



Source Water Protection Practices Bulletin

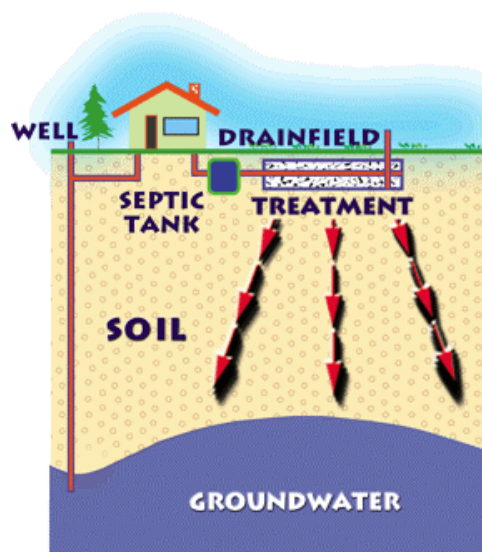
Managing Septic Systems to Prevent Contamination of Drinking Water

Septic systems (also known as onsite wastewater disposal systems) are used to treat and dispose of sanitary waste. When properly sited, designed, constructed, and operated, they pose a relatively minor threat to drinking water sources. On the other hand, improperly used or operated septic systems can be a significant source of ground water contamination that can lead to waterborne disease outbreaks and other adverse health effects.

This fact sheet discusses ways to prevent septic systems from contaminating sources of drinking water. Septic systems that receive non-sanitary wastes (e.g., industrial process wastewater) are considered industrial injection wells, and are not the primary focus of this fact sheet. Other fact sheets in this series address prevention measures for contamination sources such as fertilizers, pesticides, animal feeding operations, and vehicle washing.

SOURCES OF SEPTIC SYSTEM EFFLUENT

About 25 percent of U.S. households rely on septic systems to treat and dispose of sanitary waste that includes wastewater from kitchens, clothes washing machines, and bathrooms. Septic systems are primarily located in rural areas not served by sanitary sewers.



A typical household septic system consists of a septic tank, a distribution box, and a drain field. The septic tank is a rectangular or cylindrical container made of concrete, fiberglass, or polyethylene. Wastewater flows into the tank, where it is held for a period of time to allow suspended solids to separate out. The heavier solids collect in the bottom of the tank and are partially decomposed by microbial activity. Grease, oil, and fat, along with some digested solids, float to the surface to form a scum layer. (Note: Some septic tanks have a second compartment for additional effluent clarification.)

The partially clarified wastewater that remains between the layers of scum and sludge flows to the distribution box, which distributes it evenly through the drain field. The drain field is a network of perforated pipes laid in gravel-filled trenches or beds. Wastewater flows out of the pipes, through the gravel, and into the surrounding soil. As the wastewater effluent percolates down through the soil, chemical and biological processes remove some of the contaminants before they reach ground water.

Large capacity septic systems are essentially larger versions (with larger capacities and flow rates) of single family residential septic systems, but they may have more than one septic tank or drain field for additional treatment capacity. In some cases, an effluent filter may be added at the outlet of the large capacity septic tank to achieve further removal of solids. Many large systems rely on pumps rather than gravity to provide an even flow distribution into the drain field.

WHY IS IT IMPORTANT TO MANAGE SEPTIC SYSTEMS NEAR THE SOURCES OF YOUR DRINKING WATER?

Septic systems are a significant source of ground water contamination leading to waterborne disease outbreaks and other adverse health effects. The bacteria, protozoa, and viruses found in sanitary wastewater can cause numerous diseases, including gastrointestinal illness, cholera, hepatitis A, and typhoid.

Nitrogen, primarily from urine, feces, food waste, and cleaning compounds, is present in sanitary wastewater. Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) in infants, which reduces the ability of the blood to carry oxygen. If left untreated, methemoglobinemia can be fatal for affected infants. Due to this health risk, a drinking water maximum contaminant level (MCL) of 10 milligrams per liter (mg/l) or parts per million (ppm) has been set for nitrate measured as nitrogen. Even properly functioning conventional septic systems, however, may not remove enough nitrogen to attain this standard in their effluent.

AVAILABLE PREVENTION MEASURES TO ADDRESS SEPTIC SYSTEMS

Septic systems can contribute to source water contamination for various reasons, including improper siting, poor design, faulty construction, and incorrect operation and maintenance. Most States and localities regulate siting, design, and construction of septic systems and only regulate operation and maintenance for large capacity septic systems. Some of the more widely used prevention measures are described below. Your local health department should be able to advise you on specific requirements for your community.

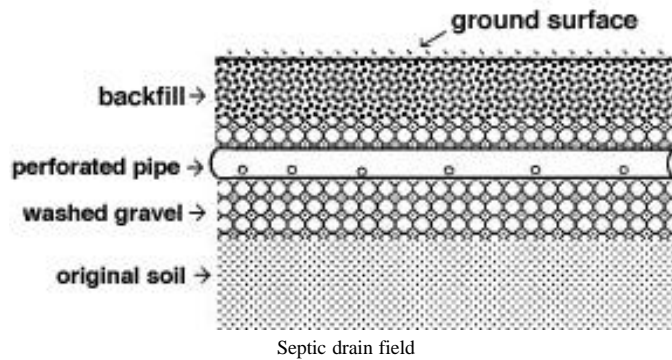
Please keep in mind that individual prevention measures may or may not be adequate to prevent contamination of source waters. Most likely, individual measures should be combined in an overall prevention approach that considers the nature of the potential source of contamination, the purpose, cost, operational, and maintenance requirements of the measures, the vulnerability of the source water, the public's acceptance of the measures, and the community's desired degree of risk reduction

Siting

Most jurisdictions have adopted, for septic systems, ***minimum horizontal setback distances*** from features such as buildings and drinking water wells and ***minimum vertical setback distances*** from impermeable soil layers and the water table. Septic systems should be located a safe distance from drinking water sources to avoid potential contamination. Areas with high water tables and shallow impermeable layers should be avoided because there is insufficient unsaturated soil thickness to ensure sufficient treatment. ***Soil permeability must be adequate*** to ensure proper treatment of septic system effluent. If permeability is too low, the drain field may not be able to handle wastewater flows, and surface ponding (thus contributing to the contamination of surface water through runoff) or plumbing back-ups may result. If permeability is too high, the effluent may reach ground water before it is adequately treated. As a result, alternative systems may be necessary in karst areas. Well-drained loamy soils are generally the most desirable for proper septic system operation. In making siting decisions, local health officials should also evaluate whether soils and receiving waters can absorb the combined effluent loadings from all of the septic systems in the area.

Design and Construction

Septic tanks and *drain fields should be of adequate size* to handle anticipated wastewater flows. In addition, soil characteristics and topography should be taken into account in designing the drain field. Generally speaking, the lower the soil permeability, the larger the drain field required for adequate treatment. Drain fields should be located in relatively flat areas to ensure uniform effluent flow.



Effluent containing excessive amounts of grease, fats, and oils may clog the septic tank or drain field and lead to premature failure. The installation of *grease interceptors* is recommended for restaurants and other facilities with similar wastewater characteristics.

Construction should be performed by a *licensed septic system*

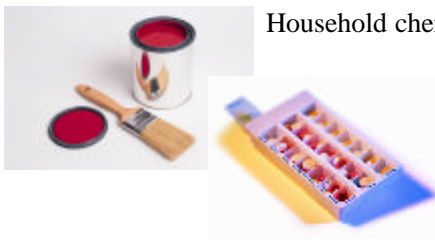
installer to ensure compliance with applicable regulations. The infiltration capacity of the soil may be reduced if the soil is overly compacted. Care should be taken not to drive heavy vehicles over the drain field area during construction or afterward. Construction equipment should operate from upslope of the drain field area. Construction should not be performed when the soil is wet, or excessive soil smearing and soil compaction may result.

Operation and Maintenance

Proper operation and maintenance of septic systems is perhaps the most crucial prevention measure to preventing contamination. Inadequate septic system operation and maintenance can lead to failure even when systems are designed and constructed according to regulation. Homeowners associations and tenant associations can play an important role in educating their members about their septic systems. In commercial establishments such as strip malls, management companies can serve a similar role. Septic system owners should continuously monitor the drain field area for signs of failure, including odors, surfacing sewage, and lush vegetation. The septic tank should be *inspected annually* to ensure that the internal structures are in good working order and to monitor the scum level.

Many septic systems fail due to hydraulic overloading that leads to surface ponding. Reducing wastewater volumes through *water conservation* is important to extend the life of the drain field. Conservation measures include using water-saving devices, repairing leaky plumbing fixtures, taking shorter showers, and washing only full loads of dishes and laundry. Wastewater from basement sump pumps and water softeners should not be discharged into the septic system to minimize hydraulic load. In addition, surface runoff from driveways, roofs, and patios should be directed away from the drain field.

If an excessive amount of sludge is allowed to collect in the bottom of the septic tank, wastewater will not spend a sufficient time in the tank before flowing into the drain field. The increased concentration of solids entering the drain field can reduce soil permeability and cause the drain field to fail. Septic tanks should be pumped out every two to five years, depending on the tank size, wastewater volume, and types of solids entering the system. Garbage disposals increase the volume of solids entering the septic tank, requiring them to be pumped more often.



Household chemicals such as solvents, drain cleaners, oils, paint, pharmaceuticals, and pesticides can interfere with the proper operation of the septic system and cause ground water contamination. Homeowners should take advantage of **local hazardous waste collection programs** to dispose of these wastes whenever

possible. Grease, cooking fats, coffee grounds, sanitary napkins, and cigarettes do not easily decompose, and contribute to the build-up of solids in the tank. The use of additives containing yeast, bacteria, enzymes, and solvents has not been proven to improve the performance of septic systems, and may interfere with their normal operation. Bacterial “starters” are not necessary because a wide range of bacteria are normally present in sewage entering the tank. Additives containing solvents or petrochemicals can cause ground water contamination.



Vehicles and heavy equipment should be kept off the drain field area to prevent soil compaction and damage to pipes. Trees should not be planted over the drain field because the roots can enter the perforated piping and lead to back-ups. Last, any type of construction over the drain field should be avoided. Impervious cover can reduce soil evaporation from the drain field, reducing its capacity to handle wastewater.

FOR ADDITIONAL INFORMATION

For information on septic system regulations in your community, contact your state or local health department. The information sources below contain information on measures to prevent septic system failures. All of the documents listed are available free of charge on the Internet.

Numerous documents on septic systems are available for download from U.S. Department of Agriculture Cooperative State Research, Education, and Extension Service State Partners. Links to the various State Partners can be found at <http://www.reeusda.gov/1700/statepartners/usa.htm>. Several examples of these documents are presented below:

Bicki, T.J. and D.G. Peterson. “Septic Systems: Operation and Maintenance of On-site Sewage Disposal Systems.” *Land and Water: Conserving Natural Resources in Illinois*, Number 15, Cooperative Extension Service, University of Illinois at Urbana-Champaign. Retrieved February 26, 2001 from the World Wide Web: http://web.aces.uiuc.edu/vista/pdf_pubs/SEPTIC.PDF.

Hiller, Joe and Andrea Lewis. (October 1994). *Septic System Failure: What To Do*. University of Wyoming Cooperative Extension Service. B-1007. Retrieved February 27, 2001 from the World Wide Web: <http://www.uwyo.edu/ag/ces/PUBS/Wy1007.pdf>.

Hiller, Joe and Andrea Lewis. (October 1994). *Septic System Maintenance*. University of Wyoming Cooperative Extension Service. B-1008. Retrieved February 26, 2001 from the World Wide Web: <http://www.uwyo.edu/ag/ces/PUBS/Wy1008.pdf>.

Porter, E., R. Rynk, K. Babin, and B.N. Burnell. *Care and Maintenance of Your Home Septic System*. University of Idaho College of Agriculture, Cooperative Extension System. CIS 1027. Retrieved February 27, 2001 from the World Wide Web: <http://info.ag.uidaho.edu/Resources/PDFs/CIS1027.pdf>.

Powell, G. Morgan. (March 1996). *Get to Know Your Septic System*. Kansas Cooperative Extension Service, Kansas State University. MF-2179. Retrieved February 26, 2001 from the World Wide Web: <http://www.oznet.ksu.edu/library/H20QL2/MF883.PDF>.

Powell, G. Morgan. (July 1992). *Septic Tank – Soil Adsorption System*. Kansas Cooperative Extension Service, Kansas State University. MF-944. Retrieved February 27, 2001 from the World Wide Web: <http://www.oznet.ksu.edu/library/H20QL2/MF944.PDF>.

Powell, G. Morgan, Barbara L. Dallemand, Judith M. Willingham. (August 1998). *Septic Tank Maintenance: A Key to Longer Septic System Life*. Kansas Cooperative Extension Service, Kansas State University. MF-947. Retrieved February 28, 2001 from the World Wide Web: <http://www.oznet.ksu.edu/library/H20QL2/MF947.PDF>.

Powell, G. Morgan, Barbara L. Dallemand, Judith M. Willingham. (December 1998). *Why Do Septic Systems Fail?* Kansas Cooperative Extension Service, Kansas State University. MF-946. Retrieved February 27, 2001 from the World Wide Web: <http://www.oznet.ksu.edu/library/H20QL2/MF946.PDF>.

Runyan, R. Craig, *Septic Tank Maintenance*. Cooperative Extension Service, College of Agriculture and Home Economics, New Mexico State University, Guide M-113.

Washington State University Cooperative Extension and U.S. Department of Agriculture. (Reprinted January 1998). *Properly Managing Your Septic Tank System*. EB1671. Retrieved February 26, 2001 from the World Wide Web: <http://cru.cahe.wsu.edu/CEPublications/eb1671/eb1671.html>.

The National Small Flows Clearinghouse has developed a series of brochures on septic systems. They can be found at http://www.estd.wvu.edu/nsfc/NSFC_septic_news.html.

North Carolina State University Water Quality Group. *Septic Systems*. Retrieved February 27, 2001 from the World Wide Web: <http://h2osparc.wq.ncsu.edu/estuary/rec/septic.html>.

Septic Information Website: Inspecting, Designing, & Maintaining Residential Septic Systems. Retrieved February 28, 2001 from the World Wide Web: <http://www.inspect-ny.com/septbook.htm>.

Stormwater Manager's Resource Center. *Non-Stormwater Fact Sheet: Septic Systems*. Retrieved February 26, 2001 from the World Wide Web: http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool7-Non_Stormwater/SepticSystems.htm.

U.S. Environmental Protection Agency. (September 1999). *The Class V Underground Injection Control Study, Volume 5: Large Capacity Septic Systems*. Retrieved February 27, 2001 from the World Wide Web: <http://www.epa.gov/safewater/uic/classv/volume5.pdf>.

U.S. Environmental Protection Agency. *Decentralized Onsite Management for Treatment of Domestic Wastes*. Retrieved May 1, 2001 from the World Wide Web: <http://www.epa.gov/seahome/decent.html>.

U.S. Environmental Protection Agency. *Principles and Design of Onsite Waste Disposal with Septic Systems*. Retrieved May 1, 2001 from the World Wide Web: <http://www.epa.gov/seahome/onsite.html>.