United States
Environmental Protection
Agency

Office of Water
Program Operations
Washington DC 20460

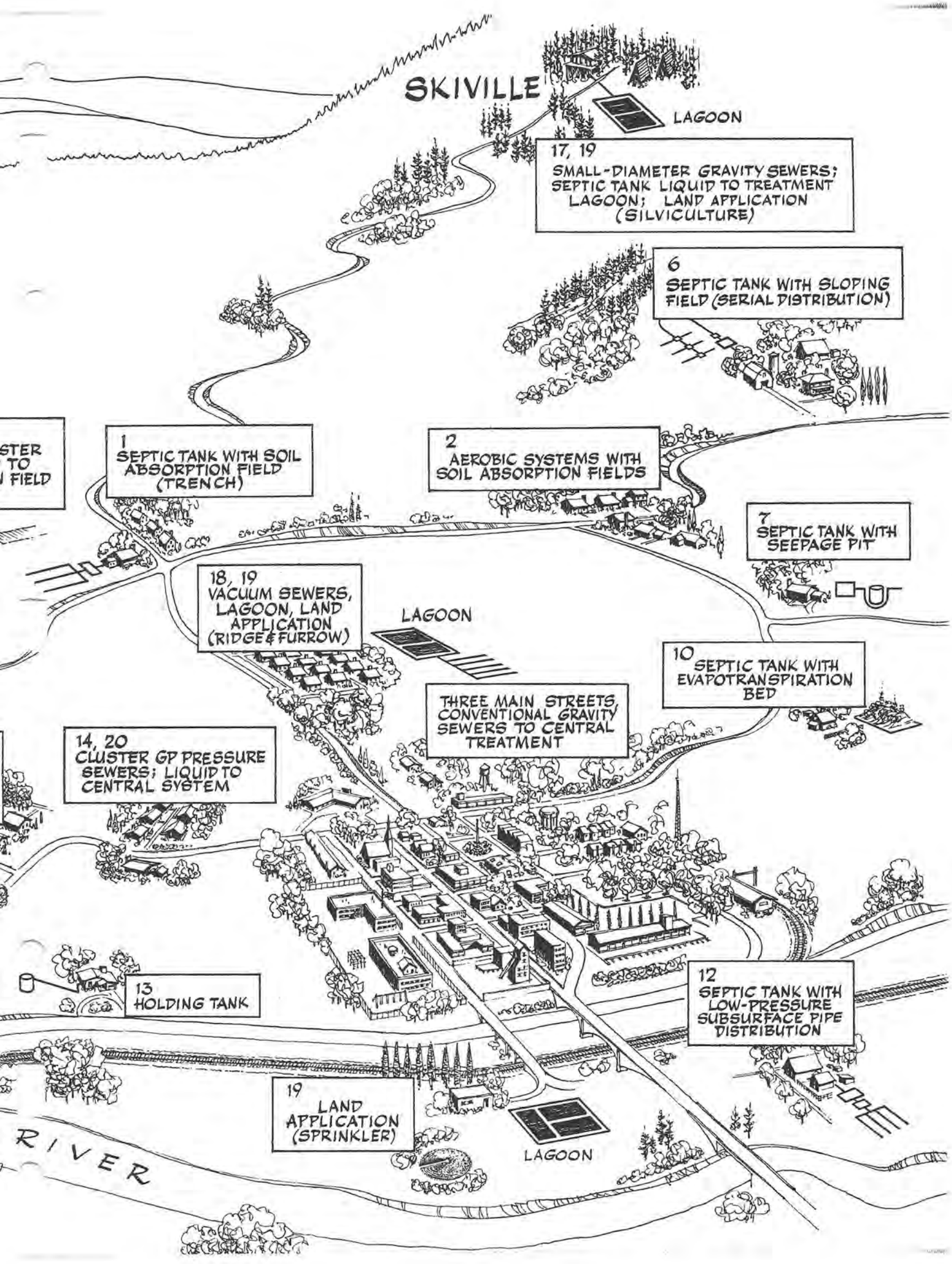
January 1980
FRD-10

EPA

Small Wastewater Systems

Alternative Systems for Small Communities and Rural Areas

THE SMALL COMMUNITY AND TYPICAL USES OF ALTERNATIVE WASTEWATER SYSTEMS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Why Small Systems?

Lower Water & Sewer Rates	Save Energy, Water, Materials	Save Prime Farmland, Prevent Urban Sprawl
Rates skyrocket when a few people have to pay for a large system.	Most small systems use less.	Large central sewage systems in rural areas can bring unwanted development.

Federal Government Pays 85%

EPA Construction Grants Program

If you're a *small community* or a *sparsely populated area of a large community* and have a water pollution problem caused by buildings in use December 27, 1977:

- The Government pays 85% of eligible costs for alternative systems if your State, local government, and EPA approve them for your project. Your community, often with State help, pays the other 15%. Farmers Home Administration, Economic Development Administration, Housing & Urban Development, and Community Services Administration programs also help in some areas.
- The Government pays to repair or replace the system if it fails within 2 years of final inspection because it proves unsuited to the project or its design concept is faulty.
- Systems can be *publicly or privately owned.* They can be for residences or small commercial establishments.

— *Publicly owned* systems are owned by the local government.

— *Privately owned* systems are owned by the property owner or a community organization. They can be funded if:

- An authorized local government unit applies for the grant; guarantees a system for inspection, proper operation, maintenance, and user charges; and says public ownership isn't practical;
- They're more cost effective than a conventional central system;
- The residence is a principal dwelling; vacation or second homes are not eligible.
- Commercial users pay back their share of system cost.

You Must Consider Alternatives

EPA can't approve a central system plan submitted after Sept. 30, 1978, unless the community shows it considered alternative systems.

More Information From:

- **EPA National Small Wastewater Flows Clearinghouse**
  West Virginia University; Morgantown, WV 26506; 800-624-8301.
- **Center for Environmental Research Information**
  26 W. St. Clair; Cincinnati, OH 45268; 513-684-7391.
- **Your EPA Regional Office**

1. Boston
(Conn., Maine, Mass., N.H., R.I., Vt.); JFK Federal Bldg.; Boston, MA 02203; 617-223-7210.

2. New York
(N.J., N.Y., P.R., V.I.); 26 Federal Plaza; New York, NY 10007; 212-264-2525.

3. Philadelphia
(Del., Md., Pa., Va., W.Va., D.C.); 6th & Walnut Sts.; Philadelphia, PA 19108; 215-597-9814.

4. Atlanta
(Ala., Ga., Fla., Miss., N.C., S.C., Tenn., Ky); 345 Courtland St., N E.; Atlanta, GA 30308; 404-881-4727.

5. Chicago
(Ill., Ind., Ohio, Mich., Minn., Wis.); 230 S. Dearborn St.; Chicago, IL 60604; 312-353-2000.

6. Dallas
(Ark., La., Okla., Tex., N.Mex.); 1201 Elm St.; Dallas, TX 75270; 214-767-2600.

7. Kansas City
(Iowa, Kans., Mo., Nebr.); 324 E. 11th St.; Kansas City, MO 64108; 816-374-5493.

8. Denver
(Colo., Utah, Wyo., Mont., N.D., S.D.); 1860 Lincoln St.; Denver, CO 80203; 303-837-3895.

9. San Francisco
(Ariz., Calif., Guam, Hawaii, Nev., Amer. Samoa, Trust Territories of the Pacific); 215 Fremont St.; San Francisco, CA 94105; 415-556-2320.

10. Seattle
(Alaska, Idaho, Oreg., Wash.); 1200—6th Ave.; Seattle, WA 98101; 206-442-1220.

Engineers and consultants: For detailed technical information get EPA's onsite systems manual free from Center for Environmental Research Information; 26 W. St. Clair; Cincinnati, OH 45268; 513-684-7391 ; and Innovative and Alternative Technology Assessment Manual from Municipal Construction Division (WH-547), OWPO, EPA, 401 M St. SW., DC 20460; 202-426-8976 .

This publication isn't 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 described here. Not all systems shown are approved by all jurisdictions. To get EPA funds, a project must meet Federal, State, and local standards.

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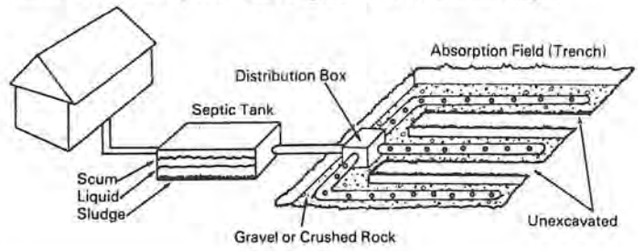
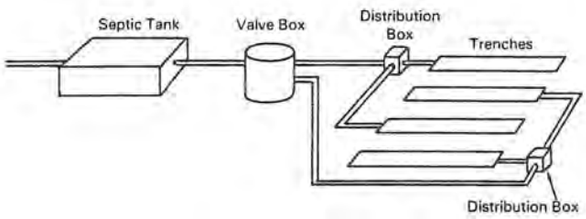
1 Septic Tank & Soil Absorption Field (Trench)

Sewage bacteria break up some solids in tank. Heavy solids sink to bottom as sludge. Grease & light particles float to top as scum. Liquid flows from tank through closed pipe and distribution box to perforated pipes in trenches; flows through surrounding crushed rocks or gravel and soil to ground water (underground water). Bacteria & oxygen in soil help purify liquid. Tank sludge & scum are pumped out periodically. Most common onsite system. Level ground or moderate slope.



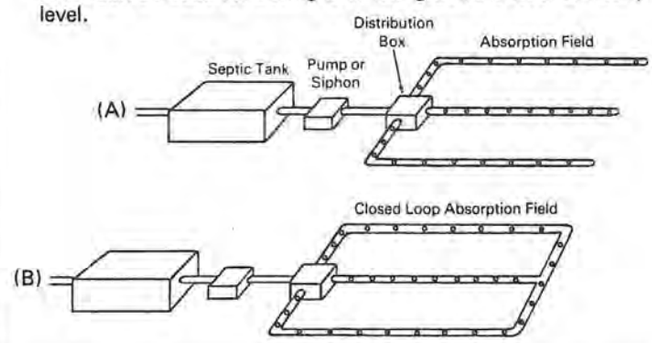
4 Septic Tank with Alternating Absorption Fields

One field rests while other is in use. Allows field to renew itself. Extends life of field. Provides standby if one field fails. Valve directs sewage liquid to proper field. Fields usually switched every 6-12 months.



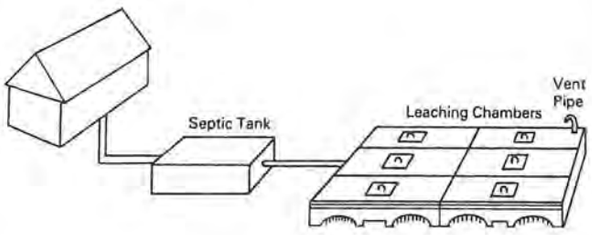
5 Septic System Refinements: (A) Dosing (B) Closed Loop

(A) Pump or siphon forces liquid to perforated pipes in controlled doses so all pipes discharge liquid almost at same time (dosing). Spreads liquid more evenly & gives field chance to dry out between dosings. (B) Variation of Sketch 1 absorption field. Can be used for dosing & where ground is level or nearly level.



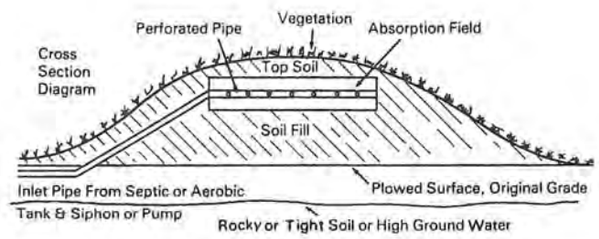
8 Septic Tank & Leaching Chambers

Open-bottom concrete chambers create underground cavern over absorption field. Liquid is piped into cavern & spread over field by troughs, splashplates, or dams. Liquid filters through soil. Chambers replace perforated pipe, trenches, & rocks of conventional absorption field. Access holes at top allow maintenance & soil inspection.



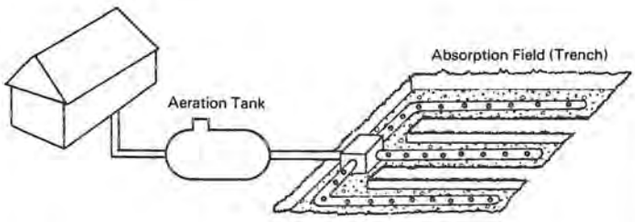
9 Mound System (Used with Septic or Aerobic Tank)

Liquid is pumped from storage tank (as in Sketch 21) to perforated plastic pipe in sand mound that covers plowed ground. Liquid flows through rocks or gravel, sand, & natural soil. Mound vegetation helps evaporate liquid. Rocky or tight soil or high water table.



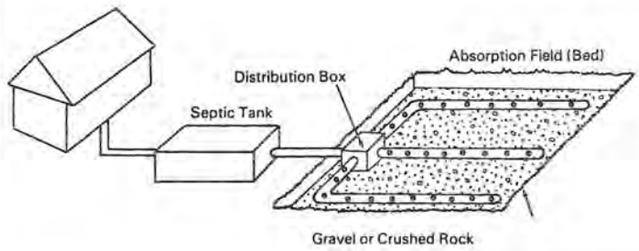
2 Aerobic System & Soil Absorption Field

Air and wastewater are mixed in tank. Oxygen-using (aerobic) bacteria grow, digest sewage, liquefy most solids. Liquid discharges to absorption field where treatment continues. Can use same treatment & disposal methods as septic tank. Maintenance essential. Uses energy.



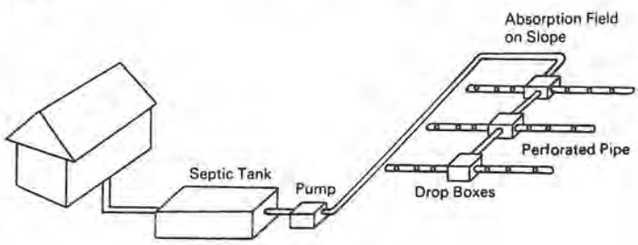
3 Septic Tank & Soil Absorption Field (Bed)

Similar to Sketch 1 but smaller field. Total field excavated. Used where space limited. Nearly level ground.



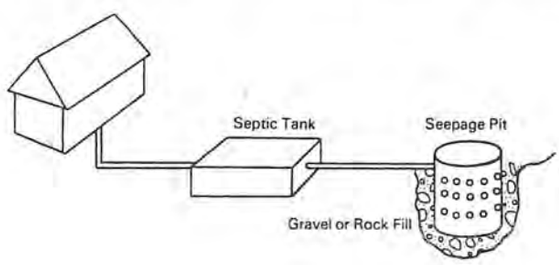
6 Septic Tank with Sloping Field—Serial Distribution

Pump forces liquid to perforated pipes in contoured absorption field. Drop boxes regulate liquid flow so highest trench fills up first, second fills up next, & lowest fills up last. Plastic fittings can be used instead of drop boxes to regulate flow. Used on slopes.



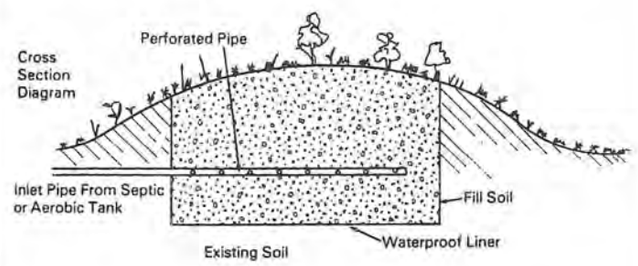
7 Septic Tank with Seepage Pit

Liquid flows to pit that has open-jointed brick or stone walls surrounded by rocks. Precast tanks with sidewall holes can also be used. Liquid seeps through walls & rocks to surrounding soil. Pit sides are cleaned periodically to prevent clogging.



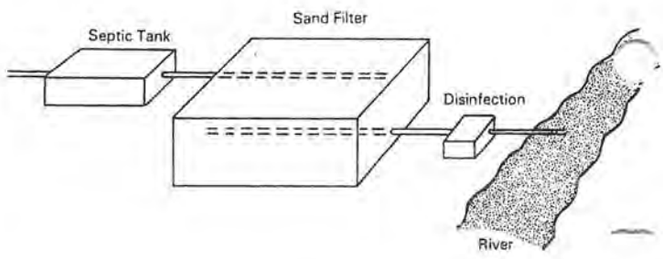
10 Evapotranspiration Bed (Used with Septic or Aerobic Tank)

Similar to Sketch 9 but sand bed is lined with plastic or other waterproof material. Bed could be mound or level. Liquid evaporates because liner prevents it from filtering through natural soil. Plants speed evaporation by drawing moisture from soil & breathing it into the air. Used where conventional absorption field not possible.



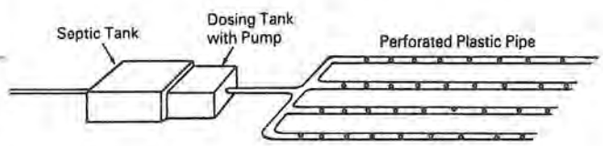
11 Septic Tank, Sand Filter, Disinfection & Discharge

Filter is ground-level or buried sand pit. Liquid enters perforated pipe at top & filters through sand & gravel to bottom pipe. Bottom pipe conducts liquid to disinfection tank. Liquid discharges to stream or ditch. Variations are intermittent sand filter & recirculating sand filter. Used where soil absorption field not possible.



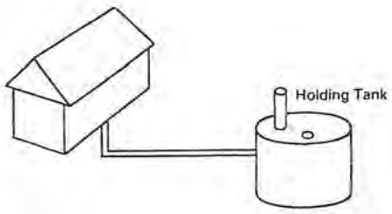
12 Low-Pressure Subsurface Pipe Distribution

Network of small-diameter perforated plastic pipes are buried 6"- 18" in 4"- 6"-wide trenches. Pump forces liquid through pipes in controlled doses so liquid discharges evenly. Site & soil determine pipe layout & pipe-hole size & number. Absorption field is same size as conventional field. Rocky or tight soil or high water table.



13 Holding Tank

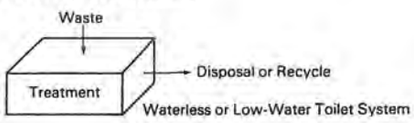
Sewage flows to large, underground, watertight storage tank. Tank is pumped periodically & sewage hauled away. Isolated or remote areas where absorption field not possible. Sewage hauling cost high.



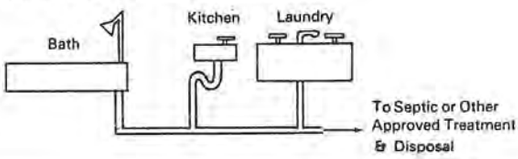
16 Dual Systems: Blackwater & Graywater

Many systems. In this one: (A) toilet wastes (blackwater) are handled by waterless or low-water toilet system [Sketch 15]. (B) Other household wastewater from kitchen, bath, laundry (graywater) needs separate treatment & disposal.

(A) Blackwater (Toilet Wastes)

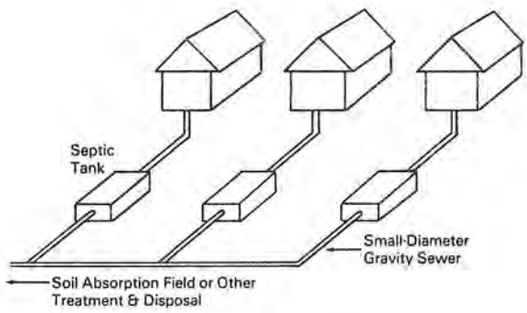


(B) Graywater (Other Household Wastewater)



17 Small-Diameter Gravity Sewers (Collection System)

4"- 6" pipe is sloped so liquid from septic or aerobic tank flows through pipe to treatment & disposal. Treatment & disposal system can be conventional or alternative. Small pipe costs less than conventional 8" pipe.



19 Land Application

Sewage liquid is applied to land to nourish vegetation & purify liquid. Methods:

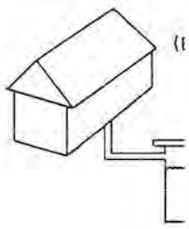
1. **Irrigation**—Liquid is applied to crops or to forests (silviculture) by sprinkling, flooding, or ridge & furrow. Liquid is sometimes disinfected before application.
2. **Overland flow**—Liquid flows through vegetation on graded slope. Runoff is collected at bottom & reused or discharged to river or stream. Suitable for tight soils.
3. **Rapid infiltration**—Partly treated sewage is applied in controlled doses to sandy soil. Solids break down. Liquid purifies as it seeps to ground water (underground water) or is collected & may be reused.

Aquaculture:

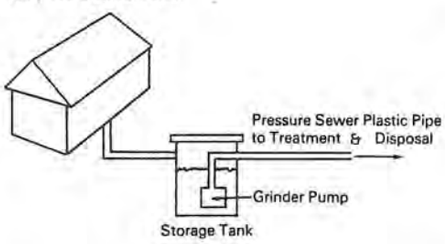
Plants & animals that grow in wastewater help purify water by digesting pollutants. Harvest is used as food, fertilizer, etc.

20 Pressure Sewers, GP (Grinder Pump)

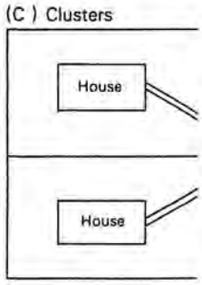
Unit grinds sewage & pumps it through small-diameter plastic pipe to central or alternative treatment & disposal. Doesn't use septic tank but existing tank (B) may remain for emergency storage. Used for one or several homes (C).



(A) No Septic Tank

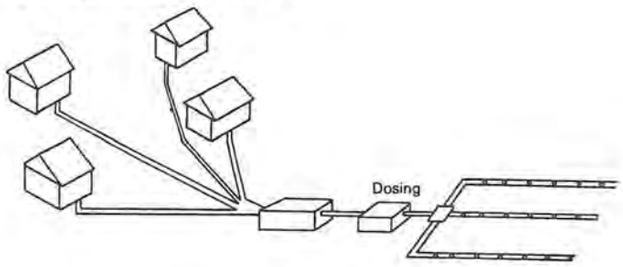


(C) Clusters



14 Cluster System
(Two or More Users on One Alternative System)

Several houses are served by common treatment & disposal system. Houses could also have onsite septic or aerobic tanks with liquid conducted to common absorption field. Clusters of houses can also use other alternative systems, such as mounds (Sketch 9), pressure & vacuum sewers (Sketches 18, 20, 21), & sewage treatment lagoons.



15 Waterless or Low-Water Toilet Systems*

Composting: No water.
Large & small systems. Converts toilet wastes & most food wastes to compost. Electric vent fan & heating element optional on large systems; essential on small systems. Proper care vital.

Incinerating: No water.
Electricity, gas, or oil burns solids & evaporates liquid. Small amount of ash is removed weekly. Roof vent. Proper care essential.

Recycling Oil Flush: No water.
Similar to water-flush toilet but uses oil for flush. Oil & wastes go to large storage tank where wastes settle at bottom & oil rises to top. Filtered oil recycles for flush. Storage tank is pumped & oil replaced periodically. Uses electricity. Proper care essential.

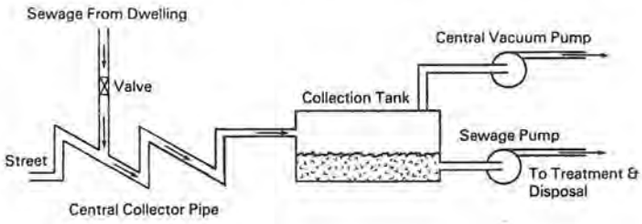
Recycling Chemical: Low water.
Water-chemical flush mixture is pumped into toilet bowl. Mixture & wastes go to storage tank. Filtered liquid recirculates for flush. Permanent or portable types. Permanent needs water hookup. Storage tank is pumped & chemicals added periodically. Uses electricity. Proper care essential.

Recycling Water: Low water.
Various systems. Some reduce wastes to water, gas, & vapor. Treated wastewater recycles to flush toilet. System vents to outside. Multiflush commercial units available. Most systems use electricity. Professional maintenance essential.

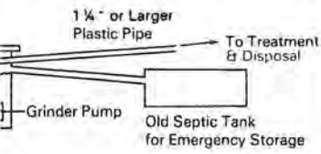
**Treat toilet wastes (blackwater). Other household wastewater (graywater) needs separate treatment & disposal system.*

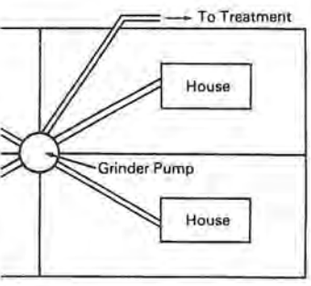
18 Vacuum Sewers
(Collection System)

Vacuum pump creates vacuum in collector pipes. Valve opens when sewage from dwelling presses against it. Sewage & plug of air behind it enter pipe. Air forces sewage to collection tank. Sewage pump forces sewage from tank to treatment system. Needs standby electric power & failure alarm system. Can be used with large cluster systems (Sketch 14).



Old Septic Tank Left in Place



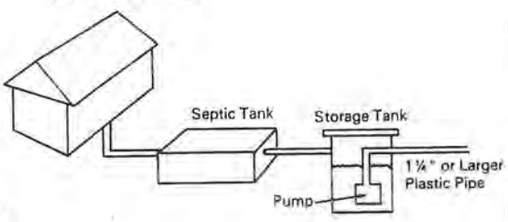


21 Pressure Sewers, STEP
(Septic Tank Effluent Pump)

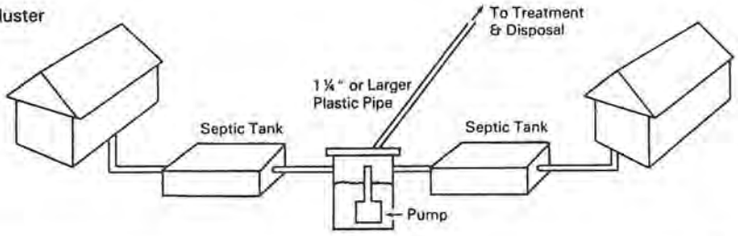
(A) One dwelling. Pump forces liquid from septic tank through plastic pipe to further treatment & disposal. Sludge is pumped from septic tank periodically.

(B) Cluster system. Liquid from several septic tanks flows to one pumping tank. Pump forces liquid through plastic pipe to treatment & disposal.

(A) One Dwelling



(B) Cluster



GPO 864-289