rather than collected and transported to a centralized community wastewater treatment plant. If properly designed, installed, and maintained, a septic tank system can effectively treat household wastewater for up to 20 years or more.



There are several variations of the basic septic system design in use today. While many systems are individually designed or adapted for a specific site, most work using the same basic principles.

A septic system consists of two main parts—a *septic tank* and a *drainfield*, also known as a leachfield, disposal field, or a soil absorption system. The entire system is connected by pipes, and a sewer pipe connects the home or business to the septic system.

The Septic Tank

The main function of the septic tank is to collect household wastewater, which includes water from the toilet, referred to as blackwater, and water from the bathtub, showers, sinks, and laundry, which is known collectively as graywater. The septic tank treats the wastewater naturally by holding it in the tank long enough for solids and liquids to separate.

Treatment begins when the household wastewater flows from the home to the septic tank through the sewer pipe. A baffle (an internal flap) or tee (a T-shaped pipe) at the inlet slows the flow of wastewater going into the tank and directs it downward toward the middle of the tank. The wastewater is then retained for a day or more in the tank to allow the solids in the wastewater to separate from the liquids.

Inside the tank, solids lighter than water—such as greases, oils, and, sometimes, other solid materials like toilet paper—float to the top forming a layer of scum. Solids heavier than water settle at the bottom of the tank forming a layer of sludge. This leaves a middle layer of partially clarified wastewater.

An outlet baffle in the septic tank is positioned to allow only the partially treated liquid waste in the middle layer to flow out of the tank for further treatment.

The layers of scum and sludge remain in the septic tank where bacteria found naturally in the wastewater work to break the solids down. This process takes place anaerobically, or without the presence of oxygen, and gases produced from the decaying solids are vented back through the sewer line and released, usually through a plumbing vent located on the roof of the house. The sludge and scum that cannot be

Continued on page 4

What Homeowners Need To Know About Septic Tank Design

Septic tanks are usually made of precast concrete, fiberglass, or plastic, and come in a variety of shapes and sizes. In order for septic tanks to work properly, they must be watertight and resistant to corrosion—for this reason, metal tanks are not recommended.

Most septic tanks are single-compartment tanks. Tanks with two or more compartments use the same processes to treat the wastewater, but often retain the wastewater in the tank longer allowing for additional settling time for the solids, and thus providing additional treatment before releasing it to the drainfield. Some states recommend or require two or more compartments for septic tanks that hold 1,000 gallons or more, or two or more septic tanks used in series to provide additional treatment.

Septic tank filters, screen- or basket-like devices that trap and retain solids, are another way to enhance treatment inside septic tanks. A relatively new technology, septic tank filters are included with some newer septic tank designs, or can be retrofitted to work with older designs. Homeowners should check with their local health departments to see if septic tank filters are required or recommended.

Septic tanks are often rectangular, oval, or round. The overall shape of the septic tank has little to do with its performance, but tank size is a very important factor. Septic tanks must be large enough to accommodate the needs of the household.

The size of a septic tank is usually determined by the number of bedrooms (not bathrooms) in a home. One way to estimate the size of septic tank necessary for an average household would be to multiply 150 gallons per bedroom per day, and then multiply this number by two to allow for two days retention time in the tank. Using this formula, a three-bedroom house would use 450 gallons of water per day, and would require at least a 900-gallon septic tank for two days retention. Standard septic tank sizes include 750; 1,000; 1,200; and 1,500 gallons.

While there are several formulas available for estimating septic tank size, it is most important for homeowners to know the specific regulations for septic tank size and design in their state or area. *For more information on septic system regulations, see the article on page 6.*

A Proper Site Evaluation Is Essential

In a typical site evaluation, a sanitarian, engineer, or other wastewater professional examines the soils, landscape features, and past surveys of the potential site. He or she makes special note of the location of nearby wells, other septic systems, the slope of the land, depth to the groundwater source and to impermeable layers (such as bedrock), natural drainage patterns, and the boundaries of the lot.

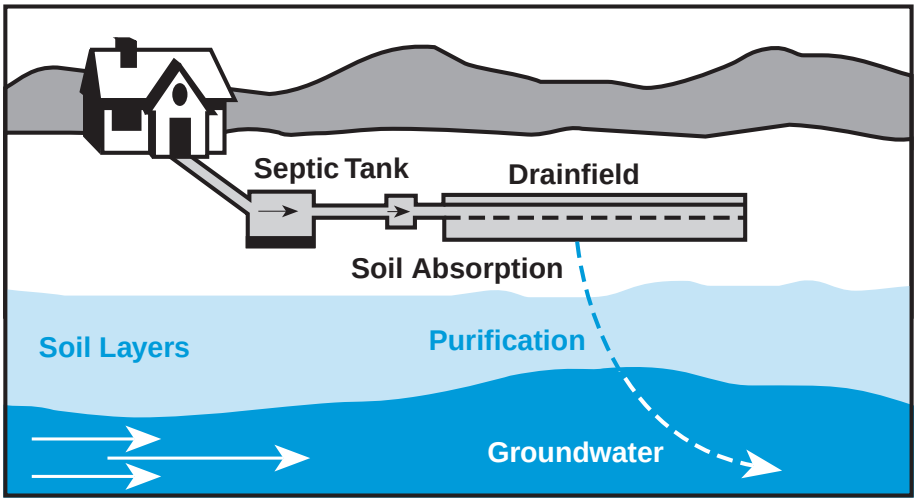
An important feature of the site evaluation is a thorough study of the soil. Marking the position of the absorption field, the sanitarian digs an observation pit to examine the soil layers for texture, structure, and color patterns that will give clues about the soil's permeability and potential for seasonal water saturation. Sometimes the sanitarian will conduct a percolation, or "perc," test to measure how quickly the water moves through the soil. In some states, other methods of testing soil permeability may be used.

A good site evaluation defines the limitations of a site. If the soil or other conditions are inappropriate for a conventional drainfield, workable alternatives can be designed using the data collected in the evaluation.

Poorly sited septic systems may fail, causing inadequately treated wastewater to pond on the ground surface or to contaminate the groundwater.

If you are planning to construct a septic tank system, be sure to contact your local health department for more information on site evaluation and permit requirements for your area.

How Septic Systems Work—*continued from page 3*



broken down is retained in the tank until the tank is eventually pumped.

After the wastewater is allowed to settle and separate in the septic tank, the partially treated liquid from the middle layer flows through the outlet baffle or tee to the drainfield.

The Drainfield

In a conventional septic system, the wastewater flows by gravity from the septic tank to the drainfield or to a distribution device, which helps to uniformly distribute the wastewater flow in the drainfield. *(For more information on distribution methods, see the article on page 5.)*

The drainfield or soil absorption field provides the final step in the wastewater treatment process. A standard drainfield is a series of trenches or a bed lined with gravel or coarse sand and buried one to three feet below the ground surface. Perforated pipes or drain tiles run through the trenches to distribute the wastewater.

The drainfield treats the wastewater by allowing it to slowly trickle from the pipes out into the gravel and down through the soil. The gravel and soil in a drainfield act as biological filters.

As the wastewater percolates (moves through the soil) to the groundwater below, the filtration process and organisms in the soil work together to remove toxics, bacteria, viruses, and other pollutants from the wastewater. Soil particles, particularly clay, chemically attract and hold sewage nutrients, metals, and disease carrying organisms. This process can effectively treat the wastewater to an acceptable level that will not contaminate the groundwater.

Certain toxics, such as paints, thinners, pesticides, waste oils, and other hazardous chemicals, cannot be treated by the drainfield and should never be disposed of through a septic system. Some of these chemicals also kill the bacteria found in the septic tank, temporarily disrupting the natural treatment process that occurs in the septic tank.

The size of the drainfield is determined by the amount of wastewater flow anticipated and the quality of the soil below. Soil type and the position of the water table also help determine how deep the trenches should be. A thorough site evaluation should be conducted when the septic system is still in the planning stages. Septic system failures are often caused by poorly sited drainfields. *For more information, see the article on site evaluations at left.*

WARNING

Toxic gases, including methane and hydrogen sulfide, are produced by the natural treatment processes in septic tanks. These gases can kill in minutes. Extreme care should be taken when inspecting your tank, even when just looking in. Never enter a septic tank or try to inspect the tank alone. Most communities have licensed septic contractors who can inspect your system periodically. For guidelines on how to safely and properly inspect your system, call your local health department.

DISTRIBUTION SYSTEMS FOR DRAINFIELDS

Some septic systems require the use of a distribution system to ensure that the flow of wastewater coming from the septic tank is evenly distributed to the different parts of the drainfield. Uneven distribution can overload areas of the drainfield, causing it to fail.

Following are descriptions of some of the most common distribution methods.

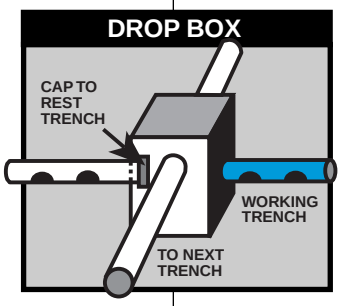
Distribution Box

A distribution box is a tank-like box with as many outlets as there are pipes or lines in the drainfield. The effluent, or partially treated wastewater, from the septic tank flows into the box and through the different outlets to the drainfield. Because the outlets in the box are level with each other, and because this system relies on gravity to work effectively, it is important that the distribution box be level. If the distribution box is not exactly level, the flow to the drainfield will be uneven.

Advantages of this distribution method include easy inspection (the top of the box opens) and the option of capping outlets to give certain drainfield trenches a chance to rest.

Drop Box

A drop box is also a very simple tank-like box designed for effluent distribution. A series of drop boxes can be used for distributing wastewater to drainfields on sloped sites using only gravity.



Inside the drop box, the pipe inlet is higher than the outlets, allowing the wastewater to flow downward to the drainfield trenches. A series of drop boxes can be arranged on the sloped drainfield so that after the highest drainfield trench is saturated with wastewater, the flow continues on to the next drop box and trench below. Drop box outlets can also be capped to control the direction of flow and to give the saturated upper trenches a rest.

Siphons and Pumps

Some septic systems, because of site conditions, soil conditions, or design, cannot rely on gravity alone to efficiently distribute the flow of effluent from the septic tank to the drainfield. Siphons or pumps are sometimes used as a method of distribution with these systems.

Siphons are often used when septic tank effluent must be evenly distributed over a large area; for example, with drainfields using more than 500 feet of pipe. The effluent flows from the siphon to the drainfield in pressurized doses, making uniform distribution easier to achieve. The effluent from the septic tank flows into a dosing tank, then through the siphon to the drainfield. Siphons work using only air, water pressure and gravity—no outside power source is necessary.

Siphons are a relatively low-cost technology that can improve the performance of the drainfield, but because they require approximately two feet between the septic tank outlet and the drainfield, they are unsuitable for some sites and septic system designs. They also require more maintenance than some other methods of distribution.

Electric pumps are also used to deliver controlled amounts or doses of effluent to the drainfield. Dosing can improve the performance of any drainfield by guaranteeing more uniform distribution, but it is especially advantageous for drainfields with shallow or poor soil conditions. However, electric pumps are more expensive to operate than other distribution systems and they require regular maintenance.

Some sites and drainfield designs require the use of electric pumps because the drainfield is higher than the septic tank, making it impossible to rely on gravity for distribution. Mound systems, for example, always require an electric pump to elevate and distribute the effluent flow from the septic tank. *For more information about mound systems and other alternative septic system and drainfield designs, see the article on page 6.*

Q&A

How much do septic systems cost?

The cost of installing and maintaining a septic system varies greatly depending on its location and design. In order to accurately estimate what a septic system will cost, homeowners should contact their local health department for more information about the costs of septic systems in their area.

In most areas in the U.S., conventional septic systems cost from $2,500 to $7,500 to install. While certain site conditions or alternative drainfield designs can make installation more expensive, this is a general range for standard septic tank and soil absorption systems. Alternative septic systems requiring pumps or specially constructed drainfields can be considerably more expensive.

As a general rule of thumb, septic systems are most cost-effective in communities where houses are spaced widely apart, and where connection to a sewer system is not an option. When the cost of operation and maintenance of a centralized treatment plant is factored in, residents in small rural communities may pay many times more per household for a centralized sewer system than residents in more densely populated areas. In certain communities, a centralized sewer system would be so expensive to install and maintain that costs per household could exceed property values.

In order to find the most cost-effective wastewater system for their homes, small community residents should discuss available options with local health department officials, neighbors, and community leaders.

How Regulations Affect Septic System Owners

Homeowners considering installing or upgrading their septic systems need to familiarize themselves with local regulations.

In most areas of the U.S., there are laws regulating the construction of the septic tank itself, the size of the tank, the number of tank compartments required, the construction and design of the drainfield, and maintenance of the system.

These regulations can vary from state to state and county to county. Often, communities have their own practices and standards regarding how and where septic systems may be constructed. Homeowners should contact their local health department for information about local regulations and permit requirements. *See the list of contacts on page 7.*

NSFC Offers Watersheds Information Package—

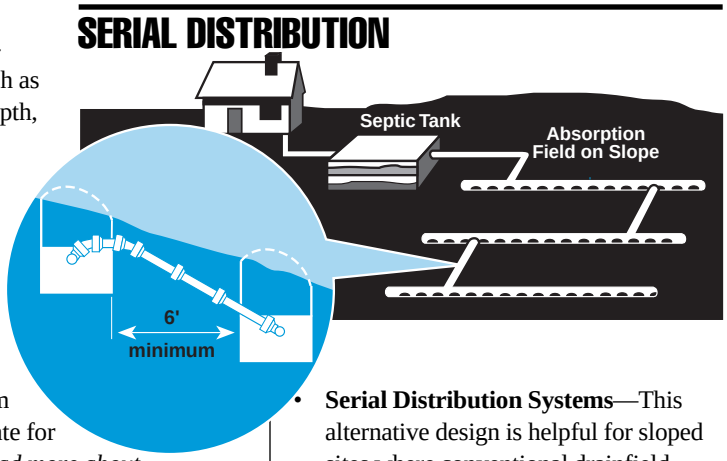
Watershed and groundwater protection have become important concerns for everyone who cares about the environment. Questions often arise about the role of wastewater and wastewater treatment systems in preventing water pollution.

To answer these concerns, The National Small Flows Clearinghouse (NSFC) is offering a new information package, "Wastewater in Watersheds." This helpful package defines what a watershed is, describes the role of septic tanks and other onsite systems in maintaining watershed and groundwater quality, provides examples of successful watershed management projects, and lists additional resources for information.

The cost of the package is $16.40. To obtain a copy, call the NSFC at (800) 624-8301 and ask for Item #WWPCGN57. Please include $2 for shipping and handling.

Alternative septic system designs

Because of the importance of site-related factors, such as soil quality, soil depth, the position of the water table, lot restrictions, and slope of the land, a thorough site evaluation is needed to determine if a conventional septic system design is appropriate for a given site. *(To read more about site evaluations, see the article on page 4.)*



If the evaluation reveals difficult or unsuitable site characteristics, many alternative drainfield designs are available. The following are just a few of the many available alternatives *(be sure to contact your local health department for more information about these alternatives, state regulations, and other options available in your area)*:

- **Low Pressure Pipe (LPP) Systems**—This drainfield design is typically used in areas where the land is rocky, the soil is shallow or tight, or the water table is high. A pump is used to guarantee uniform distribution and to prevent soil saturation.

  LPP system trenches are more shallow and narrow than conventional drainfield trenches, and the drainfield pipes are perforated and made of plastic. Advantages of LPP systems include the relatively low cost of installation for an alternative system and that septic systems can be used effectively with less than perfect site conditions.

- **Serial Distribution Systems**—This alternative design is helpful for sloped sites where conventional drainfield designs are unsuitable. A series of trenches is dug parallel to the slope so that each trench is higher than the next. Starting with the highest, each trench fills with wastewater completely, then overflows through a series of overflow pipes (as illustrated) or drop boxes (instead of a single distribution box). Discharge to each trench can be controlled through the overflow pipes or drop boxes.

- **Mound Systems**—These systems are helpful for sites where the water table is high, or the soil is too shallow or tight to provide adequate treatment.

  The drainfield is located in a man-made mound constructed of materials that will provide adequate treatment. The wastewater trickles through gravel beds or trenches located on top of a bed of sandy soil or fill, which is built on the plowed natural ground surface. With this design, a pump is necessary to

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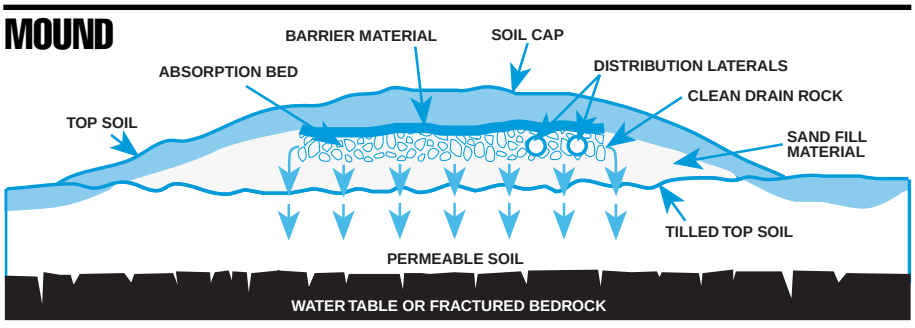

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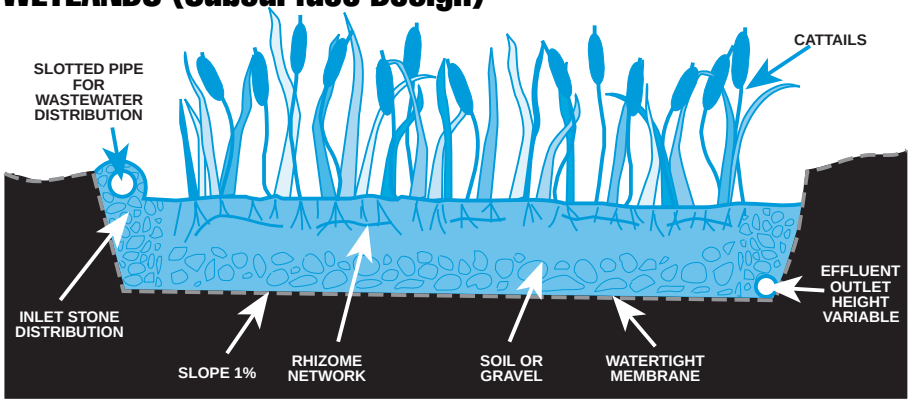
move the wastewater from the septic tank to the drainfield mound.

- **Constructed Wetlands**—These alternative drainfield systems are built to resemble small natural wetlands. Reeds and other aquatic vegetation are planted to provide a natural filtering process. For example, in a subsurface wetland design, a drainfield area is excavated and covered with a synthetic or clay waterproof liner, and then filled with rock, gravel, sand, and soil. Wastewater is treated by both the plants and the soil. Climate is an important consideration in wetland design, because certain plants will not perform well in cold weather. Usually, wastewater treated by wetlands require additional treatment, such as disinfection or discharge to a drainfield. These systems require a lot of land area, but can be a very beautiful use of the land, and are good for sites where the soil is not suitable for adequate absorption.

- **Sand Filters**—A sand filter consists of several layers of sand located under or above ground. The wastewater is pumped evenly, or dosed, over the sand filter, which also contains naturally occuring bacteria that aid the purification process. After this treatment, the wastewater usually needs to be discharged to a drainfield or, less commonly, disinfected before being discharged directly to a body of water. This design is used in areas that require the effluent (treated wastewater) to be very clean before being discharged.

There are several other alternative septic system designs available and successfully being used in small communities throughout the U.S. Some of these include drip and spray irrigation systems, gravelless systems, and contour trenches. Homeowners should contact their local health department for help in determining the most suitable septic system design to fit their needs. The National Small Flows Clearinghouse (NSFC) offers technical assistance and a variety of resources on septic system alternatives. *Refer to page 8 for a partial listing of resources, or contact the NSFC for more information.*

WETLANDS (Subsurface Design)



Fall issue of *Pipeline* to focus on septic system maintenance for homeowners

Everyone who owns a septic system should keep a copy of the next issue of *Pipeline* around the house. *Pipeline*'s fall issue will include all the information you need to properly care for your septic system so that it can serve you, trouble free, for many years to come. Regulations, inspection, pollution prevention, and other important issues for septic system owners will also be covered. If you are not already on our regular mailing list, call the National Small Flows Clearinghouse at (800) 624-8301 to request a free issue or subscription to *Pipeline*.

CONTACTS

Health Department

Homeowners with questions about regulations or location requirements for septic system construction and maintenance should contact their local health department (usually listed in the yellow pages).

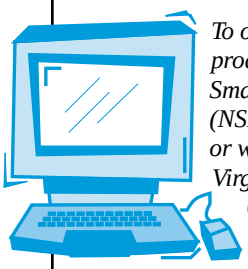
National Small Flows Clearinghouse (NSFC)

The National Small Flows Clearinghouse located at West Virginia University is also a good place for homeowners and community officials to contact for more information about septic systems and alternative systems. The NSFC is funded by the U.S. Environmental Protection Agency and offers technical assistance and a variety of free and low-cost products to help small communities with wastewater issues. Some of these NSFC products are listed on page 8.

Extension Services

Many universities have U.S. Department of Agriculture cooperative state extension service offices on campus and field offices in counties and other localities. Part of the mission of these extension services is to provide access to information and assistance to the public, and to help educate the public about federal wastewater policies and requirements. To locate the extension office in your area, contact the U.S. Department of Agriculture at (202) 720-3377, or NSFC at (800) 624-8301 and ask for Crystal Stevens in the technical assistance department.

RESOURCES AVAILABLE FROM NSFC



To order any of the following products, call the National Small Flows Clearinghouse (NSFC) at (800) 624-8301 or write to NSFC, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Be sure to request each item by title and item number. Please allow a minimum of $2 shipping and handling charges per order.

Onsite Wastewater Treatment: Septic Tanks
Septic tank functions, design, and geometry are discussed in this semi-technical, 15-page booklet available from the NSFC. Included are tables illustrating typical wastewater flows from commercial, institutional, and recreational services. Septic tank construction, operation, and maintenance are also addressed. The price is $1.20. Item #WWPCDM18.

Small Wastewater Systems: Alternative Systems for Small Communities and Rural Areas
This foldout poster describes 20 different alternative wastewater systems for small communities. It also includes an illustration of a sample community that details where each system would be appropriate. The price is $1. Item #WWBLPE02.

So . . . Now You Own a Septic System
This free brochure describes how homeowners should care for their septic systems. Item #WWBRPE20.

Your Septic System: A Guide for Homeowners
This 11-minute videotape discusses septic system operation and maintenance, covering 10 basic rules for homeowners to follow. The price is $27. Item #WWVTPE16.

Septic Systems—A Guide for Homeowners
Conventional septic systems and how they should be cared for are described in this free brochure. Tips for trouble-free operation are also provided. Item #WWBRPE17.

Septic Systems and the Sanitarian
This 10-minute videotape explains health department inspection procedures for septic tank systems. It also discusses common problems and suggests alternative solutions for the construction of septic tanks. It contains information of interest to homeowners and community officials. The price is $24.50. Item #WWVTGN11.

Septic System Information Packet for Homeowners
This information packet includes a variety of resources that no septic system owner should be without. The packet includes brochures, articles, and other materials on septic system design and the proper care and feeding of a septic system. The price is $3.80. Item #WWPCPE28.

Site Evaluation for Onsite Treatment and Disposal Systems
Critical site and soil characteristics and the use of soil surveys and necessary equipment are discussed in this semi-technical report on site evaluation. Price is $4.95. Item #WWBLDM12.

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