Water Quality
in Georgia

Septic Tank Design and Construction

The University of Georgia College of Family & Consumer Sciences and College of Agricultural & Environmental Sciences • Cooperative Extension Service

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The first known installation of a septic tank in the United States was in 1876, although Louis Mouras of Vesoul, France, was given a patent in 1881 and credited with the invention. Baffles, which regulate the flow, were added in 1905 to make the septic tank more efficient. The first baffles were made of oak boards.

At the turn of the century, there were some very large community septic tanks. In 1903, four community tanks were constructed in Saratoga, New York, with a total capacity of one million gallons.

By 1920, septic tanks began to be a common feature. After World War II, septic tanks became important to housing developments in unsewered areas.

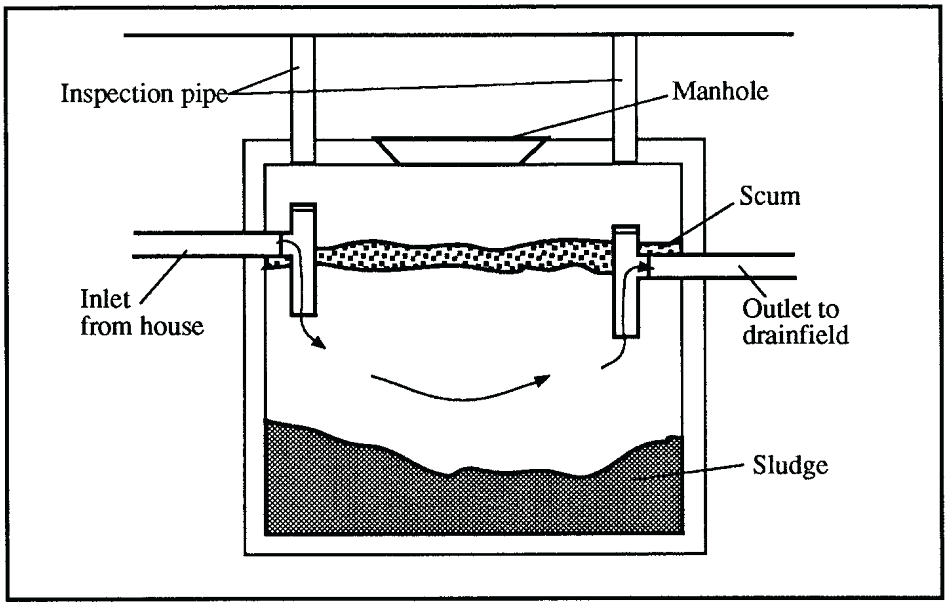

Figure 1. *Cross-section of a septic tank*

Septic Systems and Groundwater

A few rules of thumb tell us when septic systems are most likely to function properly and minimize groundwater contamination:

Good soil facilitates treatment and disposal of septic system wastewater. Soil profiles made of sand, silt and clay work best. If there is too much clay in the soil, the waste may percolate poorly. If the soil contains too much sand and large particles, wastewater may pass through to the groundwater without being treated by soil microbes.

Soil treatment occurs best when above the water table and the soil is relatively dry with oxygen present. Water at greater depths allows wastewater to remain in the unsaturated soil, where it can be treated most effectively before reaching groundwater.

Septic systems need space. Only part of the microorganisms and chemicals are removed from wastewater as it moves downward. Even properly operating systems can discharge some phosphates, nitrates and bacteria or viruses into the groundwater. To reduce loading of groundwater with effluent, install systems on lots with adequate space.

Proper design and use is important. Septic systems are designed to treat and dispose of a specific volume and type of wastewater in the conditions found at the site. The system must not be overloaded. Hazardous chemicals or large amounts of grease should not be disposed in septic systems. Kitchen grease should be placed in the garbage, not the septic tank. Water conservation extends the life of the system.

Routine maintenance is critical. Septic tanks must eventually be pumped. Sludge and scum accumulate and, if allowed to remain, will eventually cause the tank to overflow and clog the drainfield.

Good judgment in planning and design and diligent maintenance are the most important aspects of an effective septic system management program.

Septic Tank Function

Sewage or untreated household waste will quickly clog all but the most porous gravel formations. The septic tank conditions sewage to allow percolation of the liquid portion into the subsoil. The most important function of septic tanks is to protect the absorption ability of the subsoil. In doing this, the septic tank does the following three things.

Removes solids from liquid. As sewage enters the tank, the rate of flow is reduced and heavy solids settle, forming sludge. Grease and other light solids rise to the surface, forming a scum. The sludge and scum are retained and break down while the clari-

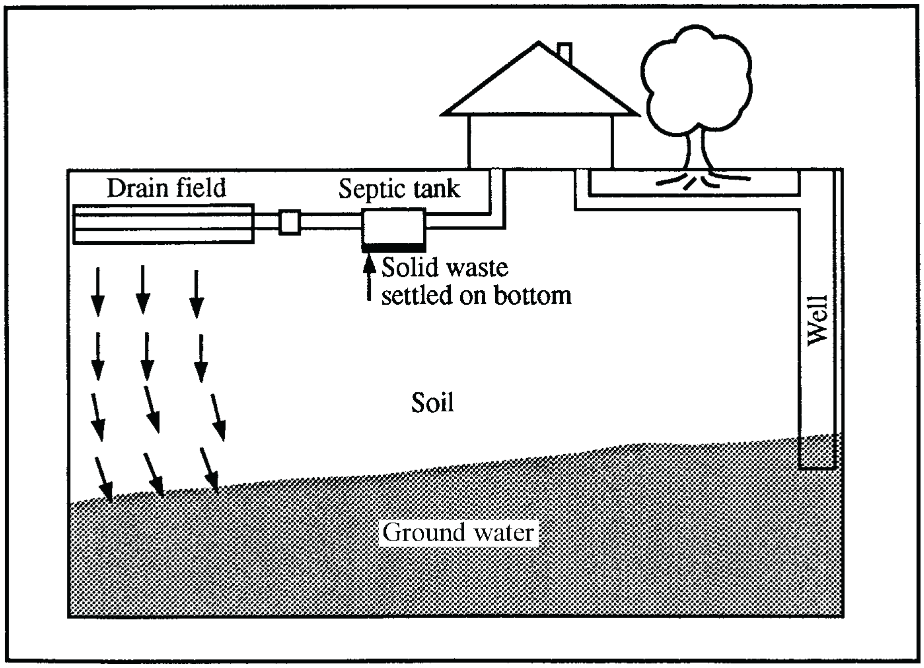

Figure 2. Septic systems can affect groundwater.

fied effluent (liquid) is discharged to the drainfield for soil absorption.

Provides biological treatment. Natural processes break down the solids and liquids by bacterial action. The breakdown occurs in the absence of oxygen (anaerobic conditions). The anaerobic conditions are referred to as "septic," giving the tank its name.

Stores scum and sludge. The solids accumulate in the bottom of the tank to form sludge. The scum is a partially submerged mat of floating solids and grease. Scum and sludge are digested over time and compacted into a small volume. Areas with warm climates, such as the southern United States, allow more complete breakdown of solids and scum than in the cooler climates of the North. For this reason, tanks in warm climates do not usually need to be pumped or cleaned out nearly as often as those in cold climates. Regardless of climate, a non-volatile residue of material remains in the tank. Sufficient volume for the solids must be provided in the tank between pumpings or cleanings. If the solids fill the tank and enter the drainfield, the solids can clog the soil in the drainfield.

Grease from the kitchen is detrimental to septic tank functions. Effluent from grease traps must go through septic tanks before being discharged to drainfields to prevent soil plugging. The best approach is to put kitchen grease in old milk jugs and place in the garbage rather than into the drain. Small amounts of kitchen grease can go into the septic tank without damaging the system.

Effluent — Bacteria and Nutrients

The liquid faction that leaves the septic tank and enters the drainfield is called the effluent. The bacterial level of the effluent is quite high, contrary to popular belief.

The effluent also contains nitrates (among other nutrients), which move downward. To reduce potential for groundwater contamination by the effluent, many areas restrict building lot sizes. Larger lots reduce loading rates and help protect groundwater. Some areas with porous or sandy soils are located in groundwater recharge areas. These areas may be unsuited for septic tanks or require building lot sizes 50 to 100 percent larger than lots not in the recharge areas. Pathogens break down with soil contact and pathogen levels are reduced as the effluent percolates through the soil. Bacteria eventually die and are removed by the filtering effect of the soil, further purifying the effluent.

The drainfield pipe is placed on the contour and perforated to allow the effluent to percolate into the soil. For this reason, the percolation of the soil is a critical factor when determining the amount of drainfield needed. A percolation test of the soil in the drainfield area is essential. If you are considering installing a septic tank, contact your local health department and building inspector for local requirements. The percolation test procedure is described here for your information.

Percolation Test

To conduct a percolation test, dig several straight-sided holes (with a hole digger or auger) at least 4 inches in diameter down to the drainfield level in the area to be used for the drainfield. Roughen or scratch any slick clay or compacted soil in the bottom or sides of the holes by scraping lightly. Remove loose material and add two inches of fine gravel to each hole. Put water into the holes and saturate the soil, allowing time for clay to swell. All soils except sands must be soaked at least four hours before percolation test results are analyzed.

After soaking, add six inches of water over the gravel and select a fixed point at ground level where repeated measurements can be made. Use the same time interval between measurements and record the settling distance over the time interval. Add water if the depth of the water over the gravel falls below two inches. Take measurements at approximately the same time intervals until a constant rate of percolation is found. The time in minutes required for the water to drop one inch is the percolation rate in minutes per inch (see Table 1).

Boring to determine ground water elevation in low areas may be required by the county health department. In such

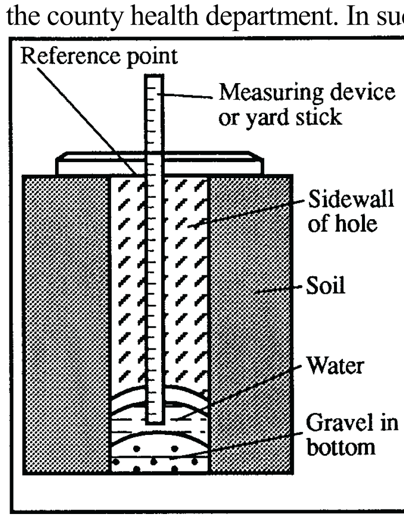

Figure 3. The percolation test

cases, bore to a depth of six feet and provide sufficient time for the water level to stabilize. Sufficient time may mean overnight for clay soils and no less than 30 minutes in sandy soil.

Drainfield Size

Once the percolation rate is known, the drainfield trench bottom area can be found. Table 1 can be used for residential areas.

Table 1: Residential drainfield area per bedroom in house

Average percolation rate at tile depth (min/inch)	Trench bottom per bedroom (square feet)	Length of trench in feet		
		18" wide	24" wide	36" wide
5+	125	84	63	42
10	165	110	83	55
15	190	127	95	64
20	215	144	108	72
30	250	167	125	84
45	300	200	150	100
50	315	210	158	105
60	340	227	170	113
70	360	240	180	120
80	380	254	190	127
90*	400	267	200	134

+ Fastest rate allowed; * Slowest rate allowed

If more than 500 linear feet of drainfield is needed, a dosing siphon is required to disperse liquid throughout the drainfield. The siphon must have a capacity equivalent to 60 to 75 percent of the interior volume of the lines to be dosed. A typical cross-section of a drainfield line is shown in Figure 4.

Location and Dimensions

Drainfields should be at least 100 feet from the closest well or spring, at least 10 feet from water supply lines, and not closer than 50 feet to a pond or stream.

Drainfield trenches should normally be level and not less than 25 inches or more than 36 inches in depth. In rare cases, trenches will be deeper and filled with several feet of gravel to obtain acceptable percolation. The tile drain must have at least 12 inches of soil over the tile. The aggregate should be a minimum of six inches deep under the drain tile. The drainfield trenches should not exceed 36 inches in width.

Septic Tank Capacity

Septic tanks must provide at least 24-hour retention time or at least 750 gallons for a one- or two- bedroom house, 900 gallons for a three-bedroom house and 1,000 gallons for a four-bedroom house. Add 250 gallons for each bedroom exceeding four. Septic tanks must have access openings over inlet and outlet baffles.

Access location should be marked and visible for easy inspection.

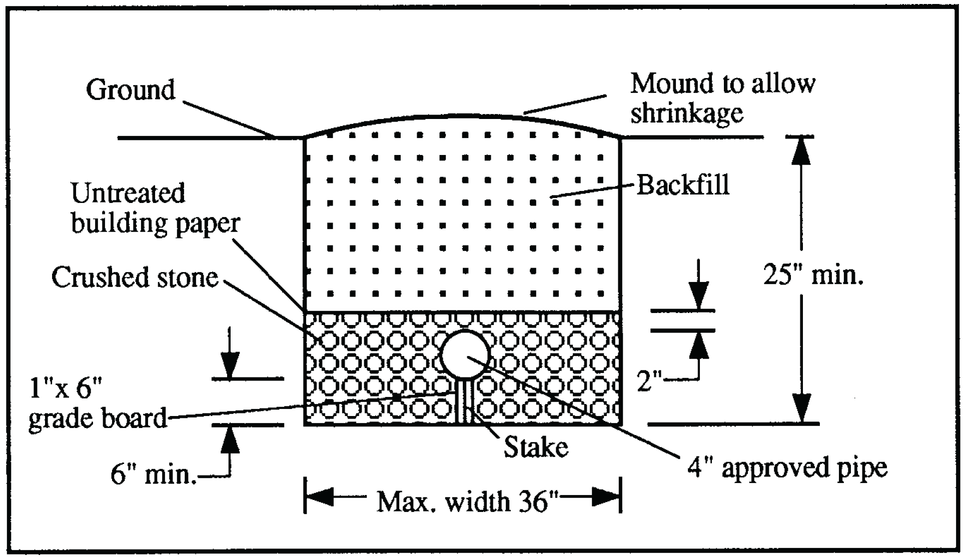

Figure 4. *Cross-section of a typical drainfield line*

Selecting A Site

- Stay at least 100 feet from drinking water sources, 50 feet from streams or ponds and 10 feet from water lines.
- Slope drainfields away from houses, buildings and the water supply.
- Keep drainfields unshaded and free from trees and shrubbery.
- Allow sufficient space to enlarge the drainfield if it becomes necessary.
- Keep septic tanks or drainfields uncovered by driveways or concrete.
- Locate septic tanks and drainfields away from drainage areas and waterways.
- Never use an open flame or matches to inspect a septic tank. Sewer gases may explode violently.

Planning the Drainfield

Drainfields consist of two or more trenches not more than 100 feet in length. Each trench contains sections of open-jointed four-inch drain tile or perforated plastic drainpipe laid with the holes down. The pipe is level to disperse effluent evenly over the soil area. The

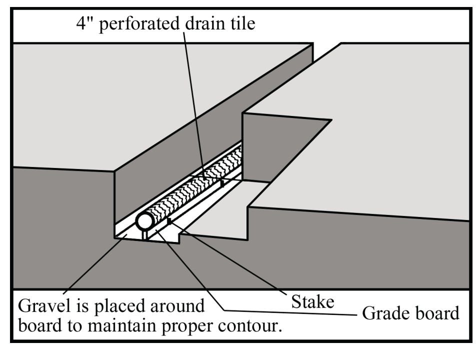

Figure 5. *Drainfield tile can be leveled using a grade board.*

percolation rate indicates how fast water will penetrate the soil and sizes the drainfield. Some counties require additional soil analysis.

How to Construct Drainfields

- Using the percolation rate and Table 1, find the trench bottom area required per bedroom. Multiply this by the number of bedrooms to get the total trench bottom area. Decide on the trench bottom width (not to exceed 36 inches) and then deter-mine the total drainfield length (no one trench can exceed 100 feet).
- Drive stakes to mark the position of the trenches on the contour. A builder's level is helpful but not essential. Drive grade stakes and attach a board by using a good carpenter's level.
- Use a distribution box to distribute effluent to the drainfield. Drop boxes are also used in some states, but are not commonly used in Georgia.

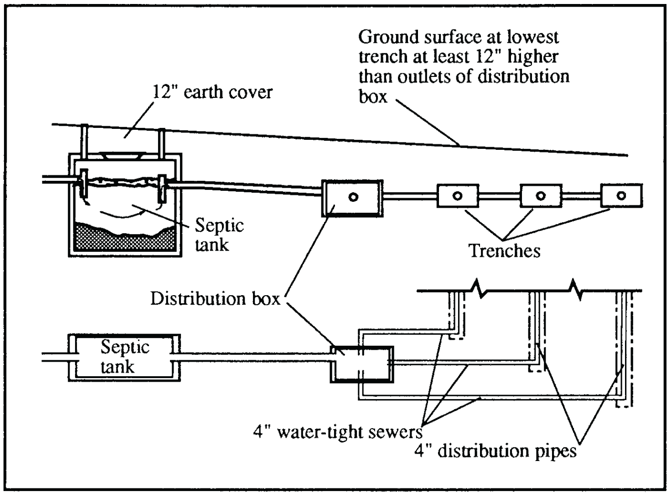

Figure 6. *Sewage treatment system with distribution box*

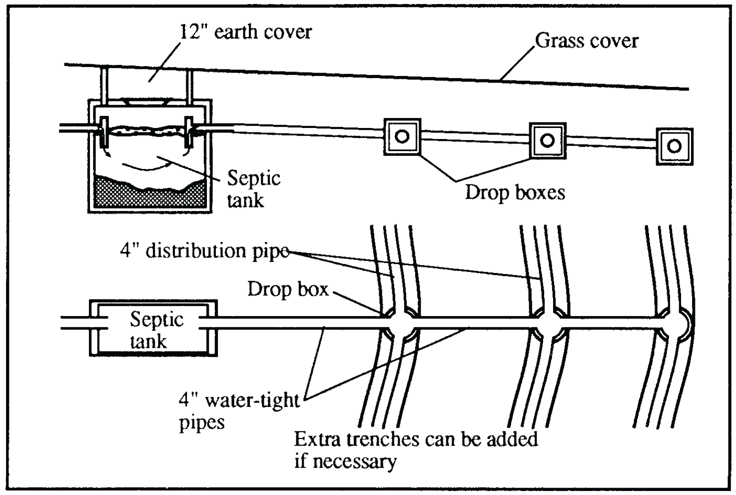

Figure 7. *Sewage treatment system with drop boxes*

- Use serial distribution if the terrain is hilly. The drainfield lines should be at least eight feet apart.
- The distribution box method can be used on level or sloping terrain and is required in Georgia when dosing tanks are used.

A firm earthen or concrete foundation extending at least 12 inches beyond the box walls is required to ensure against tilting of the box. Care is required when backfilling over and around the box. The top of the box must have a minimum of six inches of soil over the top, but no more than 24 inches unless ready access is provided. The sewer line from the septic tank or dosing tank enters the distribution box and terminates in a downward turned elbow.

- Absorption lines or drainfield lines of equal lengths are connected to the distribution box outlets by independent watertight sewers.

The absorption or drainfield trenches may be installed at the same elevation or at different elevations. All the watertight sewers leading from the distribution box outlet to the drainfield lines must be at the same elevation at the distribution box and the watertight sewers must be level for the first two feet as they lead away from the distribution box.

If drainfield trenches are at different elevations, some special requirements should be met. After extending two feet from the box, the watertight sewers must have a slope of at least l/8-inch per foot down to the individual drainfield trenches. The drainfield lines should also be installed on a uniform grade of not less than two inches nor more than four inches per 100 feet (two inches is preferred). An increased number of shorter trenches is preferable to fewer longer trenches in this situation.

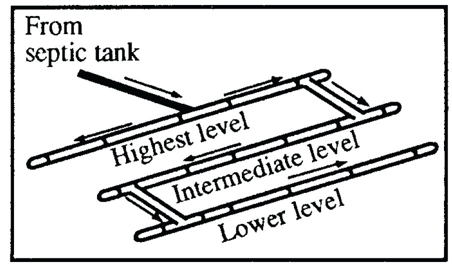

Figure 8. *Serial distribution does not require a distribution box and can be used on sloping land. The individual drainfield lines are on the contour. The first trench receives effluent from the tank and when full overflows through the relief line to the next trench.*

Conclusions

Properly designed and installed septic tanks can function for many years. Annual inspection to determine sludge depth is desirable to prevent tank solids from overflowing and sealing the soil in the drainfield. Minimize the amount of grease from the kitchen and garbage disposal solids going into septic tank. Water conservation reduces the loading and saturation of the drainfield.

Check with your local health department for specific requirements in your county before purchasing lots or beginning construction. Septic tanks serving a central system to serve commercial or industrial facilities, institutions, travel trailer and mobile home parks, subdivisions or multiple family dwellings of five or more family units require a design by a professional engineer.

To protect groundwater, many areas increase lot size requirements to reduce septic tank densities. Septic tank permits may be subject to additional restrictions in groundwater recharge areas.

Contact your local health department or county Extension office for additional information on septic tank maintenance.

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