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United States
Environmental Protection
Agency

Office of Water
(WH-595)

830/F-92/001
May 1992

EPA

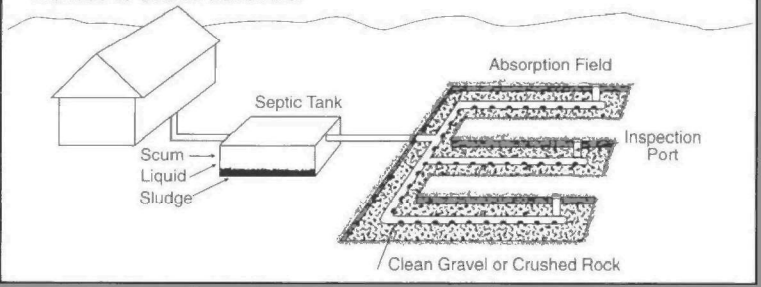
Small Wastewater Systems

Alternative Systems For Small Communities And Rural Areas

COMMON ONSITE SYSTEMS

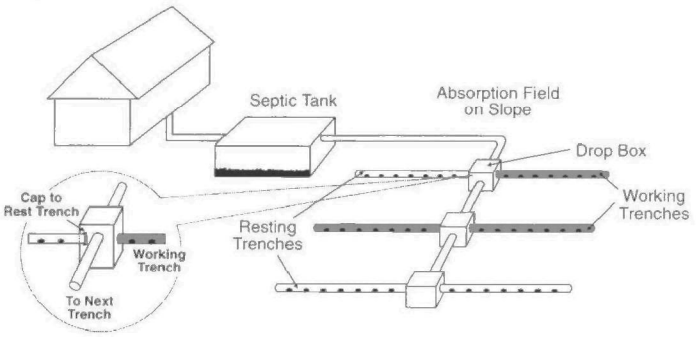
1 Septic Tank & Gravel Absorption Trench

This is the most common system used on level land with adequate soil depth above the water table. Heavy solids in the liquid settle and greases float to the top of the tank. Bacteria break down some solids. The liquid flows from the tank through a closed pipe into perforated pipe and into gravel-filled trenches where it seeps into the soil. Bacteria and oxygen purify the liquid as it slowly moves through the soil. Inspection ports permit checking liquid depth. Regular pumping of the tank reduces the solids discharged into the trenches and extends the life of the system. Using two compartment septic tanks and resting the trenches (#4) are also recommended to extend trench life.



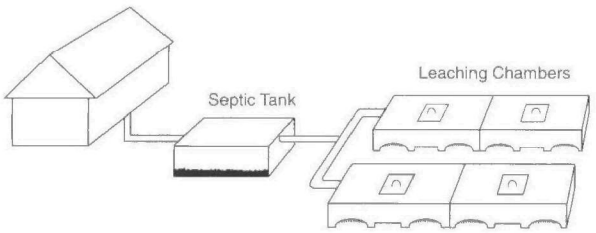
2 Septic Tank With Serial Distribution

Starting with the highest, each trench fills completely, then overflows through one drop box to the next. The effluent floods all soil surfaces. The drop box enables inspection of the system and control of discharge into each trench. Capping the pipe outlets in the upper trench forces resting. Serial distribution automatically loads upper trenches and minimizes the loading on lower trenches. Used on gently to steeply sloped sites.



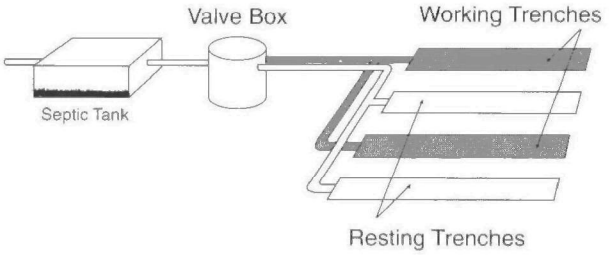
3 Septic Tank & Leaching Chambers

Open bottom concrete chambers or arched plastic chambers create an underground cavern that stores effluent. The effluent floods the soil surface prior to seeping vertically through the bottom of the chamber.



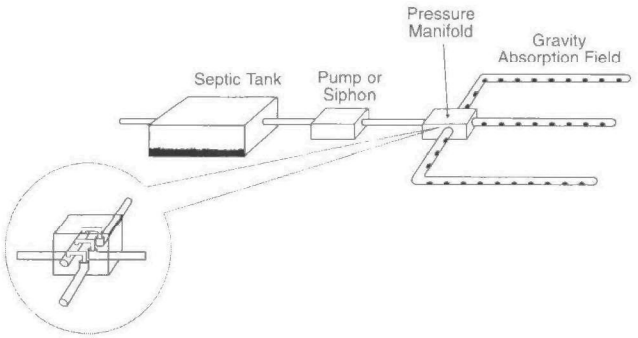
4 Septic Tank With Alternating Trenches

One set of trenches rests while the other treats the liquid from the septic tank. This design extends system life and provides a backup should one field clog. For system repairs, a new field and valve box may be added to the old system. The new field works while the old field rests and renews. Switch the fields annually in the summer.



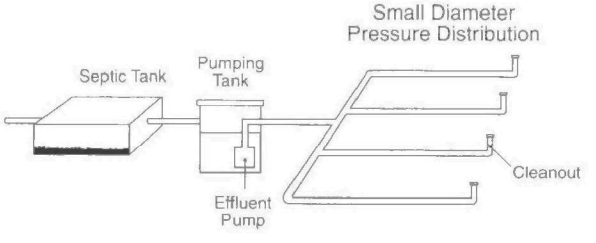
5 Pressure Dosed Distribution

A pump or siphon doses a pressure distribution manifold that disperses the effluent evenly to each trench. Dosing prolongs system life by flooding a larger area and by forcing the exchange of air in the soil. Dosed systems are more common for larger flows. The pressure manifold can include valves or plugs that permit more control over trench loading or trench resting. Annual inspection is suggested.



6 Shallow Trench Low-Pressure Pipe Distribution

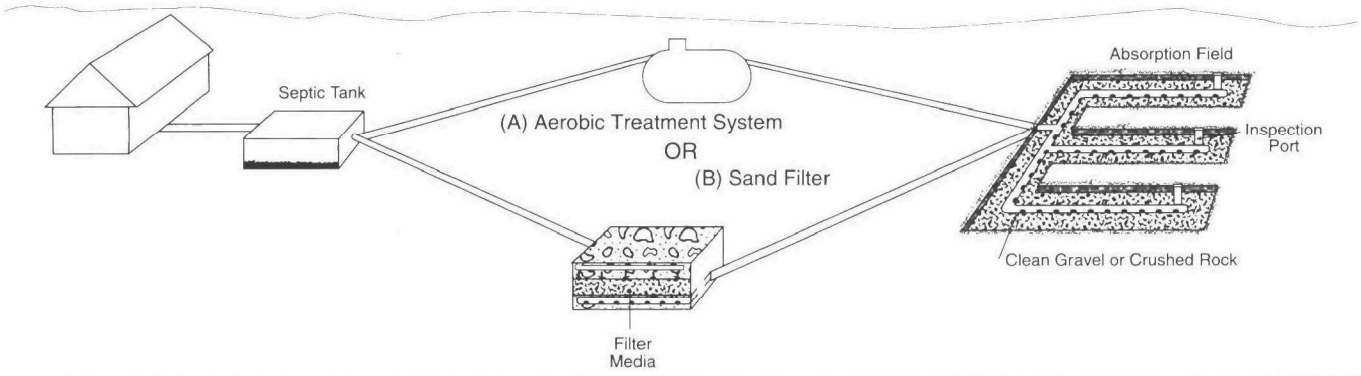
Small diameter pipe, located at a more shallow depth than a conventional system, receives pumped effluent. Effluent moves under pressure through small holes in the pipe and soaks the entire trench network area. Even dosing of more open and aerobic soil horizons improves treatment. Used in areas with high groundwater or shallow soils (because it places the treatment higher in the soil profile) or on steep slopes that require hand excavation. Professional maintenance is needed to flush the lines annually.



OPTIONS FOR DIFFICULT SITES

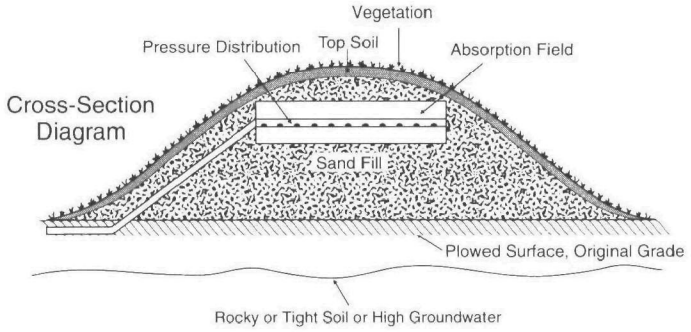
7 Pretreatment & Soil Absorption

Pretreatment addresses the need to treat higher strength waste (such as from restaurants) and can help repair biologically overloaded systems where no additional absorption area is available. Aerobic treatment systems and filters can be used for this purpose. For aerobic treatment (called "package plants"), wastewater and air mix in a tank. Bacteria grow in the tank and break down the waste. For filters, septic tank effluent passes over porous media that trap the solids. Bacteria that grow in the media break down the waste. Professional maintenance by certified operators and a lot of energy are required for aerobic systems.



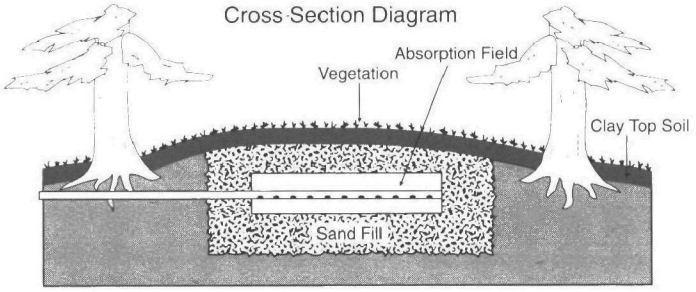
8 Septic Tank & Mound System

Pumps dose effluent (#6) into a gravel bed or trenches on top of a bed of sand. Sandy soil carefully placed above the plowed ground surface treats the effluent before it moves into the natural soil. The system extends onsite system use in areas with high groundwater, high bedrock, or tighter clay soils. Regular inspection of the pumps and controls and flushing of the distribution network are needed.



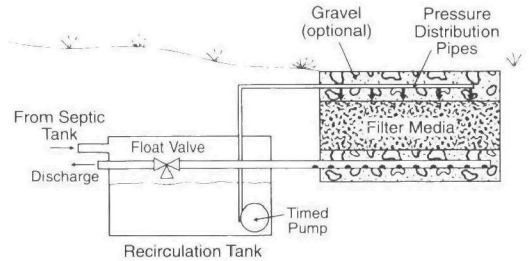
9 Evaporation & Absorption Bed

Effluent from a septic tank or aerobic tank flows into gravel trenches or chambers in a mound of sandy soil. Less permeable soil placed at the surface of the mound helps shed rain from the system. Trees that grow around the system and plants on top of the system pull liquid from the sand and transpire the water into the air. Some effluent may seep into the soil. This system requires a climate where evaporation consistently exceeds rainfall.



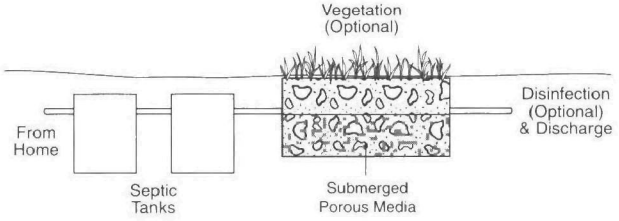
10 Septic Tank, Sand Filters, Disinfection & Discharge

Open or buried beds of sand may receive single or repeated applications of effluent. Effluent passes through the media and drains from the gravel and pipe network below the filter. Effluent may be discharged to the environment directly or into a soil absorption or land treatment system (#16). Disinfection often precedes discharge into a stream or land irrigation. Certain types of filters can significantly reduce nitrogen and may be used in areas where soil absorption is not possible. Requires inspection and periodic maintenance. Surface discharge requires management.



11 Constructed Wetlands

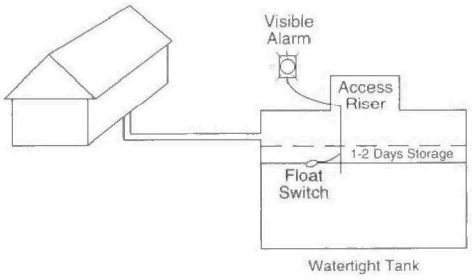
Effluent from a series of septic tanks passes through a bed of rocks planted with reeds. Liquid evaporates and drains into a soil absorption system or discharges. Used for additional treatment or where soils are not suitable for absorption. Discharge usually requires disinfection.



OPTIONS FOR SPECIAL SITUATIONS

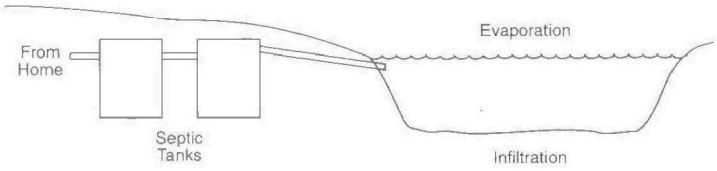
12 Holding Tank

Sewage flows from low-flush toilets and water-saving fixtures into a large watertight storage tank. The alarm in the tank signals the owner to have the sewage hauled away. Only recreational housing utilizes holding tanks because of the high hauling cost. Public management is frequently required. Contracting for hauling helps to reduce costs.



13 Lagoon

A series of septic tanks or other pretreatment systems (#7, #10, #11) discharge into a lagoon. Sunlight and long storage times support the natural breakdown of the waste and die off of harmful organisms. Effluent evaporates, slowly seeps into the soil, or receives further treatment through land application (#16). Onsite lagoons require large lots and may be fenced.



14 Waterless or Ultra Low-Flush Toilet System

Composting Toilets: No water
Serve commercial and single family units. Well-designed units produce a dry mixture that should be managed by professionals. Reduces discharge of nutrients into water resources. Electric vent, fan, and heating element common. Proper care is essential.

Incinerating: No water
Electricity, gas, or oil burns solids and evaporates the liquid, which is vented to the roof. Small amounts of ash are removed weekly. Proper care is essential. Limited to less frequent use sites, such as recreational cabins.

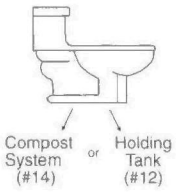
Water Conservation Toilets: Low water
Low-flush toilets use 1.6 gallons or less per flush. They generally cost slightly more than conventional units, but pay for themselves by lowering the water bill. They perform well. Many work as well as 4 gallons per flush models.

Recycling Water: Low water
Treated wastewater or graywater recycles to flush toilets. Treatment systems use electricity and require professional maintenance.

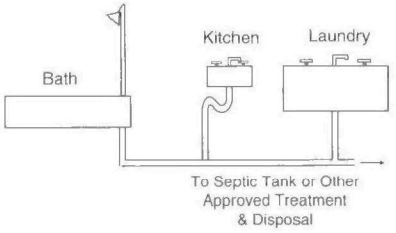
15 Dual Systems

Two systems treat the waste. Composting toilets or low-flush (1.6 gallons or less) toilets coupled with a holding tank (#14, #12) exclude nutrient rich toilet wastes (blackwater) from the wastewater disposal system. All other household wastewater (graywater) must be treated in an approved septic tank and absorption system, which is usually smaller.

(A) Blackwater (Toilet Wastes)



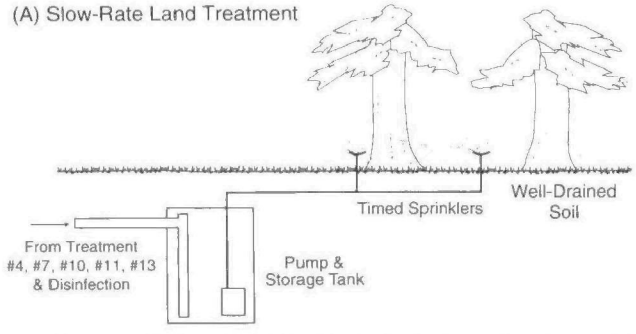
(B) Graywater
(Other Household Wastewater)



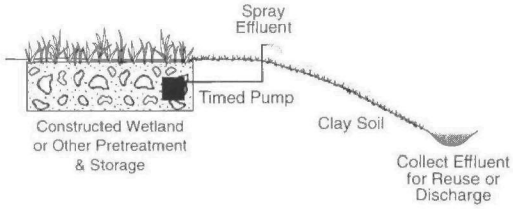
16 Land Application

Effluent from a septic tank is further treated (#7, #10, #11, #13) and stored. Timed sprinklers apply the effluent at night or below the soil surface to plants and trees in a large treatment area. Protects high groundwater in more permeable soils as plants take up nutrients and water. Disinfection and fencing may be required for individual home use. More common in warm climates, but not widely permitted by health authorities.

(A) Slow-Rate Land Treatment



(B) Overland Flow

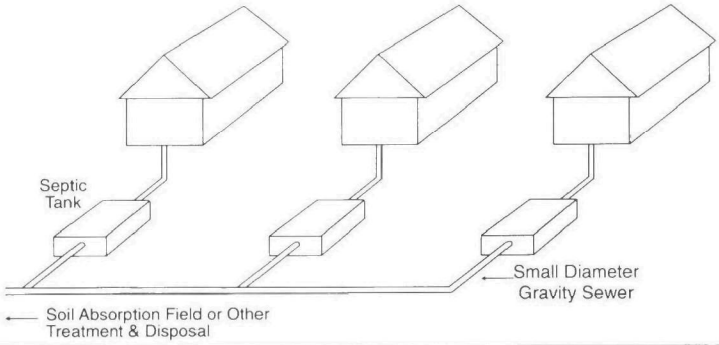


Treated effluent from a lagoon (#13) or wetland (#11) is sprayed on the surface of a gentle, grass covered slope. Effluent flows over the clay soil through the grass and collects at the base where it is disinfected before being discharged. Best for tight soils where absorption systems are not possible. A professional operator usually cares for the grass and disinfection system.

COLLECTION OPTIONS FOR OFFSITE TREATMENT

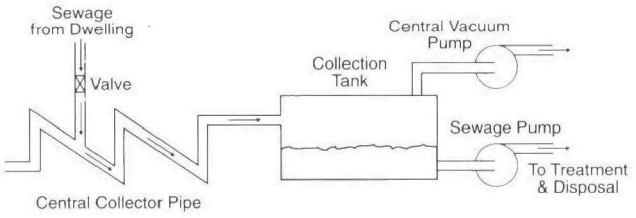
17 Small Diameter Gravity Sewers

Liquid from a septic tank flows under low pressure in 3-inch or larger collection pipes. Houses below the pipe must use small pumps (septic tank effluent pumps such as #19A and #20). Houses higher than the pipes may drain by gravity. Larger developments favor treatment by a discharging technology such as #10, #11, #13, or #16. Common in rural areas where the community treatment site is generally downhill. Central management is required.



18 Vacuum Sewers

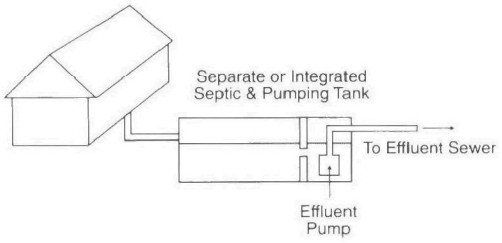
A vacuum station maintains a vacuum in the collection lines. When the sewage from one or several homes fills the storage pit, a valve opens, and the sewage and air rush into the collection line toward the vacuum station. Pumps in the vacuum station transfer the sewage to a treatment system. Power is required only at the vacuum station. Most economical where many homes are served or in areas with high excavation costs and lift stations. Requires a professional operator.



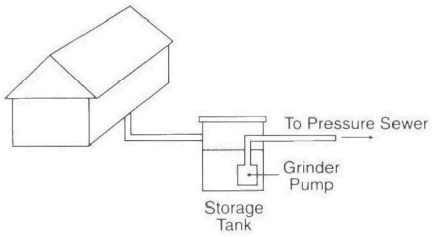
19 Pressure Sewers: Grinder Pump (GP) or Septic Tank Effluent Pump (STEP)

Sewage is first pretreated in a septic tank or grinder pump and then a pump forces the liquid through small diameter lines to a conventional gravity sewer or to a neighborhood treatment plant such as #10, #11, #13, or #16. The community usually owns and operates shared pumping units. Plastic lines located near the surface ease installation and reduce cost. Best for low-density or slow-growth areas or where conventional sewers are costly. Central management is required.

(A) Septic Tank Effluent Pumping System

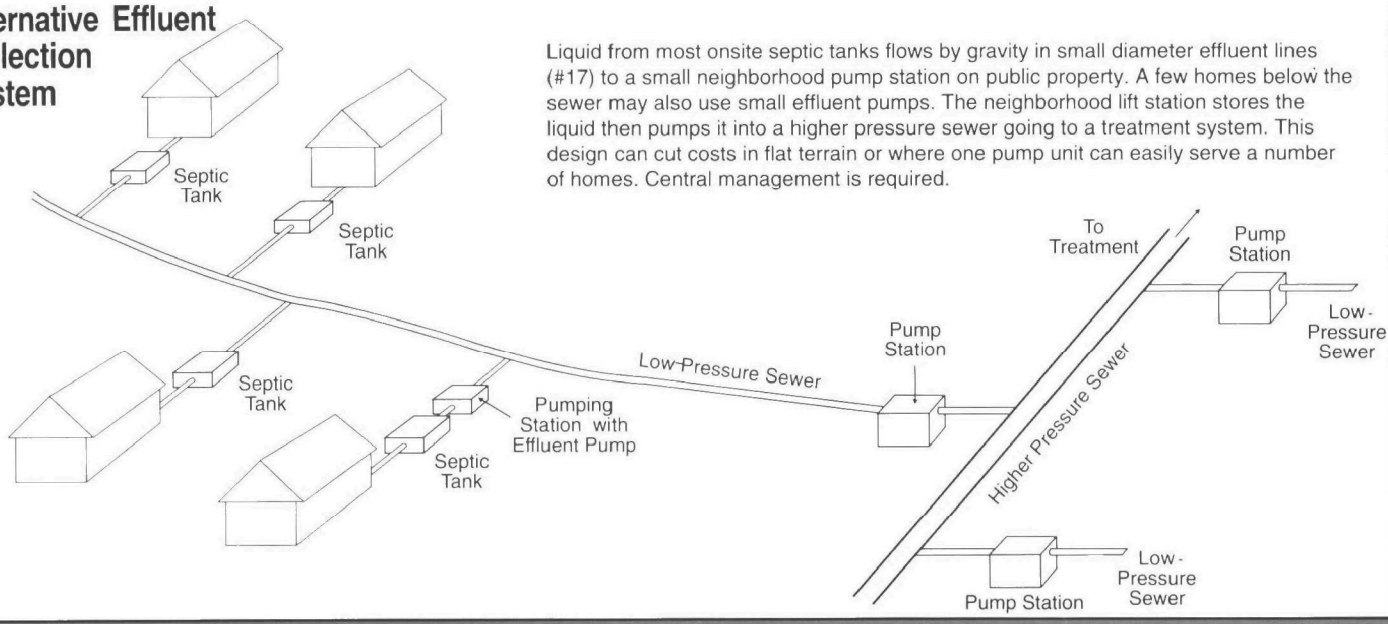


(B) Grinder Pump System



20 Alternative Effluent Collection System

Liquid from most onsite septic tanks flows by gravity in small diameter effluent lines (#17) to a small neighborhood pump station on public property. A few homes below the sewer may also use small effluent pumps. The neighborhood lift station stores the liquid then pumps it into a higher pressure sewer going to a treatment system. This design can cut costs in flat terrain or where one pump unit can easily serve a number of homes. Central management is required.



Why Small Systems?

Lower Water & Sewer Rates

Rates skyrocket when a few people have to pay for a large sewer system. Small natural systems are generally much simpler to operate and maintain and make use of the inherent capacity of the land.

Save Energy, Water & Materials

Most small systems rely on the soil, natural biological processes, and recharge of groundwater as well as use much less energy and mechanical equipment.

Save Prime Farmland & Prevent Urban Sprawl

Large regional sewage systems in rural areas encourage growth and loss of open space.

U.S. EPA's Small Community Outreach & Education (SCORE) Program

If your small community needs to build or upgrade its wastewater system, one of the small systems this foldout describes may be for you. This foldout is one of several publications, available through the SCORE program, that provides useful information on financial management and appropriate technology for small communities. EPA's SCORE program can direct you to organizations that can give you additional information or technical assistance. Check with your EPA Regional Office SCORE coordinator or the National Small Flows Clearinghouse.

Total System Management Makes It Possible

The figure for Skiville and Lake Pristine shows a variety of technologies serving different land uses and environments, all served by one wastewater management entity. More restrictive environments require a variety of advanced systems that need careful siting, design, and construction as well as more oversight of operation and maintenance. Total system management provides the expertise and oversight to insure this careful siting and design. Total system management also certifies that the system is properly built. During construction some systems installed in fragile environments require frequent inspection by trained professionals. Having a management agency also assures the community that the systems will be cared for. Many communities choose operating permits to guarantee maintenance by professionals, while other communities own onsite systems and assume the responsibility for system inspection and maintenance. Finally, the management agency educates the citizens on the value of their systems and how to protect their investment and the environment.

Through total system management, small communities can maintain their rural character while having the freedom to develop natural systems that harmonize with the environment. Communities may also choose less expensive alternative sewers with cluster treatment systems that reduce collection cost, the most expensive component of wastewater systems. For small communities and rural areas, a variety of professionally managed natural systems are usually less expensive, simpler to operate, require less energy, and can be more reliable than a conventional mechanical treatment system.

Other Small Community Systems Information Available From:

National Small Flows Clearinghouse
West Virginia University, PO Box 6064, Morgantown, WV 26506
800-624-8301

Center for Environmental Research Information
26 West Martin Luther King Drive, Cincinnati, OH 45268
(513) 569-7562

Or Your EPA Regional SCORE Coordinators:

1. Boston
(CT, ME, MA, NH, RI, VT)
JFK Federal Bldg.
1 Congress St.
Boston, MA 02203
(617) 565-3492

2. New York
(NJ, NY, PR, VI)
26 Federal Plaza
New York, NY 10278
(212) 264-8969

3. Philadelphia
(DE, MD, PA, VA, WV, DC)
841 Chestnut Bldg.
Philadelphia, PA 19107
(215) 597-6526

4. Atlanta
(AL, GA, FL, MS, NC, SC, TN, KY)
345 Courtland St., NE
Atlanta, GA 30365
(404) 347-3633

5. Chicago
(IL, IN, OH, MI, MN, WI)
77 W. Jackson
Chicago, IL 60604
(312) 886-0246

6. Dallas
(AZ, LA, OK, TX, NM)
1445 Ross Ave.
11th Floor, Suite 1200
Dallas, TX 75202
(214) 655-7130

7. Kansas City
(IA, KS, MO, NE)
726 Minnesota Ave.
Kansas City, KS 66101
(913) 551-7217

8. Denver
(CO, UT, WY, MT, ND, SD)
999 18th St., Suite 500
Denver, CO 80202-2405
(303) 294-1169

9. San Francisco
(AR, CA, Guam, HI, NV, American Samoa)
75 Hawthorne St.
San Francisco, CA 94105
(415) 744-1935

10. Seattle
(AK, ID, OR, WA)
1200-6th Ave.
Seattle, WA 98101
(206) 553-8575

Engineers, Regulators, and Consultants: For detailed technical information, get EPA's *Onsite Wastewater Treatment and Disposal Systems Design Manual, Septage Treatment and Disposal Handbook, Alternative Sewer Systems Design Manual* and others from the Center for Environmental Research Information, 26 W. Martin Luther King Dr., Cincinnati, OH 45268, (513) 569-7562.

This publication is not meant to be a comprehensive guide to alternative systems. It tries to acquaint the layperson with some representative systems used in the United States. EPA does not endorse, approve, or disapprove any system here. **Not all systems shown are approved by all jurisdictions.**

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