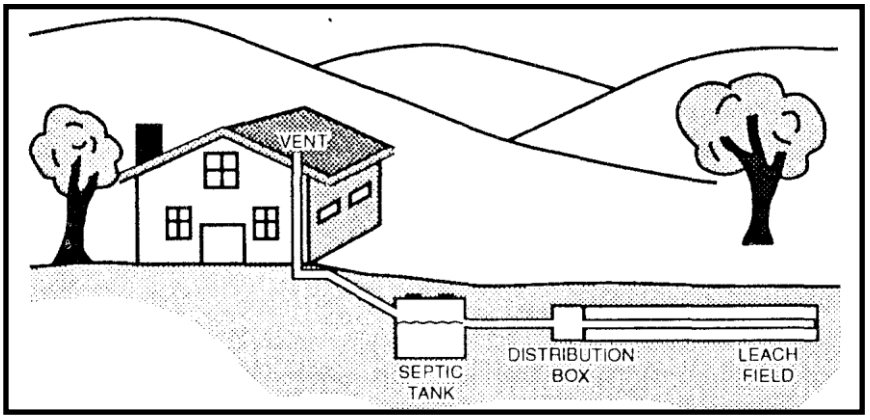
Septic Systems for Waste Water Disposal



American Ground Water Trust
Consumer Awareness Information Pamphlet # 4

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INTRODUCTION

This pamphlet provides basic information for homeowners about septic system waste disposal. One-third of all American homes use on-site waste water treatment systems. When they are properly **designed, installed and maintained,** septic tanks and similar on-site disposal systems are effective from an engineering perspective, economic for home owners and **friendly to the environment.**
Because septic systems are out of sight, many homeowners rarely think about them. All states have septic system regulations that are intended to protect ground water. Most on-site waste water systems are used for homes that also have their water supply from a well.

In some rural and suburban areas, sewer lines would have to stretch great distances to connect homes with a centralized treatment plant, making the connection to such systems impractical. Fortunately, in many rural areas, natural soils can treat waste water as thoroughly and safely using an on-site disposal system, as can be achieved by municipal sewage treatment systems.

WHAT IS TUE PURPOSE OF WASTE WATER DISPOSAL SYSTEMS?

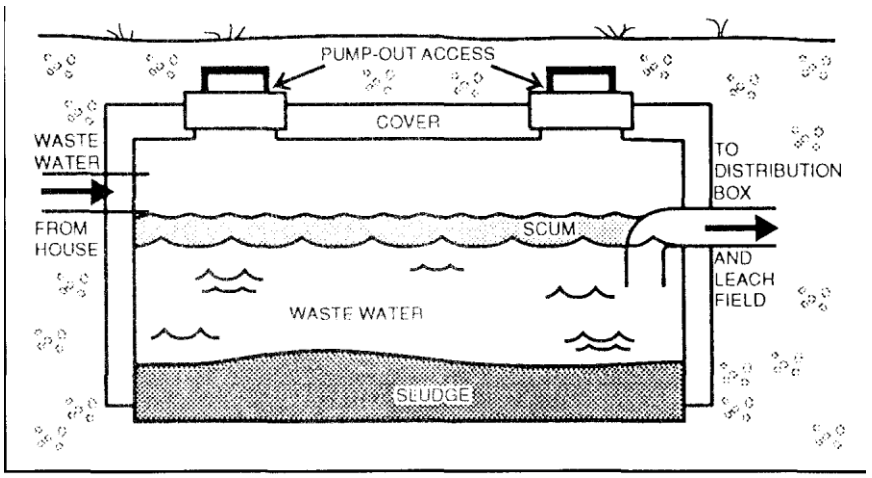
Disposal systems remove waste water (effluent) from the home, separate contaminants from the waste water, and return effluent to the soil. Each American produces an average of about *50* gallons (about 200 liters) of waste water per day from water use in the kitchen, baths, showers, toilets and laundry. This waste water includes suspended solids, dissolved organic and inorganic materials, and microorganisms such as viruses and bacteria. An on-site waste water treatment system treats this waste on the property where the waste water originated.

There are many different types of septic system design. The most frequently used design for single family homes has two parts:
waste water storage and treatment tank, and the soil absorption and filter part (leach field).

The waste water tank separates out the large solids, and the soil filter removes the fine solids and allows natural biological and

biochemical processes to destroy accompanying bacteria. The only maintenance required by a properly operating system is the removal of accumulated solids from the waste water tank every few years.

A waste water tank may be a septic tank (anaerobic) or an aerobic tank (with an air agitator). In both, the large solids are separated and partially decomposed by bacteria. Bacteria also digest some of the solids and grease. The digestive (septic) processes release a smelly gas that moves back through the sewer pipes and is discharged by a vent through the roof of the house. The liquid out-flow from the waste water tank (effluent) contains disease-causing bacteria and nutrients and must have further treatment through a soil absorption system. The laws of most states and counties prohibit the direct discharge of septic system effluent onto the ground surface or into surface waters.

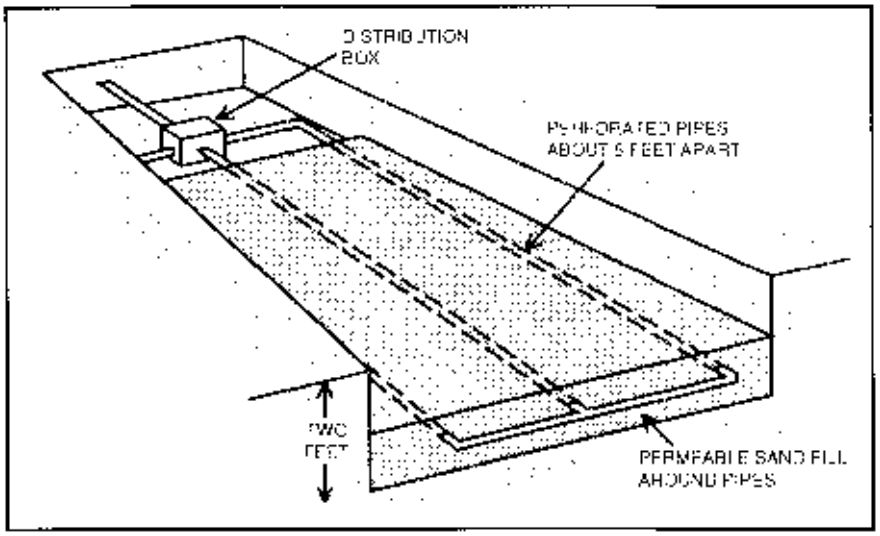


Cross-section of septic tank

HOW DO SEPTIC TANKS WORK?

Eighty-five percent of U.S. on-site waste water disposal systems are septic systems. They treat waste water by allowing anaerobic bacteria (those that live in the absence of air) to digest organic materials, while allowing scum and sludge materials to separate from the waste water. Wastes that the bacteria cannot digest are filtered and removed from the effluent in a soil absorption system.

Septic tanks may have one or several chambers where solids are separated from waste water. The biological action of bacteria compacts the heavier solids causing them to settle at the bottom of the chamber; lightweight compounds such as waxes and grease drift to the surface. Any indigestible solids must be periodically removed from the tank. Even after the septic tank has separated sludge and other solids, its clarified effluent is not yet purified. For example, the effluent is likely to contain high levels of bacteria and phosphorus, which must be removed or inactivated before reaching the water table.



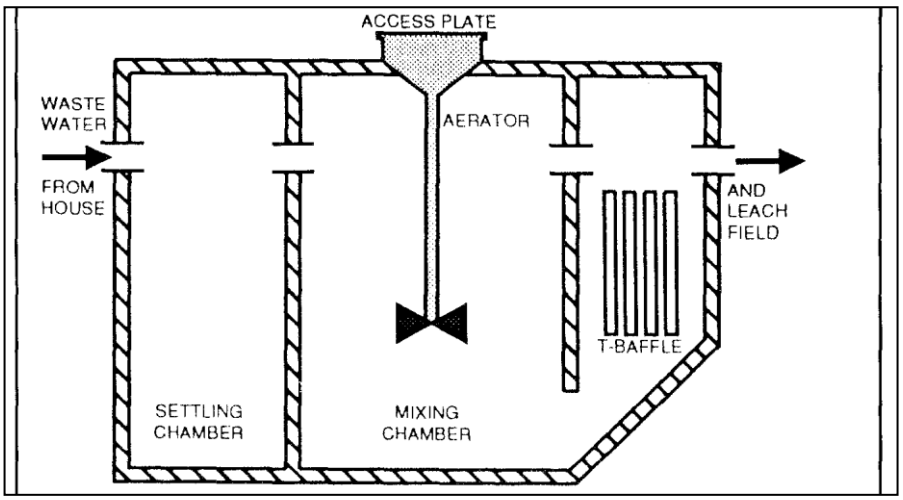
Perspective View of typical leach field construction

Make sure you know the exact location of your septic system. Check your phone book to find septic system pumping companies. The Cost of the service will vary (usually between $100 and $200) according to the volume pumped and the distance of your home from the disposal site.

HOW DO AERATION SYSTEMS WORK?

Aeration systems are “cousins” to septic tanks; they use bacteria that live only in the presence of air. The purification process in an

aeration system is generally similar to a septic tank in its initial stages. Following treatment in the first chamber, incoming waste water forces effluent into a second chamber, through a pipe equipped with a filter or baffle. Next, fine bubbles of air are blown into the effluent, encouraging the growth of aerobic bacteria which feed on the organic nutrients and decompose them. The partially treated effluent then flows into a settling chamber. Bacteria fall to the bottom of the chamber, where a sloping floor returns them to the first chamber to continue biodegradation.



Cross-section of aeration tank

WHICH SYSTEM - SEPTIC TANK OR AERATION?

Local builders and waste water specialists are usually familiar with which system is most appropriate for a home. Aeration systems can purify waste water much more thoroughly than septic tanks. Sometimes they can remove as much as 90 percent of organic material and suspended solids. However, aeration systems have disadvantages too; they require servicing and maintenance more frequently than septic tanks. An aeration system uses electricity to

operate the mixing mechanism and therefore is vulnerable to power failures. Aeration tanks are usually more expensive to purchase and install than septic tanks.

Deciding which system is right for you will depend on several factors: the soil and slope of the site, proximity to environmental features such as wetlands and streams, proximity to roads and buildings, the projected daily and peak waste water volume, your budget, and state and local building codes and regulations in your area.

WHAT IS THE PURPOSE OF A SOIL ABSORPTION SYSTEM?

Although septic and aeration tanks remove many pollutants from waste water, further treatment is required after the effluent leaves the tank. Nitrogen compounds, suspended solids, organic/inorganic materials, bacteria, and viruses still must be reduced before the effluent is considered purified.

There are two similar words, **adsorption** and **absorption**, that need to be explained. "A**d**sorption" refers to the process by which pollutants are attracted to and held on the surfaces of soil molecules, thus immobilizing them. "A**b**sorption" is a more general word used to describe the way in which pollutants are removed from effluent as it percolates through the soil. Soil absorption systems remove most of the suspended solids by filtration and reduce the contaminants by adsorption and microbial degradation.

The action of microbes consumes or transforms nutrients and makes them harmless. If the volume of soil underlying a soil absorption system is great enough, all but an insignificant proportion of the pollutants (except for the nitrogen compounds) can be removed before the waste water reaches the water table.

HOW DOES A SOIL ABSORPTION SYSTEM WORK?

Effluent flows or is pumped from the waste water tank into a network of porous pipes located in trenches covered with soil and turf. The bottoms of the trenches must be level throughout their lengths, so

they usually should follow ground contours. The soil absorption system is often described as the leach field.

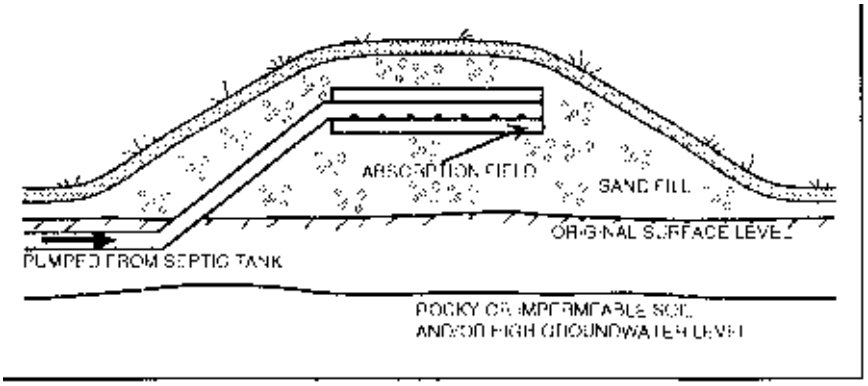
Shallow trenches do a better job of treating waste water than do deep ones. Twelve inches of soil backfill over the porous pipes in the trench is usually enough to prevent freezing, even during harsh winters. The placement of gravel surrounding the pipes promotes even distribution of the effluent. Local builders and septic system installers will know the recommended depths and code requirements for your area.

WHAT ARE THE SITING REQUIREMENTS FOR A SOIL ABSORPTION SYSTEM?

The siting requirements for a soil absorption system depend mainly on the waste water flow rate and volume, and the site conditions that affect the soil's ability to absorb, treat, and dispose of septic tank effluent. Waste water disposal via septic systems should not create a public health hazard or contaminate surface or ground water. A relatively small leach field (drain field) size may be used on sites that (1) have stable, nearly level to gently sloping land surface not subject to flooding, (2) have at least six feet of well-drained permeable soil, free of coarse fragments, and (3) occur above the maximum expected level of ground water.

A larger leach field size may be needed when there is sloping ground, a thin soil layer, low soil permeability, or ground water levels close to the surface.

The two principal criteria for determining leach field size are: the soil percolation rate and the waste water loading rate. Ideally there will be an additional adjacent area available for the installation of a repair system in the event of treatment and disposal system failure. This replacement area should be kept free of development, traffic, or soil modification. However, in practice, a septic system replacement area is rarely needed and is not usually required by building code. Final selection of an area for a leach field depends on the location of natural landscape features and proximity to pipelines, roads, buildings, etc. The distance that fecal organisms will travel laterally through soil depends mainly on gradient, hydraulic conductivity, and



Leach field ins tailed in a constructed mound

the occurrence of soil layers or bedrock that restrict vertical movement of effluent. A safe distance should be maintained between the disposal site and ground water supply sources, lakes, streams, tile drains, and natural or cut slopes where seepage may occur.

Some natural dilution of potential contaminants results from the precipitation (rain and snow-melt) that occurs on the actual leach field surface. Even greater dilution takes place as the drainage from the leach field mixes with the naturally occurring ground water. In most cases, the area of most leach fields is very tiny in comparison with the area of natural recharge and volume of water stored in surrounding geologic formations.

Plumes of nitrate above the drinking water standard level of 10 parts per million have been known to spread laterally hundreds of feet from leach fields over a period of 10 to 20 years. Buildings and roads should be set back from leach fields so that they will not interfere with proper operation of the system. Problems may occur if heavy trucks drive over the leach field, resulting in excessive compaction of soil and broken drainage pipes.

Minimum building lot size for zoning is often presented for planning purposes as a matter of public health safety. This is based on an acreage figure for maximum density of septic systems. Most local zoning decisions relating to septic density safety are made using sound science that takes into account all the geological and topographical variables. There are instances, however, when concern

over minimum lot size, while justified by proponents as being in the interest of public health, may in fact be used as a convenient "one-size-fits-all" means to achieve a no-growth or a large lot-size zoning objective.

Many states mandate minimum separation distances between natural and man-made features; others do not have comprehensive requirements. Typically suggested minimum distances appear below.

Separation Distances for Septic System Leach Fields

(State and local codes will vary.)

Distance *(ft.)*	**Feature**
10-25	Water mains
10-20	Building foundations
20	Curtain drain **up slope** from disposal area
25	Property boundary
25	Escarpments or man-made cuts that do **not** intersect restrictive layers
50	Escarpments or man-made cuts that **do** intersect restrictive layers
50	Curtain drain **down slope** from disposal area
50	Springs, perennial streams, or constructed ground water interceptors **up slope** from disposal area
50-100	Springs, perennial streams, or constructed ground water interceptors **down slope** from disposal area
100	Water supply wells

Critical factors in siting of a soil absorption system are: depth to the water table and soil texture. A leach field should not be

installed where the water table would be less than three feet below the bottom of the trench.

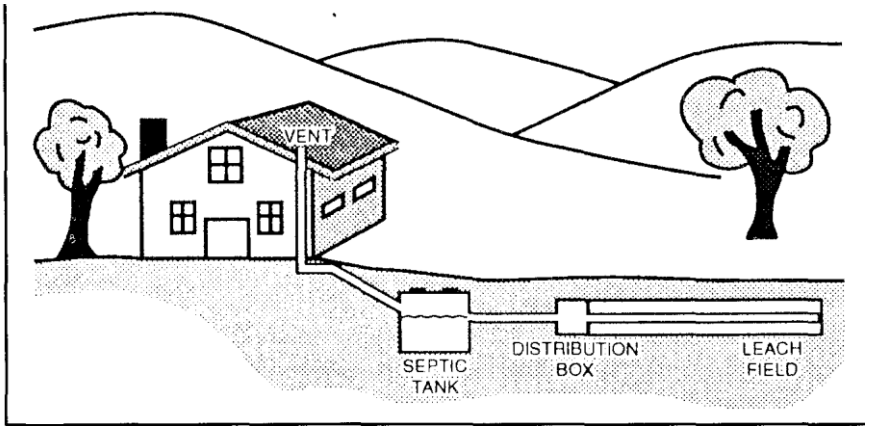
Extremely coarse soil, such as sand and gravel, cannot filter out the fine solids and bacteria from waste water tank effluent. However, coarse soil can be mixed with finer grained soil to get the right texture, or the required soil type can be purchased and trucked to the site.

Extremely fine soil, such as clay, may be too tight to allow much waste water to pass through it. In addition, clay soils frequently have perched water tables (lenses of ground water that form periodically due to poor drainage). Therefore, such soils are not suitable for a soil treatment system. It is possible to overcome the problem of poorly drained soils and a high water table by installing the whole leach field system in a constructed mound.

It may be necessary to install a pump in order to raise the effluent from the septic tank to the mound. There are many simple engineering solutions for waste water disposal. The Smallflows Clearinghouse in West Virginia (see page 13) provides technical information about waste water treatment options for homes and small communities.

HOW CAN SEPTIC SYSTEM FAILURE BE PREVENTED?

There are two main factors that cause problems: overload and lack of maintenance. An overloaded (or under-designed) septic system can occur if, for example, an original two bedroom home has subsequeni bedroom and bathroom additions, but no increase in septic system capability. With overload, waste water flows to the leach field before there has been time for natural biological process to settle out solid waste in the septic tank. As a result, particles can clog up the holes ir the drain-field pipes and build up extra pressure on the holes thai remain open. The increased flow through fewer drain holes produces more liquid than the soils of the leach field can naturally treat. The result can be contaminants moving to the ground water, rise of wastc water to the surface, or both. In the case of subsurface overload, the situation may go unnoticed for years.



Cross-section view of typical home septic system

Lack of maintenance can also lead to problems even if the system is not overloaded. If the solid material is not periodically removed from a septic tank there could be insufficient room for solid matter to settle out. In such cases, solid material may also clog parts of the drain field. If the septic system is both overloaded and the septic tank full with solids, then there can be a real risk of environmental degradation, such as nitrates moving to aquifers.

Reduced production of waste water helps prevent system overload. Most Americans can cut water consumption 15 to 20 percent without discomfort. (For water conservation tips, see the Trust's pamphlet #7, "Water Conservation In Your Home.")

If your septic system is the right size and properly maintained, it should not give you any problems. If it is undersized and you have a house full of friends and relatives, then just go easy on the use of water. Household water use peaks just after your family awakens, and again at bedtime. Try to avoid using more water than necessary during these peak periods.

The following practices can also help prevent septic system problems:

✓Make sure that outdoor drains from roofs or driveways do not discharge into the system. Although most state and local codes prohibit such discharge, it is not strictly monitored. Drain water should be discharged into a drainage ditch or surface water source.
✓Be conservative with your use of water. Each gallon of water used must be treated and disposed of. Repair all leaky fixtures and reduce the amount of water used in doing laundry, bathing, and toilet flushing.

CAUTION: The diversion of so-called grey water (water from laundry, showers and baths) away from the septic system for use on lawns, gardens and trees needs to be undertaken with caution. Local plumbing codes may forbid the practice and your septic system will need a certain amount of dilution water in order to work efficiently. Consult local experts before altering your home's waste water system.

✓Wash only full loads in the washer and spread the washing out during the week to avoid overloading the waste water system in a single day.
i/Each bath or shower uses up to 30 gallons of water. Filling the tub not quite so full and using a low-flow shower head will reduce water use.
✓Routinely check the toilet float valve to be sure that it isn't sticking and the water running continuously. Don't use the toilet to dispose of tissue paper or cigarette butts.
✓The salt used in water softeners will not harm septic tank action although it could eventually lead to a slight increase in ground water sodium levels. Check the local codes and regulations that apply to water conditioning equipment discharge.
✓**A biological** "starter" is not needed for bacterial action to begin in a new septic system.
✓Only in exceptional cases, and on the advice of an expert, should additives be used. Be aware of telemarketing calls that claim that "Product X" added regularly to your water will save you money. Most additives are of no benefit and some may do great harm if they cause the sludge and scum to be flushed out into the drain field where it may block drain holes.

✓Household chemicals labeled “septic friendly” are available in most stores; however, normal amounts of regular detergents, bleaches, drain cleaners, toilet bowl deodorizers, and other household chemicals can be safely used without harming the bacterial action in the septic tank.
✓Don’t deposit coffee grounds, cooking fats, disposable diapers, or similar materials into the septic tank. Avoid dumping grease down the drain.
✓Remove the sludge and scum by pumping the septic tank. (Every one to three years for a 1000-gallon tank serving a typical four person household).
✓If you must use a garbage disposal unit, you may need to remove the septic tank solids every year or more often. Ground garbage will frequently find its way out of the septic tank and clog the soil treatment system. It is better to compost, incinerate, or throw out garbage with the trash.
✓Do not use your septic tank to dispose of organic compounds such as acetone alcohol, naptha, motor oils, or dry cleaning fluids. Do not use organic chemicals to clean your septic system. The addition of organics can lead to serious ground water contamination.

If any part of your on-site disposal system does fail, you should contact a qualified contractor immediately.

HELPING YOUR SYSTEM SERVE YOU

To ensure proper system design, location, and construction, consult a qualified contractor. Discuss requirements for your on-site waste water disposal system before construction begins. Many water well contractors also install septic tanks, and can offer complete service by installing your water and waste disposal systems at the same time.

Remember that your septic tank or aeration system operates according to standard engineering principles. It is not a mysterious machine that works best when left to itself. With proper use and maintenance, your waste water disposal system can offer a reliable, inexpensive alternative to centralized waste water treatment

The amortized cost of a properly designed and adequately maintained privately owned on-site waste water system is usually considerably less than regular monthly charges for district systems. In many areas the natural purification and recycling of water back into the ground water system represents very efficient water conservation.

WHERE TO GO FOR MORE INFORMATION

Local building inspectors, agricultural extension offices and state environmental departments will have information about specific septic system requirements. A one-stop-shop of information about small community waste water systems is:

National Smallflows Clearinghouse
West Virginia University, P0 Box 6064
Morgantown, West Virginia 26506
Telephone 800-624-8301

Information in this pamphlet is provided in good faith to inform the public about ground water and ground water related issues. In all cases, the Trust urges consumers to contact local experts, and where appropriate, to refer to local codes, rules, regulations and laws.

AMERICAN GROUND WATER TRUST

Independent Authority on Ground Water

The Trust - Working Everyday for you and for America:

- ✯ Protecting ground water & promoting resource sustainability
- ✯ Communicating the environmental & economic value of ground water
- ✯ Showcasing ground water science & technology solutions
- ✯ Increasing citizen, community & decision-maker awareness
- ✯ Facilitating stakeholder participation in water resource decisions

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AMERICAN GROUND WATER TRUST

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