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A Septic Tank System for Sewage Treatment

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A Septic Tank System for Sewage Treatment

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A properly designed, installed and maintained septic tank system is an approved method of sewage treatment for private residences in rural or urban areas where public sewage treatment systems are not available. The components of a septic system are the house sewer, the septic tank and the absorption field, as illustrated in *Figure 1.* Sewage flows to the septic tank through the house sewer. In the septic tank, the solids are separated from the liquids, undergo anaerobic digestion and are stored as sludge at the bottom of the tank. The liquid (septic tank effluent) flows to the absorption field where it percolates into the soil. The soil acts as a final treatment by removing bacteria, pathogens and fine particles.

All household wastes and normal amounts of cleaning materials, including soaps, detergents, bleaches, drain cleaners and other mild chemical preparations, can be tolerated by a septic system. Roof drains and foundation drains should not be connected to the septic tank system. These sources of clear water only overload the septic system and may cause premature failure of the absorption field.

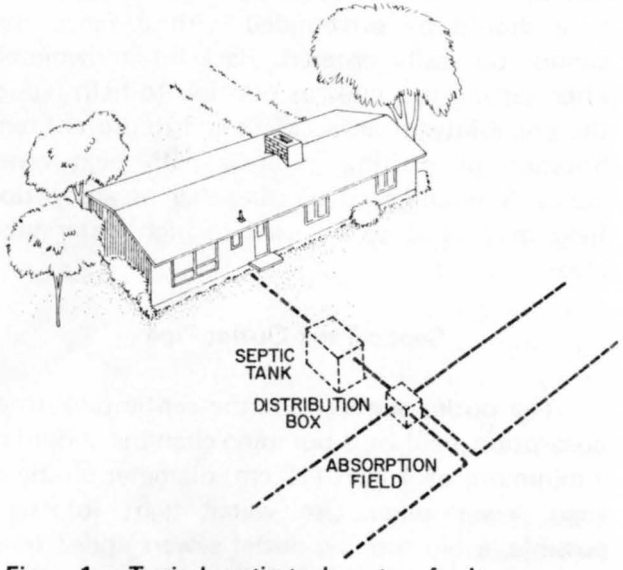

Figure 1. Typical septic tank system for home sewage treatment.

Septic Tank Location

The site of a septic tank is usually determined by the location of major bathroom and kitchen plumbing within the home and by the slope of the land. Locate septic tanks at least 15 feet (4.5 m) from the foundation walls and approximately straight out from the point where the house sewer pipe goes through the wall. *Table 1* gives minimum distances between the septic tank system and water lines, property lines and surface water supplies.

Table 1. Minimum horizontal distance from septic system to various items.

	Septic Tank		*Absorption Field*	
	Feet	*(Meters)*	*Feet*	*(Meters)*
Public Water Supply	500	(150)	500	(150)
Well or Suction Line	50	(15)	100	(30)
Water Supply Line (Pressure)	10	(3)	25	(7.5)
Surface Waters	50	(15)	50	(15)
Dwelling	15	(4.5)	30	(9)
Property Line, Easements, Right-of-Way	5	(1.5)	5	(1.5)

Locate the septic tank out of high traffic areas where excessive loads may damage the tank

top. Keep clear of areas subject to flooding, ponding or surface drainage from surrounding areas. The location should be accessible to a driveway or other acceptable route so a tank truck can be driven close enough to pump out the sludge and clean the tank. Do not locate septic tanks under sidewalks or patios where the tank is inaccessible for pumping. Consider the possibility of future expansion and locations for additions, such as sidewalks, patios, garages and storage buildings, before selecting the tank site.

Sizing and Septic Tank Construction

The minimum septic tank size for any installation is 1,000 gallons (3,800 l). For more than 3 bedrooms, add an additional capacity of 250 gallons (950 l) per bedroom. Garbage disposals add an extra load to the system, requiring about 25 percent additional tank capacity. Minimum tank capacities are listed in *Table 2.*

Table 2. Minimum Capacities for Septic Tanks Serving Residential Units

	Minimum Liquid Tank Capacity	
Bedrooms	*Gallons*	*(Liters)*
3 or less	1,000	(3,800)
4	1,250	(4,750)
5	1,500	(5,700)
6	1,750	(6,650)

Septic tanks must be watertight and constructed of sound and durable materials that are not subject to excessive corrosion, frost damage, cracking or buckling due to settlement or backfilling. Common construction materials include concrete, fiberglass and steel. Minimum liquid depth of the tank should be 4 feet (1.2 m). The inlet should not be less than 2 inches (5 cm) above the liquid level. Many septic tank shapes are satisfactory and the shape may depend on the type of material used. *Figure 2* illustrates a typical septic tank with sanitary tees used as baffles on the septic tank inlet and outlet.

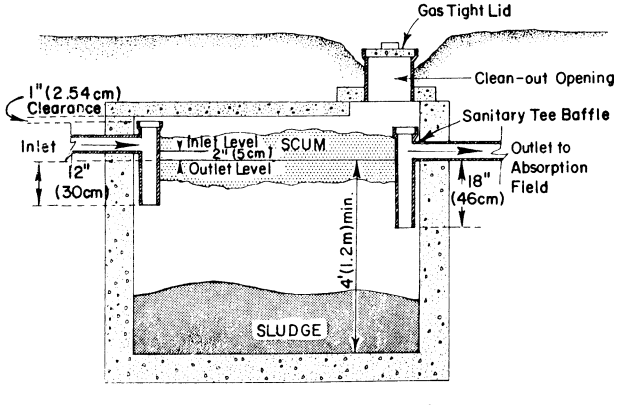

Figure 2. Typical septic tank cross section.

Installation

It is desirable, but not necessary, to have gravity flow throughout the sewage treatment system. The septic tank installation depth depends on house plumbing and whether gravity flow from a basement sewer drain to the tank can be provided. If a toilet is installed in the basement and a shallow tank installation must be made, use a sewage pump that includes a grinder mechanism.

An alternate approach to providing for a basement sewer drain and basement toilet is to locate the septic tank deep enough to allow gravity flow from basement plumbing to the tank. Using this type of installation, a sump pump may be necessary to lift septic tank effluent from a pumping chamber, connected to the septic tank, up to the higher field absorption lines. Select the size of sump and frequency of pump operation to provide the desired application of effluent to the absorption area.

A riser must be provided leading from the access port in the septic tank to within a few inches (cm) of ground level. Use a riser having a minimum inside dimension of 24 inches (61 cm). To prevent structural failure in deep installations, check the strength of the tank with your supplier.

It is particularly important that proper safety precautions be taken when excavations are dug to install septic tanks. Means should be provided to prevent the sidewalls from collapsing. During non-work periods, holes should be covered with boards that cannot readily be removed, or the hole should be surrounded with a fence that cannot be easily entered. Back-fill immediately after setting the tank in position to help reduce the possibility of an accident and to prevent tank flotation or shifting in areas with high water tables. A mound system rather than an absorption field may need to be used in high water table areas.

Septic Tank Outlet Pipe

The outlet sewer from the septic tank to an absorption field or a pumping chamber should be a minimum of 4 inch (10 cm) diameter plastic or rigid sewer pipe. Use water tight joints. If possible, avoid running outlet sewers under driveways to avoid the possibility of crushing and

freezing. Lay the outlet sewer on a uniform slope with no high or low spots. Slope the pipe at least 1 percent [1/8 in. per ft. (1 cm/m)]. Effluent leaving the septic tank should not contain any solids; therefore, the outlet sewer does not need to run straight. When using a pump, the pipe from the pumping chamber to absorption field can be 1-1/4 inch (3.2 cm) or larger plastic water pipe, installed below the frost line.

Distribution Box

In some installations, septic tank effluent flows to a distribution box where it is discharged through outlets into several field disposal lines. The distribution box *(Figure 1)* is a tank-like box that has at least as many outlets as there are tile lines in the absorption field. When the box is constructed correctly, the outlets deliver equal amounts of effluent to each line. Equal distribution is necessary to prevent one tile line from becoming overloaded while another remains unused.

Place the distribution box on a substantial concrete foundation below the frost line so that its level position will not be affected by the heaving action of freezing soil. The outlets should be at least 4 inches (10 cm) above the bottom of the box so that any sludge escaping from the septic tank will be trapped and will not flow directly into the tile lines. The inlet to the distribution box should be at least 1 inch (2.54 cm) above the outlets. You can purchase a precast distribution box with your septic tank.

Absorption Field Location

When selecting the absorption field site, consider the locations of all improvements, including water supplies *(Table 1).* Investigate all areas of the lot either higher or lower than your house to find the best absorption field location. Locate the absorption field where good grass cover is possible. Do not locate it near trees or shrubs.

Suitable soil is necessary for successful treatment of septic tank effluent. A suitable soil texture has a percolation rate between 5 and 60 minutes per inch (2.54 cm). Clay loam or clay soils are not suitable as sewage will not flow through them at an adequate rate. Very coarse-textured soils, sands or gravel are also not suitable because sewage flows through them too rapidly to be filtered properly. Bacteria may reach the ground water table if sewage is applied to coarse soil.

Check with your local Soil Conservation Service (SCS) office about the suitability of soils on your property for treating sewage. The soil survey maps (if available) provide information on soil texture as well as high seasonal water tables or bedrock that will interfere with your sewage system. Keep in mind that a water table or bedrock within 4 feet (1.2 m) of the trench bottom will keep the absorption field from working properly. Percolation test results will provide information on the required size of absorption field needed.

After identifying a suitable absorption field site, keep vehicles off the area before, during and after construction. During the winter and spring months, keep all traffic off—including snowmobiles and foot traffic. Protect the absorption area against surface runoff water from roofs, patios, driveways, or other paved areas. Where needed, construct a small diversion or grassed waterway on the upslope side of the absorption area to lead the excess surface water away. Never discharge the water from basement footing drains or other sources onto the absorption area.

Absorption Field Size and Construction

The conventional absorption field consists of two or more flat-bottom trenches not more than 100 feet (30 m) long. Shorter trenches, 60 feet (18 m) or less, are preferred. Each trench contains a line of 4 inch (10 cm) perforated plastic or sewer pipe, open-jointed drain tile or half-moon tile laid in a gravel bed. This permits the effluent to spread uniformly over the entire length of the trench and percolate into the soil.

The amount of absorption area in the field depends on the number of bedrooms in your home and the percolation rate of the soil as illustrated in *Figure 3.* Determine the square feet (m^2) of absorption area for each bedroom and multiply this figure by the number of bedrooms to determine the total area needed. Decide on the width of trench that will be most convenient to construct, keeping in mind that a common width is 2 feet (60 cm). Dividing the total area required by the trench width gives the total trench length required.

Figure 4 illustrates a typical absorption trench. Dig the trenches 24 to 36 inches (61 to 91 cm) deep and be sure that they are nearly level,

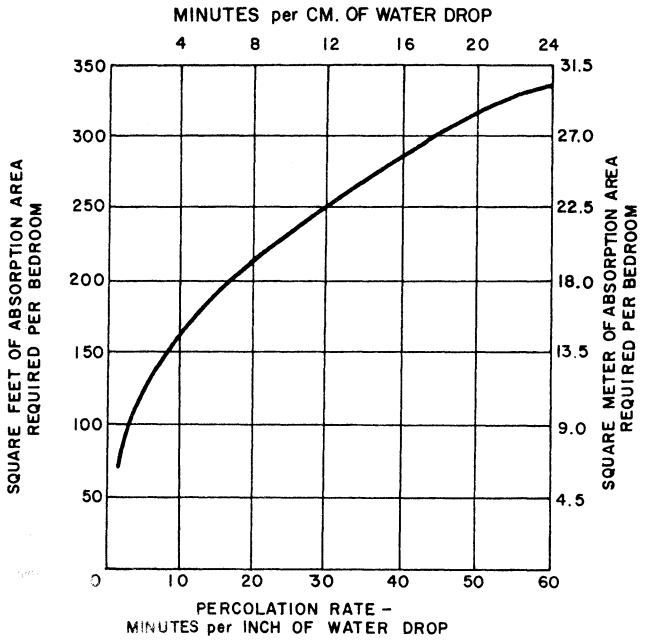

Figure 3. Absorption area required per bedroom based on the percolation rate.

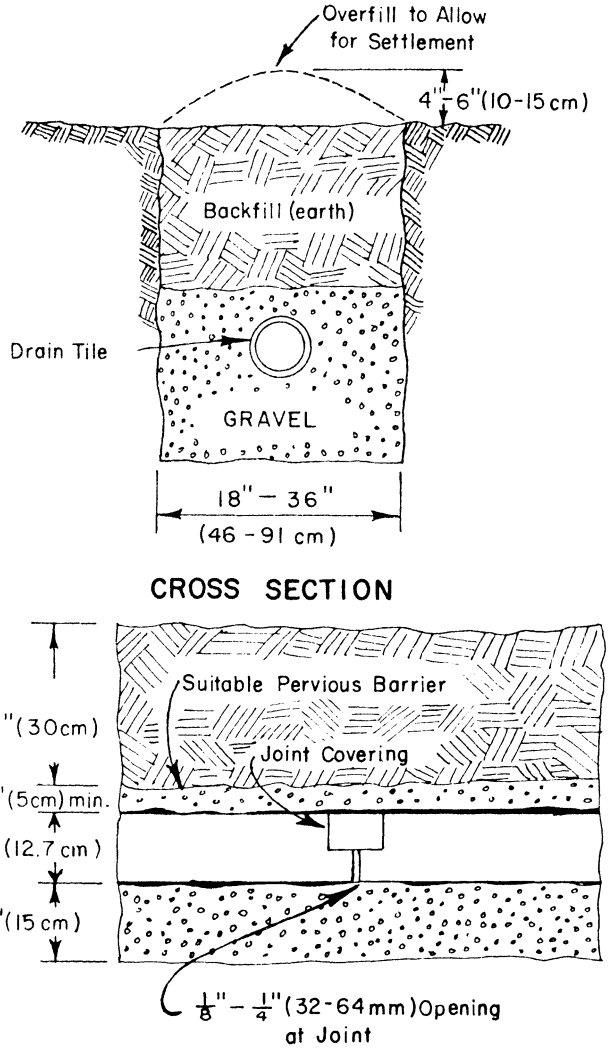

Figure 4. Typical section of absorption or disposal trench.

both across the bottom and end to end. Place about 6 inches (15 cm) of coarse gravel or crushed stone in the trench bottom. Lay the field line on a slope having about 2 inches (5 cm) of fall in 50 feet (15 m). Place more stone over and around the line until the gravel bed is at least 2 inches (5 cm) over the line. Be careful when dumping the stone not to crush the line or knock the sections out of alignment. In sandy or well-drained soils, you may cover the joints with strips of asphalt roofing paper and refill the trench with loose top soil instead of putting gravel around the tile.

Lay a strip of untreated building paper or a 2 inch (5 cm) layer of straw over the stone and back-fill the rest of the trench with the soil just removed. You should tamp loose soil in the trench but do not pack wet, poorly drained clay around the tile because it will harden like concrete. Construction during wet soil conditions may greatly reduce soil infiltration effectiveness due to compaction of the trench sides and absorption area.

Maintenance

Even the best designed and operated septic tank system eventually fails without periodic inspection and maintenance. Inadequate maintenance results in clogging of the septic absorption field. When this happens, a new absorption field may need to be constructed.

To start the sewage treatment process in a new septic tank system, begin using it as you would if it had been in operation for awhile. Normally, as the tank fills, the natural processes begin. Some authorities suggest adding 200 to 300 gallons (760 to 1,140 l) of water before use. The use of some hot water is recommended, particularly in the winter. Although products are available to seed the system with desirable bacteria—this is not necessary.

Extension work in "Agriculture, Home Economics and subjects relating thereto," The Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, Cooperating with the Counties and the U.S. Department of Agriculture
Leo E. Lucas, Director

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