What Do Septic Systems Do?

Septic systems protect human health and the environment by safely recycling wastewater back into the natural environment. Septic systems treat wastewater as well as, or better than, municipal treatment systems at a reasonable cost when properly designed, installed, operated, and maintained.

Federal, state, and local regulation of onsite systems focuses on proper treatment of sewage to protect citizens, communities, and the environment.

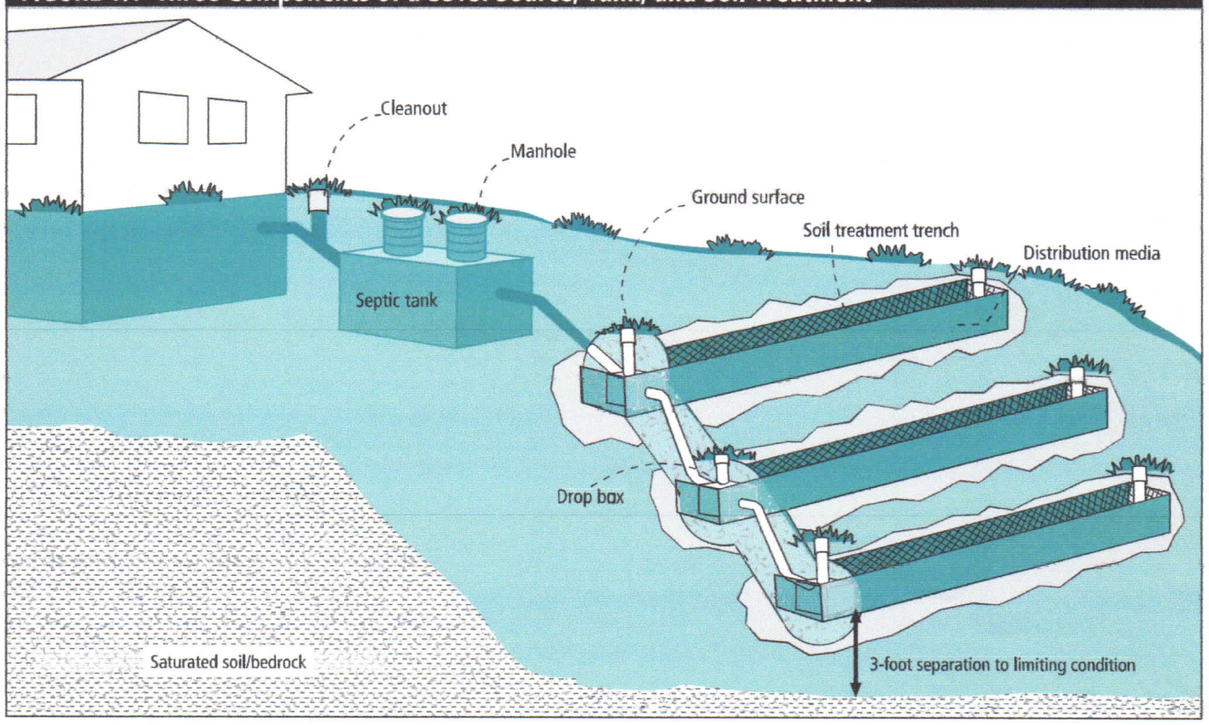
Many SSTS owners incorrectly assume that as long as their used water "goes away," their system must be working properly. Septic systems are machines that are designed to utilize physical, chemical, and biological processes to treat sewage and effluent. Disposal systems, though popular in the past, are just that—relics of a time when treatment of sewage was not considered the priority it is today. As the population grows and the demand for natural resources continues to increase, society's expectations that sewage be responsibly treated and returned to the environment will also increase. This means that many local programs will be focusing on identifying and addressing problematic disposal systems in the years to come. According to 2006 local program reporting to the Minnesota Pollution Control Agency (MPCA), approximately 1/3 of all systems in Minnesota either pose a threat to public health or are failing to protect groundwater resources (MPCA, 2007).

How Does a Septic System Work?

In typical onsite treatment systems, all wastewater is co-mingled, treated, and dispersed by one system. There are a few separation systems in which toilet wastes or grease from restaurants are treated separately from other wastewater.

Common septic systems all have three basic components: plumbing, septic tank, and a soil treatment area (see Figure 1.1). Individual systems may have variations of each of these components.

FIGURE 1.1 Three Components of a SSTS: Source, Tank, and Soil Treatment



Plumbing

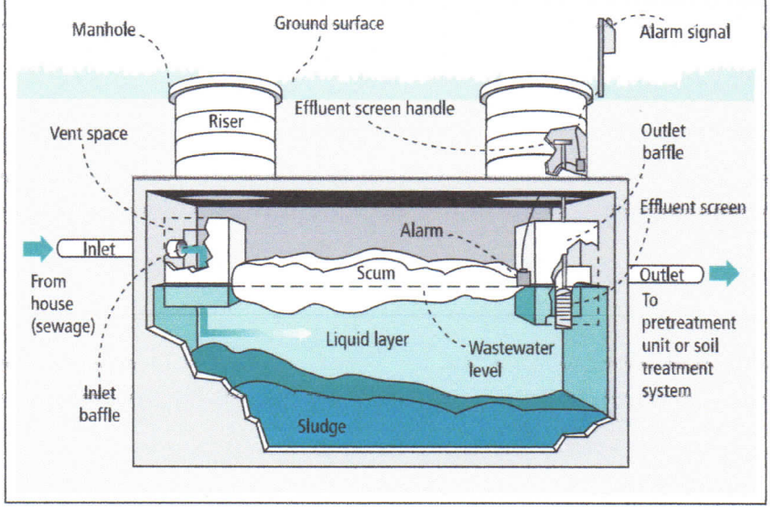
The wastewater side of household plumbing collects used water from fixtures and appliances and delivers it to the treatment system(s). Reducing the waste that enters this plumbing is an easy way to reduce the management necessary to ensure safe wastewater treatment. Determining the quantity and strength of wastewater generated on a site is the topic of Section 5. Wastewater collection specifications are highlighted in Section 6.

Septic tank - Treatment Level C

The septic tank is a solid, watertight tank, or series of tanks, that receives waste water. It separates the solids from the liquids and stores the solids until they are decomposed or removed. The liquid, called effluent, is delivered to the soil treatment system.

Inlet and outlet baffles trap the floating solids (scum) in the tank. Inspection pipes allow monitoring of the tank, and maintenance holes facilitate cleaning. Certain systems are required to add filtration to the outlet end of the tank. Effluent screens are a practical means of reducing the loading of solids to the soil treatment area and are now required in many instances. A septic tank and its components are shown in Figure 1.2. Septic tanks are the focus of Section 7 of this manual. The management of septic tanks and land application of tank septage are discussed in detail in Section 8.

FIGURE 1.2 Septic Tank and Components



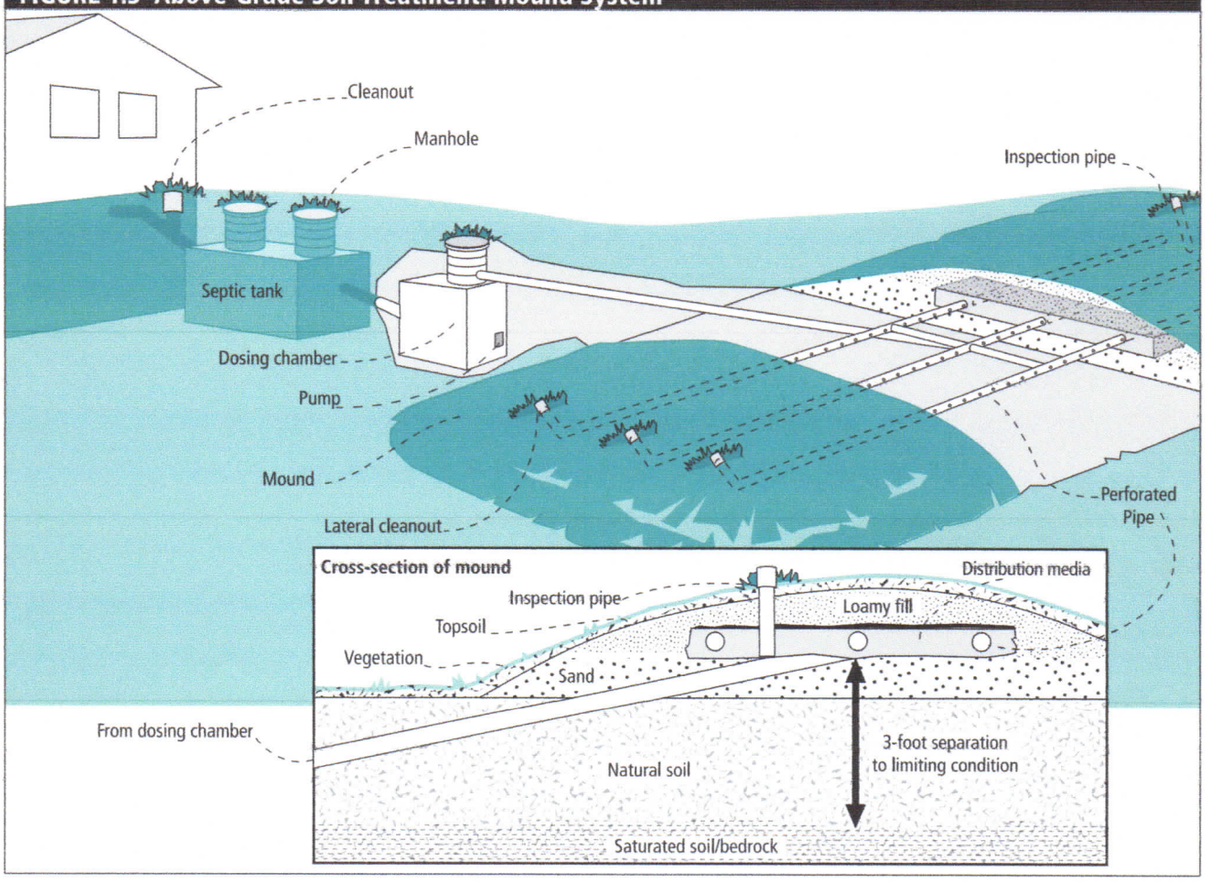
The size of the septic tank is based on the home's potential water use volume and the type of appliances used. In aerobic tank systems, pumps and other mechanisms are necessary to deliver air to the tank.

Soil treatment area

The soil treatment area for the typical septic system is a network of perforated pipes or tubes typically surrounded by small rock and soil. Some designs use large plastic tubes or chambers instead of rock to disperse effluent from the tank into the surrounding soil. Section 11 focuses on the delivery of effluent to the soil treatment area, while Section 12 provides detail about the design, installation and care of various types of soil treatment areas.

The design of the treatment area (trench, mound, etc.) is based on the depth of the limiting condition, such as saturated soil or bedrock. The soil in the treatment area must not be saturated with water for extended periods of time during the year. Three feet of unsaturated soil below the system is necessary to complete the treatment process. This is not possible in many instances in Minnesota, in which case, the system must be built at-grade or above the natural ground surface to artificially create an unsaturated treatment zone. A mound system and its components are illustrated in Figure 1.3. Details about the connection between soil science and onsite wastewater treatment are provided in Section 3 of this manual.

FIGURE 1.3 Above-Grade Soil Treatment: Mound System



The size of the soil treatment area needed depends on the volume of water to be treated and the infiltration capacity of the soil on the site. For example, a much larger soil area is needed for a large home or a home on clay soil than for a small home or one on sandy soil.

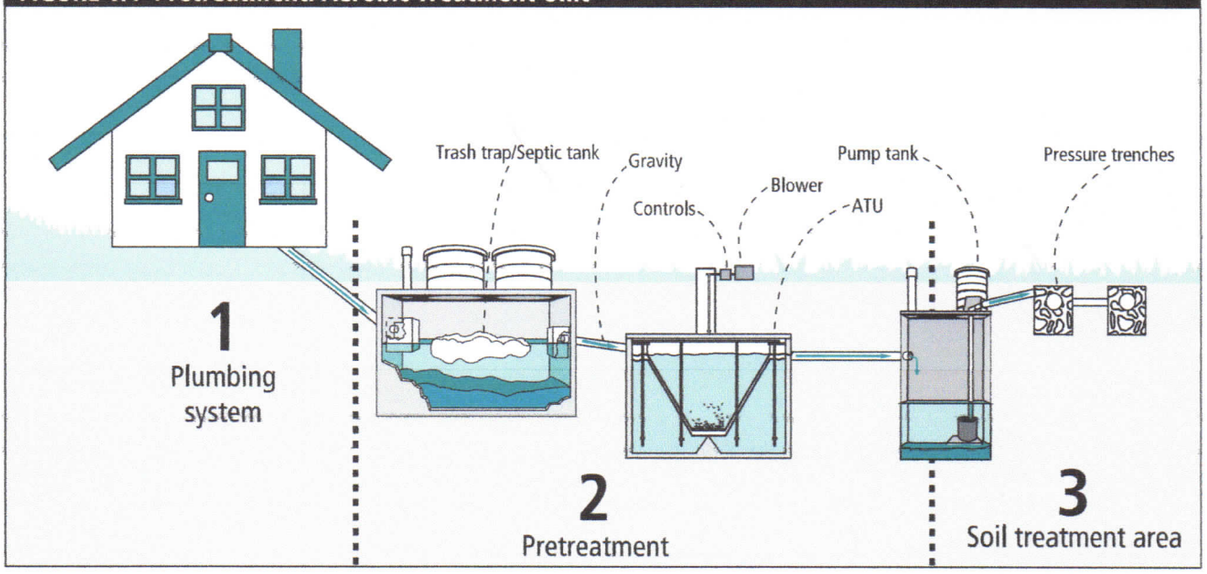
Pumps and a lift station may be components of a system where gravity flow is not possible. For example, in systems above grade and those using advanced technologies, a pump is required to provide pressurized flow for the distribution of effluent. Section 4 provides information about conducting legal and accurate site evaluations to determine the appropriate design for a given site.

Enhancements - Treatment Levels A and B

Sometimes enhancements, known as pretreatment units, are added to septic systems. Some of the options are aerobic tanks, single pass or recirculating media filters, and constructed (lined) wetlands. These are located between the septic tank and the soil treatment area to improve the performance of the system or provide treatment in difficult soil conditions (for example, shallow bedrock or high water tables). These

systems typically require additional pumps, control devices and a higher level of management. Section 10 provides information and specifications on many pretreatment devices used in Minnesota. A septic system utilizing an aerobic treatment unit is shown in Figure 1.4.

FIGURE 1.4 Pretreatment: Aerobic Treatment Unit



Separation technology systems may require containers in the home that collect and compost solid organic wastes. Other devices may collect and store wastewater for delivery to a soil treatment or dispersal unit.

How Is The Sewage Treated?

In the typical system, raw sewage is collected by the plumbing in the home and delivered to the septic tank. There the light solids float to the top, forming a scum layer, and the heavy solids sink to the bottom, forming sludge.

In the tank, organic solids such as food particles and human waste are decomposed by millions of naturally occurring bacteria. In regular septic tanks, the bacteria are anaerobic, that is, they live without air in the liquid of the septic tank. In aerobic tanks, the bacteria are aerobic and require air to live.

The septic tank delivers the partially treated liquids, or effluent, to the soil treatment area. Effluent contains pathogens (disease-causing organisms), nutrients, chemicals, and some fine solids. In order to both treat the effluent and disperse the water, the soil treatment area must be appropriately sized. The size of the soil treatment area is based on two major variables: the potential size of the home, and thus, potential water use, and the type of soils on the site, which vary significantly in conductivity, or the ability to transmit water. A thin layer of fine solids, dead bacteria, and soil bacteria, called a biomat, forms naturally where the effluent enters the soil. The biomat restricts the flow sufficiently to keep the soil beneath unsaturated. Pressurized systems dose effluent periodically to ensure unsaturated flow.

The unsaturated soil contains oxygen, which allows aerobic bacteria to live and destroy pathogenic organisms. Aerobic bacteria also consume the ever-forming biomat, creating a balance between formation (thickening) and consumption (thinning). These air spaces also force nutrients such as phosphorus to come in direct contact with soil particles to which they become attached. A portion of the nitrogen contained in the effluent passes through into the groundwater. After passing through the unsaturated soil, the effluent—now treated—returns to the soil and groundwater system. Some treated effluent does evaporate into the atmosphere, the amount of which depends on various factors such as system depth, climate, and weather.

Why Do Septic Systems Fail?

Failure of a septic system means that wastewater may come in contact with people or enter the natural environment without complete treatment of all harmful contents. Indicators of problems or a failing system include the following:

- Sewage backup into the house or surfacing in the yard
- System alarms sounding
- Frozen pipes or frozen soil treatment areas
- Algal blooms and excessive plant growth in nearby ponds or lakes
- High levels of nitrates or coliform bacteria in well water tests

System failure is most commonly the result of lack of proper maintenance, overuse of water in the home, or improper system design or installation.

Improper maintenance

The solids that accumulate in the septic tank must be removed regularly. If excessive scum or sludge builds up, it will begin to enter the soil treatment area and over time will prematurely plug it. It is required that a septic tank be cleaned (pumped) through the manhole, removing all solids, at least every three years. Cleaning frequency depends on several factors, including the number of people in the home, the size of the tank, and the use of a garbage disposal. The preferred method of completely removing solids from the tank requires flushing and back-flushing between the tank and truck several times. Another method is to agitate the contents of the tank to the extent that it becomes a "slurry" that can be completely evacuated by the vacuum truck.

Overuse of water

The typical Minnesota resident (man, woman, or child) uses about 60-70 gallons of water per day (Mayer et al., 1999). Systems are sized for typical water use, but abnormally high usage or accidental overuse (such as from leaky fixtures or tanks) can quickly overload the system. A system partially damaged from improper maintenance may not be able to accept even typical volumes of water. When ownership changes, high water use patterns by the new tenants can result in the flushing of solids to the drainfield, soil plugging, and/or system surfacing. Section 5 discusses Wastewater Sources and Flows.

Improper design or installation

This may be the result of mistakes made by the designer or installer. It is also possible that the wrong system was chosen for the site and soil conditions (for example, high water table, shallow bedrock). It is also possible that the site was compacted by construction equipment or other mistakes were made during the installation. Often

times, though, the residence has been modified to house more people or to use fixtures or appliances that the system was not designed for or sized to handle.

Cleaning up a Sewage Back-up

Adapted with permission from KING COUNTY, WA Environmental Health; www.kingcounty.gov

Thorough cleaning of indoor sewage spills is necessary to protect people – especially small children – from harmful bacteria and viruses. Clean-up should begin as soon as possible to reduce the risk of exposure to sewage. The following tips are a guide to proper spill clean up.

Clean up tips:

- Keep children and pets out of the area until clean-up has been completed.
- Wear rubber gloves and boots.
- Wash your hands thoroughly and launder clothes separately after completing the clean-up.
- Remove all furniture, loose rugs, and so on from the area.
- Saturated wall-to-wall carpeting (and the pad) usually cannot be adequately cleaned. They should be removed, wrapped in plastic, and taken to a transfer station or sanitary landfill. If you decide to keep the carpeting, hire a licensed carpet cleaning company to steam clean and disinfect the carpet.
- All hard surfaces, such as linoleum, hardwood floors, concrete, wood moldings, wood, and metal furniture, and so on, should be thoroughly cleaned with hot water and a mild detergent (dish detergent), and then rinsed with a bleach solution by mixing one tablespoon of liquid household bleach to one gallon of water. Let the surface air dry.
- Upholstered furniture, loose rugs, drapery, and so on, should be professionally cleaned or discarded. Notify the cleaner of the problem.
- Remove and replace plaster, drywall, and lath that have been saturated and are soft to the touch. If the surface has been wetted, clean as you would a hard surface, but do not saturate the plaster.
- Clean sinks, dishwashers, and other plumbing fixtures that have had sewage back-up with detergent, and then rinse with bleach solution.
- Disinfect clean-up mops, brooms, and brushes with bleach solution.
- Increase air circulation to reduce odors and mold growth - open all windows and doors. The use of fans and heaters may speed this process.

Compliance Inspections

Septic systems are evaluated during a compliance inspection to assure nothing is causing back-up of sewage into the dwelling or in the yard. Systems are further evaluated to ensure the tank is watertight, and the soil treatment area is properly sited to provide treatment.