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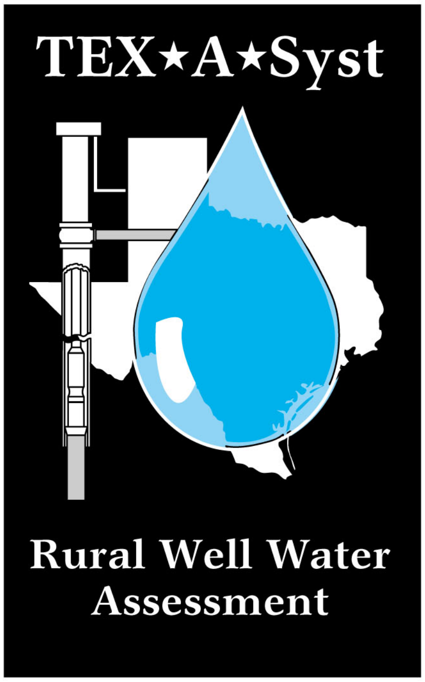


AgriLIFE EXTENSION
Texas A&M System

# Reducing the Risk of Ground Water Contamination by Improving Household Wastewater Treatment

B.L. Harris, D.W. Hoffman and F.J. Mazac, Jr.*

1. Do you have an on-site wastewater disposal system (septic tank) on your land?
2. Is your septic tank less than 50 feet from a water well?
3. Has it been longer than 3 to 5 years (or one year if you have a garbage disposal) since you have had your septic tank pumped out?
4. Do you dispose of grease, oils or leftover household chemicals down the drain?
5. Have you noticed wet or smelly areas in your yard?
6. Is your septic tank capacity too small to accommodate the number of people in your household, or has an additional restroom been added to your home?
7. Do you have non-sewage water entering your septic system or drain field?

**If these questions create doubt about the safety of your management practices, this publication will provide helpful information.**

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## Household Wastewater Treatment

Virtually all farms use a septic system or similar on-site wastewater treatment system. While these systems are generally economical and safe, household wastewater can contain contaminants that degrade water quality for such uses as drinking, stock watering, food preparation and cleaning.

Potential contaminants in household wastewater include disease-causing bacteria, infectious viruses, household chemicals, and excess nutrients such as nitrate. Viruses can infect the liver, causing hepatitis, or infect the lining of the intestine, causing gastroenteritis (vomiting and diarrhea). If coliform organisms (a group of indicator bacteria) are found in well water, the water is potentially dangerous for drinking and food preparation. Septic systems are a potential source of this pollution, as are livestock yards.

A properly installed and maintained system for treating and disposing of household wastewater will minimize the impact of that system on ground water and surface water. State and county codes specify how wastewater systems must be designed, installed and maintained. All new systems must be installed by a state certified installer and inspected by a state certified inspector prior to use. At a minimum, follow the Texas Natural Resource Conservation Commission codes for design and construction, but also consider whether the minimum requirements are sufficient at your site.

A glossary of terms at the end of this publication will clarify terminology. This publication covers the following topics:

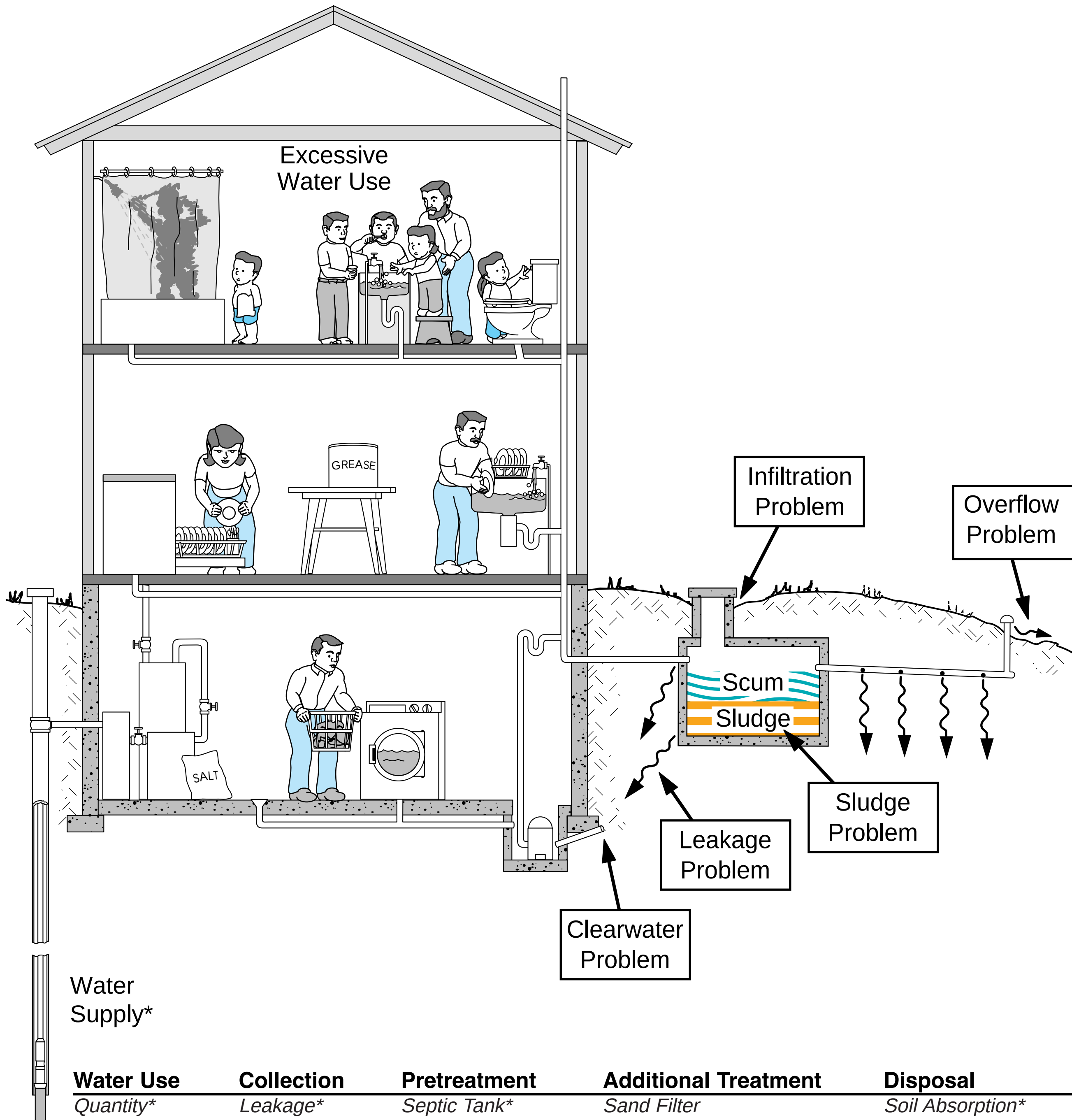
1. Septic tanks/soil absorption systems
2. Quantity of wastewater
3. Quality of wastewater
4. Collection of wastewater
5. Treatment systems
6. Disposal system
7. Assistance with failing systems or new designs
8. Evaluation table

## Septic Tanks/Soil Absorption Systems

The most common form of on-site wastewater treatment is a septic tank/soil absorption system. In this system, wastewater flows from the household sewage lines into an underground septic tank. The following then occurs:

- ★ The waste components separate, with the heavier solids (sludge) settling to the bottom and the grease and fatty solids (scum) floating to the top.
- ★ Bacteria partially decompose and liquefy the solids.
- ★ Baffles in the tank provide maximum retention time of solids to prevent inlet and outlet plugging, and to prevent rapid flow of wastewater through the tank.
- ★ The liquid portion (effluent) flows through an outlet on the septic tank to the soil absorption field.
- ★ The absorption field is usually a series of parallel trenches, each containing a distribution pipe or tile line embedded in drain field gravel or rock.
- ★ The effluent drains out through holes in the pipe or seams between tile sections, then through the drain field gravel or rock and into the soil.
- ★ The soil filters remaining minute solids, some dissolved solids, and pathogens (disease-producing microorganisms). Water and dissolved substances slowly percolate outward into the soil and down toward ground water or restrictive layers. A portion of the water evaporates into the air, and plants growing over the drain field lines utilize some of the water.

Figure 1 shows a typical household system for wastewater generation, collection, treatment, and disposal. While such systems may be called by various names (such as septic tanks or subsurface treatment and disposal systems), they are similar. In this discussion the term septic tank is used. Note the list of options below each part of the diagram. You may wish to circle the parts found in your system. The "leakage," "overflow," "infiltration" and "clearwater" components represent possible problems with the system. Unfortunately, these problems are often difficult to recognize. Over-flow from systems may be noticed as wet spots, odors and changes in vegetation cover. Water entry (infiltration and clear water) will be more difficult to detect. To help detect any water entry, trace where the floors drain, the roof drains, the foundation drains, and where sumps are directing outside water into the treatment system. Leakage from the collection and treatment system, as well as infiltration of water into the system through unsealed joints, access ports and cracks, can be very difficult to assess. The flow chart at the bottom of the box follows the flow of wastewater and sludge through the treatment system.




| Water Use | Collection | Pretreatment | Additional Treatment | Disposal |
|---|---|---|---|---|
| *Quantity** | *Leakage** | *Septic Tank** | *Sand Filter* | *Soil Absorption** |
| *Quality** | *Clearwater** | *Holding Tank* | *Nitrogen Removal* | *In Ground* |
| | *Infiltration** | *Cesspool* | *Disinfection* | *Bed* |
| | | *Aerobic System* | | *Trench* |
| | | | | *Mound, At Grade* |
| | | | | *Pump and Haul* |

** = Elements Illustrated*

**Figure 1. Typical household wastewater treatment system with problems. Illustration by Andy Hopfensperger, University of Wisconsin-Madison Department of Agricultural Engineering.**

## Quantity of Wastewater

The best strategy is to minimize the volume of household wastewater entering the treatment system. This is important because less flow (volume) means better treatment, longer system life, and less chance of overflow. Less volume also lowers costs by reducing the number of times the holding tank must be emptied.

The quantity of water used depends upon the number of people using the dwelling, their water use rates, and the maintenance of the water supply system. Average water use in rural households is 40 to 50 gallons per person per day. With low-use fixtures and individual awareness and concern, a reduction to fewer than 25 gallons per person per day is possible. However, even conservative use by several people may exceed the capacity of the wastewater treatment system.

Reducing the volume of water entering the system will improve treatment by increasing the time the waste spends in the system, thus providing more time for settling, decomposition, aeration and soil contact.

Consider the following ways to minimize water use.

- ★ Eliminate non-functional uses, such as flushing toilets to dispose of tissues or other waste that should be handled as solid waste. Turn off water between uses, fix plumbing fixture leaks, and try to eliminate sources of clear water infiltration into the system. (For example, divert roof drains away from the soil absorption field.)
- ★ Consider which actions use the most water. Toilet flushing usually ranks the highest. Low-flow models could decrease water use by more than half. Composting toilets allow even greater reductions, but they can present other waste disposal challenges.
- ★ Bathing and washing clothes are next in order of water use. Consider installing low-flow or controlled-flow showerheads, which give good cleansing with less water; taking shorter showers; and taking "wet-down-soap-up-without-water-then-rinse" showers.
- ★ Wash full loads of clothes to save soap and water. Front loading washers use much less water. When running small loads, be sure to use the reduced water level setting.
- ★ Use modern, efficient plumbing fixtures and appliances, including 0.5- to 1.5-gallon toilets, 0.5- to 2.0-gallons-per-minute (gpm) showerheads, faucets of 1.5 gpm or less, and front loading washing machines of 20 to 27 gallons per 10- to 12-pound dry load. These fixtures and appliances can reduce water use from 30 to 70 percent (see Fig. 2.).
- ★ Use water softener devices with care, because they may use significant amounts of water. Proper adjustment and timing of the softener's regeneration mechanism can reduce excessive water use. The flush backwash should not go to your septic tank.
- ★ Eliminate household water leaks. A leak in the home may be detected by opening the cleanout (usually located between the house stub-out and the septic tank) and checking for a continuous flow through the pipe to the septic tank. Since a small flow is sometimes difficult to see, you should drop a pinch of sand into the pipe and watch to see if the sand is carried away. If the sand is carried away, you have a continuous leak inside the home. To isolate the leak, check each fixture. If a leaking toilet is suspected, put a small amount of food coloring into the toilet and check to see if it appears in the flow through the cleanout.
- ★ Prevent water from other sources from entering either the septic tank or the drain field. Divert water flowing from roof drains away from the septic tank and away from the drain field. Construct a berm or a swale upslope of the drain field if there is surface runoff flowing downslope over the drain field. However, avoid diverting the runoff toward your well.
- ★ Do not allow water from basement floor drains or foundation drains to enter the septic tank through the house plumbing.

Keep in mind that your family's awareness of your water use and how it can be reduced is as important as the use of water conservation devices.

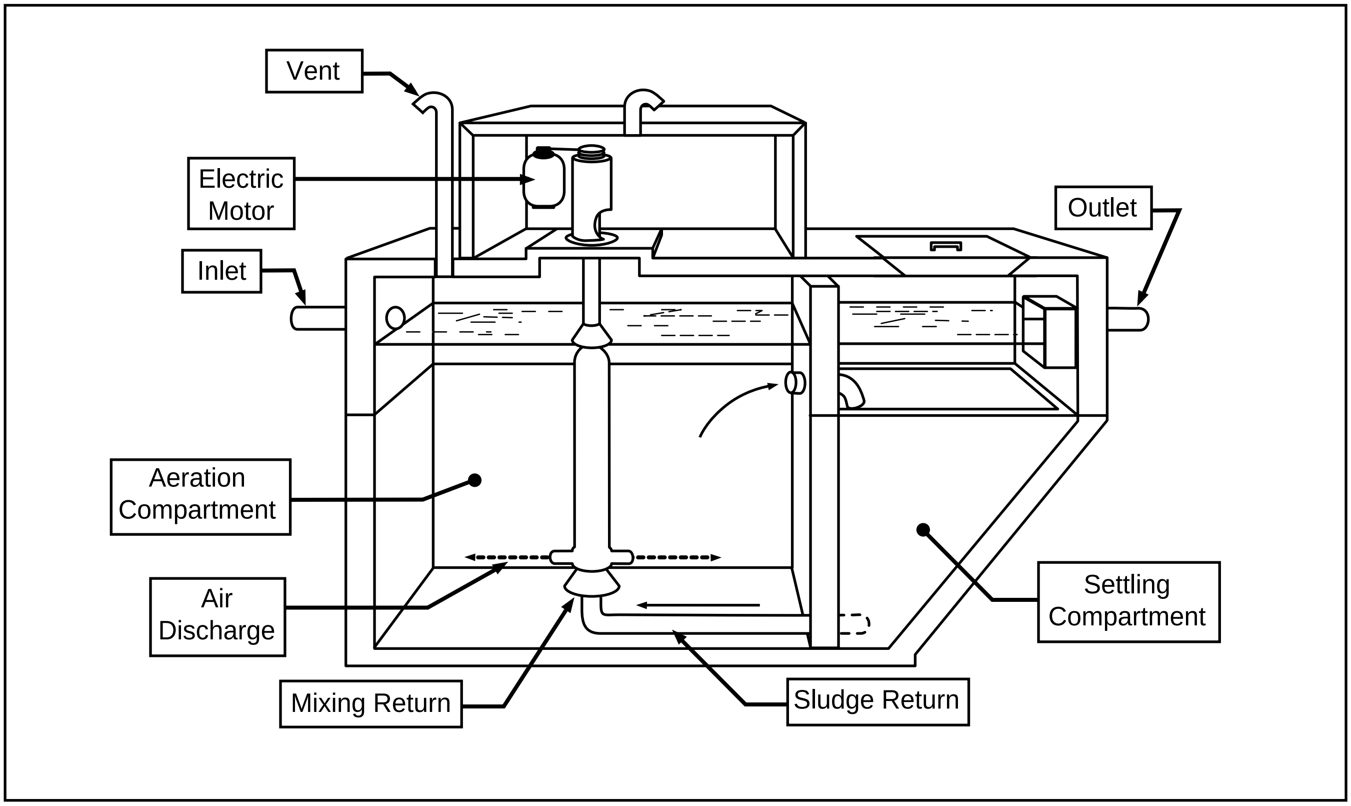



**Figure 2. Aeration tank of a household aerobic treatment system. Source: Onsite Domestic Sewage Disposal Handbook, MWPS-24, Midwest Plan Service, 1982**

## Quality of Wastewater

Domestic wastewater usually contains relatively small amounts of contaminants — less than 0.2 percent (i.e., it is 99.80 percent "pure" water), but even small amounts of contaminants can make a big difference in the usefulness of the water.

Contaminants found in wastewater include the following:

- ★ Bacteria and viruses, some of which can cause disease in humans. These microorganisms are large enough to be removed by settling, or through filtration in sand beds or soil. Many will die as they pass through the system.
- ★ Suspended solids are particles that are more dense (sludge) or less dense (scum) than water and that can be removed by filtration. Most can be separated from liquid waste by allowing enough time in a relatively calm tank. Grease and fats are a part of the suspended solids. Filtration beds and absorption systems can be clogged by wastewater high in suspended solids.
- ★ High oxygen demand can lower water quality. The microorganisms that decompose organic wastes (such as blood, milk residues and garbage grindings) use lots of oxygen. The amount of oxygen required to "stabilize" wastewater is typically measured as biochemical and chemical "oxygen demand." Aeration and digestion processes, in the presence of oxygen and organisms, produce stable, low-odor wastewater when given enough time. However, wastewater with excess oxygen demand can cause problems for soil absorption fields, ground water, streams and lakes by reducing levels of oxygen in the water.
- ★ Organic solvents from cleaning agents and fuels may not be degraded or removed through treatment and can pass along with the wastewater back into the water supply.
- ★ Nutrient contaminants are composed mainly of nitrogen from human wastes, phosphorus from dish washer detergents and some chemical water conditioners. Nitrate-nitrogen is a common ground

water contaminant, and phosphorus is a common contaminant of surface water.

Here are some ways to improve wastewater quality:

- Minimize use of the garbage disposal unit. Garbage disposals deposit large amounts of suspended solids and organic matter into the septic system, as well as using additional water.
- Do not clog septic tanks by putting items such as fats, grease, coffee grounds, paper towels, sanitary napkins, tampons or disposable diapers down drains.
- Do not put toxic substances in drains. They might end up in the ground water. These include solvents, degreasers, acids, oils, paints, disinfectants and pesticides. However, this does not prohibit the use of bleach to disinfect laundry or the washing of clothing worn for pesticide applications.
- Do not use chemicals to clean your system. They may interfere with the biological action in the tank, clog the drainfield by flushing sludge and scum into the field, or add toxic chemicals to ground water.

## Collection of Wastewater

Collect all waste that needs treatment and minimize the loss of untreated waste. Leaking pipes or treatment tanks can allow wastewater to return to the local water supply without adequate treatment. Exclude from the treatment system water that does not need treatment or disposal.

Infiltration of clear water overloads the system and dilutes the wastes. Do not allow rainwater or water from basement floor drain sumps, foundation drains or roof drainage to add to your waste water volume. Divert clean water away from the house, any wells, and any wastewater treatment system.

## Treatment Systems

Make wastewater suitable for treatment and disposal in the soil by reducing the concentration of contaminants in the wastewater.

Septic tanks retain most of the suspended solids (sludge) and scum from wastewater. In the tank, bacteria digest and compact the sludge. The partially treated water moves to additional treatment or disposal, for example, in the soil absorption field.

The design and construction of septic tanks influence their water tightness and effectiveness at retaining sludge and scum. Multiple tanks or chambers in series can improve sludge and scum removal. Gas deflectors and filter screens or inclined-plate settling units help to minimize solids entering the drain field. Tanks should be sized to accommodate at least 24 hours of wastewater flow while still allowing for sludge and scum retention. Pumping the tank before it is more than one-third filled with scum and sludge (generally every 3 to 5 years) improves the functioning of the system. When the tank is pumped, you should have the baffles checked and also check for tank leaks. Septic tanks should be made of reinforced concrete, polyethylene or prefabricated fiberglass.

Aerobic (oxygen using) biological systems, which are considered packaged systems, treat wastewater better than the typical anaerobic (no oxygen) septic units, thus improving solids separation, releasing volatile chemicals, and reducing sludge volume. These systems are, however, more expensive to operate and maintain and are more often subject to problems caused by changes in wastewater quality or environmental conditions. Aerobic systems are often used because they produce high quality effluent which may be disposed of through conventional trenches or drip irrigation, or sprayed on top of the ground.

If you have an aerobic system, you should have a maintenance person inspect the unit three times each year. The maintenance person should check the aeration mechanism, the disinfection unit (tablet chlorinator), and other critical aspects of the unit.

Between inspections you should check the tablet chlorinator for chlorine tablets. If there are no tablets, fill the chlorinator immediately. An empty chlorinator increases the chance that disease causing organisms will come into contact with people.

Additional treatment after wastewater has passed through the septic system can reduce the concentration and amount of contaminants in the wastewater and make it suitable for disposal.

Aerobic systems may be used for additional treatment of septic tank effluent, and these sys-

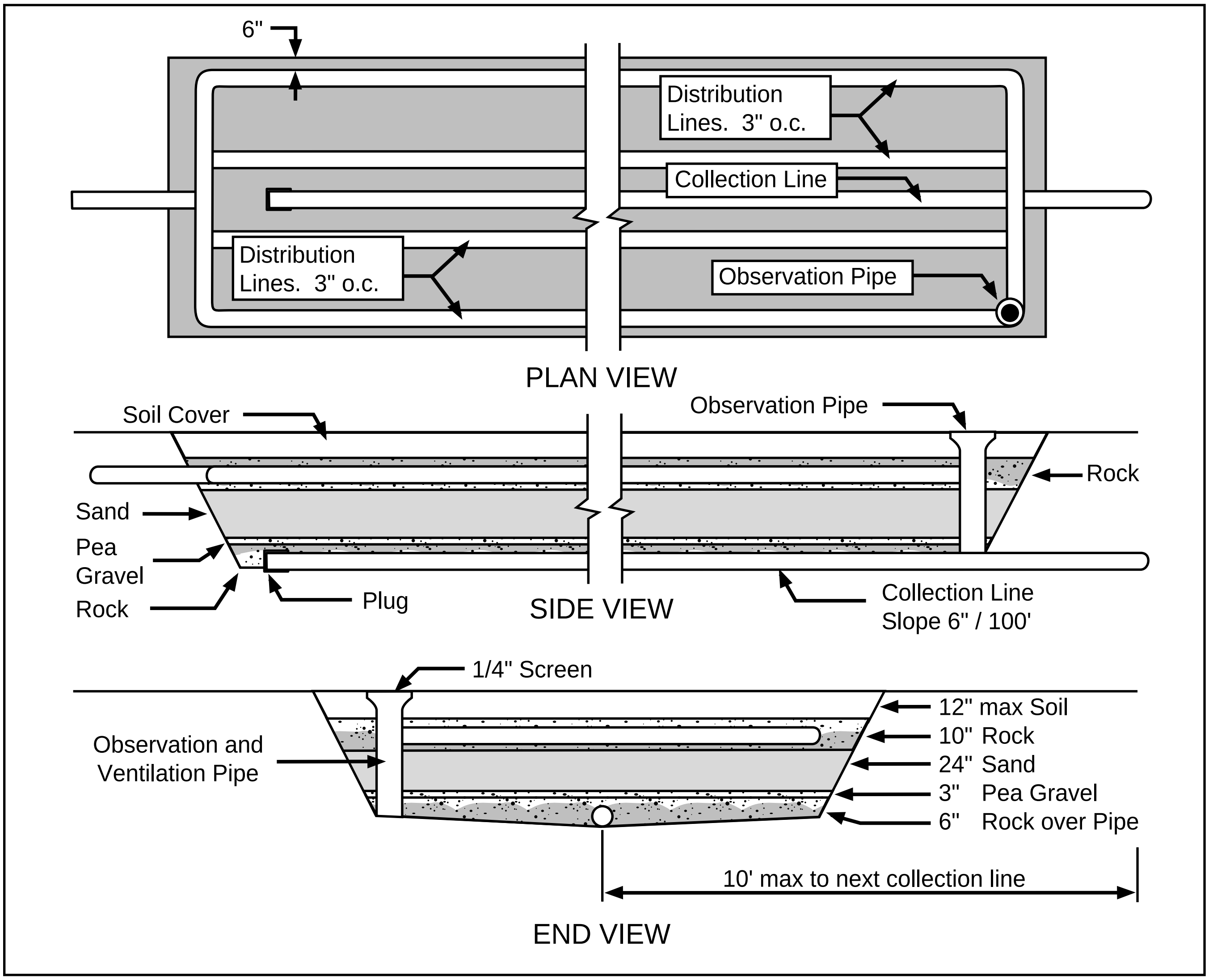



**Figure 3. Buried sand filter. Source: Onsite Domestic Sewage Handbook, MWPS-24, Midwest Plan Service, 1982.**

tems can yield a better quality effluent suitable for more disposal options.

Sand filters also improve the quality of wastewater after septic tank pretreatment. Effective treatment involves aerobic biochemical activity as well as physical filtration. Filters consist of 2 to 5 feet of sand (or other media) in a bed equipped with a distribution and collection system. Wastewater is applied by dosing, and it may be recirculated to improve treatment.

Filters should be designed according to the pretreatment system used, the quality of the wastewater, the hydraulic loading rate, the dosing frequency, the temperature, and the distribution and collection systems used. Filter maintenance includes resting, occasional raking, removal of clogged or crusted surface media, filter media replacement, and attention to dosing equipment.

Wastewater treated in such systems is generally lower in bacteria, nitrogen, phosphorus, oxygen demand, suspended solids and organic matter. The amount of reduction depends on the design of the system.

A disinfection unit is a system that kills disease-causing microorganisms in wastewater, and is used when discharge on the surface is permitted. Chlorine, iodine, ozone and ultraviolet light systems are available to treat good quality effluent, such as that from properly functioning aerobic units and sand filters.

## Disposal Systems

To reduce the risk of wastewater contaminating water supplies, disperse effluent and maximize its contact with soil and plant roots.

Discharging treated or untreated wastewater from private systems directly to surface waters or ditches is illegal in Texas. Illegal wastewater discharges or wastewater surfacing above the drain field can endanger your health as well as the health of others in your community.

### Subsurface Treatment Systems

Subsurface treatment and disposal, using soil absorption systems (trenches, beds, or mounds), is the common disposal system following septic tanks. There are, however, sites where soil absorption systems will not function properly and will endanger ground water quality. Unsuitable sites are those with impermeable soils, shallow rock, shallow water tables, or very permeable soils such as a sand or gravelly soil.

Suitable sites are those with deep, well-drained, well-developed, medium-textured soils (such as silt loam and loam). Soil beneath the disposal area must be unsaturated to provide adequate treatment. Unsaturated soil allows the effluent to remain aerobic and to flow through tighter soils, thereby filtering contaminants and giving soil microbes longer contact time with soil organic matter. Approximately 4 feet of unsaturated soil should be maintained beneath the disposal system to adequately remove pathogens and organic matter from wastewater.

Disposal systems that are downslope and far from the water well will better protect your water supply from possible contamination from wastewater.

### Surface Treatment Systems

When compared to subsurface treatment systems, surface treatment systems promote more evapotranspiration (removal of effluent by evaporation and loss through plants). Increased evapotranspiration decreases the amount of treated effluent that can reach the water supply. However, disposal systems that apply the treated effluent directly on the ground surface must have an approved method of treatment and should disinfect the effluent before application. Keep the following application strategies in mind:

- ★ The application of effluent in a surface treatment system should not produce runoff or ponding.
- ★ Spreading the effluent over a larger surface area promotes maximum vegetative uptake of nutrients. The entire application area should be covered with vegetation so that most of the effluent will encounter plant roots before reaching ground water. The plant roots will utilize many of the nutrients in the wastewater.

## Assistance with Failing Systems or New Designs

If you suspect your household wastewater treatment system is backing up or your distribution system is clogged, first contact a plumber or treatment system installer, who may have suggestions for extending the life of your system. The county public health office is the location to visit for permits to repair or replace a wastewater treatment system. Take the following steps to reduce any risk of contaminating ground water:

- ★ Do not use septic tank cleaners that contain degreasing solvents such as TCE, which can contaminate ground water.
- ★ Do not place more soil over a surfacing soil absorption field; this does not fix the system, and water will surface again.
- ★ Do not pipe sewage to the road ditch, storm sewer, sink hole, drainage well, stream, or drain tile; this pollutes the water and creates a health hazard.
- ★ Do not wait for the system to fail before pumping the septic tank. Once a system fails, it is too late to pump the tank.
- ★ Remember that spreading the effluent over a larger area and placing the effluent shallower in the soil will decrease the chance of contaminating your water supply.

A properly designed, constructed and maintained septic system can effectively treat wastewater for many years, but it requires routine maintenance. For additional information on septic systems, contact your county Extension agent, local health department, or Texas Natural Resource Conservation Commission On-Site Wastewater/Agricultural Division (512) 463-8260.

## Evaluation Table

The following table can be used to help agricultural producers and rural homeowners determine the risk that drinking water on a given property may be contaminated because of the management practices being used. For each category on the left that is appropriate, read across to the right and circle the statement that best describes conditions on your land. Allow 15 to 30 minutes to complete the table, and skip any categories that do not apply. Note any high risk ratings and take appropriate actions to remedy them. Strive for all low or low-moderate risk ratings.

| Assessing the Risk of Ground Water Contamination from Household Wastewater Treatment | | | | |
|---|---|---|---|---|
| | **Low Risk** | **Low-Moderate Risk** | **Moderate-High Risk** | **High Risk** |
| **Quality of Wastewater** | | | | |
| **Internal water use** | Conservative water use. Use water-conserving fixtures. Routinely check for and repair leaks. Water softener recharges are infrequent or not connected to septic tank. | Moderate water use. Use a few water-conserving fixtures. Periodically check for and repair leaks. Water softening recharges to septic tank twice per week or less. | High water use. Use very few water-conserving fixtures. Rarely check for and repair leaks. Water softening recharges to septic tank more than twice per week. | Excessive water use. Use no water-conserving fixtures, never check for and repair leaks, and water softening recharges to septic tank more than twice per week. |
| **Unnecessary water entering treatment or disposal system** | No inflow. Rain-water runoff and roof drains are diverted away from septic tank and disposal area. The basement or foundation drain is not connected to the system. | Moderate inflow. Rainwater runoff and roof drains are diverted away from septic tanks and disposal area. However, the system does receive water from either foundation or basement drains. | High inflow. Neither rainwater runoff nor roof drains are diverted away from the drain field and septic tank. The septic tank receives water from basement or foundation drains. | Excessive inflow. Rainwater runoff and roof drain flow directly over septic tank or drain field. Septic tank receives flow from foundation and basement drains. |
| **Quality of Wastewater** | | | | |
| **Solids** | No use of garbage disposal unit in kitchen sink. | Minimal use of garbage disposal (1 to 2 times per week). | Moderate use of garbage disposal unit (3 to 5 times per week). | Daily use of garbage disposal unit. |
| **Chemicals** | Minimal use of household chemicals (cups per week). No disposal of solvents and toxic cleaning agents. No water softener or not recharged on site. | Careful use of household chemicals (pints per week). Minimal disposal of solvents and toxic cleaning agents. Water softener used, recharged on site. | Moderate use of household chemicals (quarts per week). Moderate disposal of solvents and toxic cleaning agents. | Extensive use of household chemicals (gallons per week). Extensive disposal of solvents and toxic cleaning agents. |
| **Oils/Grease** | No disposal of grease or oils into sewer. Domestic wastes only. | Minimal disposal of grease/oils. Oil and grease wiped from cooking utensils before washing. | Moderate disposal of grease/oils. No attempt to reduce disposal of grease/oil from household, but little generated. | Extensive disposal of grease/oils. |
| **Pretreatment System** | | | | |
| **Cesspool (these are illegal systems)** | | | | Any cesspool, direct discharge of water, injection well or seepage pit. |

| Assessing the Risk of Ground Water Contamination from Household Wastewater Treatment | | | | |
|---|---|---|---|---|
| | **Low Risk** | **Low-Moderate Risk** | **Moderate-High Risk** | **High Risk** |
| **Pretreatment System (continued)** | | | | |
| **Septic tank** | More than one tank in series or two-compartment tank. Tank made of reinforced concrete. Liquid capacity of tank is equal to or greater than 300 gallons times the number of bedrooms. Tanks pumped every 3 years. | One tank or one-compartment tank. Tank made of reinforced concrete, polyethene or fiberglass. Liquid capacity of tank is less than 300 gallons times the number of bedrooms. Tanks pumped every 5 years. | Metal or cinder block tank. Total liquid capacity less than 500 gallons. Tank is pumped every 7 or more years. | Any homemade devices, particularly with small volumes. Tank or device has never been pumped. |
| **Packaged aerobic system** | Maintenance program followed. | No maintenance program, but no noticeable failures. | No maintenance, occasional failures. | No maintenance, frequent system failure. |
| **Tablet chlorinator** | Chlorine tablets present. Strong chlorine smell. | Chlorine tablets are disintegrated and caked on walls, but a chlorine smell is present. | Chlorine tablets are disintegrated and caked on walls and no chlorine smell is present. | No chlorine is in chlorinator and no chlorine smell is present. |
| **Disposal of Wastewater** | | | | |
| **Horizontal separation of wastewater disposal site from water supply** (subsurface or surface) | Offsite disposal. | Subsurface disposal downslope more than 50 feet from well. Surface disposal more 200 feet from well. | Subsurface disposal downslope less than 50 feet from well. Surface disposal less than 200 feet from well. | Upslope from well. |
| **Vertical separation of wastewater disposal site from water supply** (subsurface) | Offsite disposal. | More than 6 feet to saturated soil or bedrock. | 3 to 6 feet to saturated soil or bedrock. | Less than 3 feet to saturated soil or bedrock. |
| **Soils** | Offsite disposal. | Medium- or fine-textured soils (silt loam, loam, clay loams, clay). | Medium-to coarse-textured soils (sandy loam, sands). | Very coarse sands or gravel. |
| **Subsurface disposal system** | Pressurized system which uniformly applies effluent throughout entire field. Shallow trenches or bed covered with healthy vegetation. Vegetation harvested regularly. | Pressurized system which uniformly applies effluent throughout entire field. Deep trenches or bed without covering of healthy vegetation. | Gravity system with shallow trenches. There is healthy vegetation above trenches and vegetation is regularly harvested. | Gravity system with deep trenches or bed. There is little vegetation above trenches or bed. |
| **Surface application disposal system** | Irrigation area is covered with healthy vegetation. Vegetation harvested regularly. Area appears to produce little or no runoff. | Irrigation area is covered with healthy vegetation. Vegetation is rarely harvested and it appears that irrigation is producing runoff. | Irrigation area has bare spots and it appears that irrigation is producing runoff. | Irrigation area is totally bare and is producing channelized runoff from the site. |

*See Glossary.

## Glossary

**Approved disposal site:** A site for land application of wastewater or tank pumpage that meets state standards of the Texas Natural Resource Conservation Commission (TNRCC).

**Cesspool:** Covered excavation in the ground that receives sewage directly from a building's sanitary drainage system. It is designed to retain the organic matter and solids and to permit liquid to seep into the soil. Cesspools are not allowed for construction and/or use in the state. They are considered unsuitable on-site wastewater disposal methods.

**Clear water infiltration:** Entry of water that does not need treatment into a treatment system; clear water may enter through tile drainage, unsealed joints, access ports and cracks.

**Design capacity:** Maximum volume of liquid that can be treated in a particular wastewater treatment system. For systems that include subsurface wastewater disposal and distribution, capacity is also based on the soil's ability to accept and treat sewage effluent. In filling out the worksheet, if you do not know the design capacity of your system, use 150 gallons per bedroom per day as an estimate.

**Effluent:** Liquid discharged from a septic tank or other sewage treatment tank.

**Holding tank:** An approved watertight receptacle for collecting and holding sewage.

**Hydraulic loading rate:** The volume of waste discharged per unit area per unit time.

**Off-site disposal:** Disposal of wastewater or sludge at a municipal treatment plant or other approved disposal site.

**Scum:** Floatable solids, such as grease and fat.

**Seepage pit (dry well):** Underground receptacle constructed to permit disposal of septic tank effluent, treated wastes or clear wastes by soil absorption through its bottom and walls. Seepage pits are not allowed for construction and/or use in the state. They are considered unsuitable on-site wastewater disposal methods.

**Sludge:** Settleable, partially decomposed solids resulting from biological, chemical or physical wastewater treatment.

## Contacts and References

For additional information, contact your local county Extension agent, or:

- The Texas Natural Resource Conservation Commission at (512) 239-1000,
- Texas Agricultural Extension Service Agricultural Engineering unit (409) 845-7451,
- Texas Agricultural Extension Service Water Quality unit (409) 845-0887,
- Texas State Soil and Water Conservation Board, (817) 773-2250.

Internet address: TEX*A*Syst bulletins and links to other water quality sites are contained in a homepage located on the World Wide Web at: http://waterhome.tamu.edu.

TEX*A*Syst is a series of publications to help rural residents assess the risk of ground water pollution, and to describe Best Management Practices (BMPs) that can help protect ground water. The TEX*A*Syst documents were developed from the national Farm*A*Syst ground water protection program. The TEX*A*Syst system is designed to help the user learn more about the environment, existing environmental policies and regulations, and recommended management practices. Thus, the user can voluntarily reduce the pollution risks associated with water wells.

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