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Report to the Congress; by Elmer B. Staats, Comptroller General.

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Wastewaters generated by homes and businesses are either transported by sewers to central facilities for treatment and disposal or treated and disposed of onsite by some type of septic system. Because septic systems have performed ineffectively, they have come to be regarded as temporary methods of wastewater treatment. Septic systems generally fail, however, as a result of human error or neglect.

Findings/Conclusions: Septic systems are environmentally and technologically sound. Properly designed, constructed, operated, and maintained septic systems should not fail and can be as permanent as central treatment systems. Alternative septic system technologies are available to overcome soil, geological, and hydrological conditions which may limit the use of conventional sewage systems. These alternative systems can provide as good or better treatment than central systems, use less energy, and provide an additional benefit by replenishing groundwaters. Federal agencies do not encourage the building of septic systems to permanently solve wastewater treatment problems, and various State regulations and local enforcement have not provided effective controls to assure good septic system performance. Good management could reduce septic systems' failure and make them part of a communitywide strategy to reduce, prevent, and eliminate water pollution.

Recommendations: The Administrator, Environmental Protection Agency, should: revise regulations to require that facility plans consider water pollution problems in all community areas, encourage States and communities to obtain the necessary authority to establish effective public management programs for septic systems, establish minimum standards for public management of septic systems, and emphasize to public entities that grant assistance is available for major rehabilitation and

upgrading of septic systems. (RRS)

BY THE COMPTROLLER GENERAL

P-201

Report To The Congress

OF THE UNITED STATES

Community-Managed Septic Systems --A Viable Alternative To Sewage Treatment Plants

Millions of dollars are being spent to construct sewers and central wastewater treatment facilities to replace septic systems. Because of inadequate controls over design, installation, and operation, septic systems have become unreliable and temporary. Septic systems are, however, environmentally sound, technologically feasible, and cost effective.

The Environmental Protection Agency and other Federal agencies, should increase the acceptance of septic systems by requiring established public management entities to control their design, installation, and operation. The Environmental Protection Agency should also require facility plans to develop those institutional, legal, and financial arrangements necessary to implement community-wide strategies and public management of all wastewater treatment systems.



GED-78-168
NOVEMBER 3, 1978



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20348

B-166506

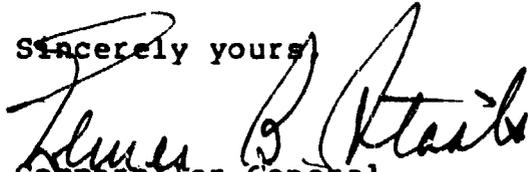
To the President of the Senate and the
Speaker of the House of Representatives

This report discusses the benefits and obstacles concerning septic systems as viable waste water treatment alternatives to central treatment processes. Properly operating septic systems can be as permanent and effective as central treatment facilities, at considerably less cost.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), the Accounting and Auditing Act of 1950 (31 U.S.C. 67), and the Legislative Reorganization Act of 1970 (31 U.S.C. 1152).

Copies of this report are being sent to the Director, Office of Management and Budget; the Administrator, Environmental Protection Agency; the Secretaries of Agriculture and Housing and Urban Development; Members of Congress; and interested congressional committees.

Sincerely yours,


Comptroller General
of the United States

D I G E S T

Use of septic systems is a viable wastewater treatment alternative to central treatment processes. If properly designed, constructed, operated, and maintained, septic systems

- should not fail,
- can be as permanent as central treatment facilities,
- are often more ecologically sound than sewers and central facilities, and
- can provide a high degree of wastewater treatment, as good or better than the effluent produced by conventional central treatment processes.

A State health department analysis of one community's septic system survival showed that, of 230 septic systems, 94 percent were still functioning 20 years after installation. (See pp. 7 through 8.)

Many small municipalities cannot afford the high installation, operation, and maintenance costs of sewers and central treatment facilities. In one community, the average household cost of central treatment would be \$11,700 to \$12,200 for 20 years. In contrast, a homeowner could expect to pay from \$2,000 to \$3,700 to install and operate a septic system over a 25-year service life. In another community, the initial facility plan recommended a \$7.8 million sewer and

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central treatment system. A revised facility plan recommended only partial sewerage and repair or replacement of failing septic systems. The estimated cost of this combination alternative was \$5 million, or \$2.8 million less than the originally recommended sewer program. (See pp. 8 through 9 and 11 through 13.)

FEDERAL AGENCIES PROMOTE COSTLY CENTRAL SYSTEMS

Federal agencies do not encourage the building of septic systems to permanently solve wastewater treatment problems. Through the construction grants program, the Environmental Protection Agency has promoted the conversion of septic systems to sewers and central treatment. Communities, with Agency approval, have built sewers and central treatment facilities without adequately considering the potential for more cost effective alternatives such as the major rehabilitation or upgrading of septic systems or combination of these systems. The Department of Housing and Urban Development and the Farmers Home Administration of the Department of Agriculture, impose controls and standards over construction of single family housing to protect Government interests and assure quality housing. GAO found that both agencies (1) promote the use of sewers and central treatment and (2) consider septic systems only a temporary method of waste water disposal, as does the Environmental Protection Agency. (See pp. 14 through 21.)

COMMUNITY MANAGEMENT OF ONSITE SYSTEMS NEEDED

Various State regulations and local enforcement have not provided the effective controls to assure good septic system performance. Good management of septic systems could reduce failure and make

septic systems part of a community-wide strategy to reduce, or prevent and eliminate, water pollution in communities.

The lack of financial incentives and problems with proper system siting, design, and construction has inhibited the consideration of these alternatives. Septic system failures caused by the lack of effective control and management are the results of human error or neglect and are controllable. Unless the States and communities develop more effective techniques to manage and control their septic system design, construction and operation, Federal, State, and local governments will continue to absorb the environmental costs associated with ineffective performance. (See pp. 22 through 26.)

RECOMMENDATIONS

The Administrator, Environmental Protection Agency, should

- revise regulations to require that facility plans consider water pollution problems in all community areas, including a comprehensive strategy to control pollution throughout the community;
- encourage States and communities to obtain the necessary authority to establish effective public management programs for septic systems;
- establish minimum standards for public management of septic systems; and
- emphasize to public entities that grant assistance is available for major rehabilitation and upgrading of septic systems.

GAO also recommends that the Administrator work with the Secretaries of Agriculture and the Department of Housing and Urban Development to insure that guidelines and requirements are developed for public management of wastewater disposal systems funded by the Department of Housing and Urban Development and the Farmers Home Administration.

AGENCY COMMENTS

Matters in this report were discussed with Agency officials who agreed with most of the conclusions and recommendations. These officials said that the report was technically accurate. GAO recommendations will be included in interim regulations to implement the Clean Water Act of 1977. An Environmental Protection Agency guidance memorandum is being prepared to further clarify the interim regulations.

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ABBREVIATIONS

EPA	Environmental Protection Agency
FARHA	Farmers Home Administration
GAO	General Accounting Office
HUD	Department of Housing and Urban Development

CHAPTER 1

INTRODUCTION

Wastewaters generated by homes and businesses are either transported by sewers to central facilities for treatment and disposal or treated and disposed of onsite by some type of septic system. In 1970 about 19.5 million homes--nearly 29 percent of the Nation's housing units--used onsite systems to dispose of their wastewater. Each year about 500,000 new homes are built with onsite systems.

Onsite systems have generally been regarded as a temporary solution for wastewater disposal, however, and are usually replaced by sewers and central wastewater treatment facilities. From 1950 to 1970, for example, 10 million homes with onsite systems were converted to sewers and centralized treatment.

Although sewers and centralized treatment facilities have received widespread use in recent years, they are expensive, particularly for smaller, less populated communities. We wanted to determine if onsite treatment systems were still an environmentally sound, technically feasible, and less costly alternative method of wastewater disposal.

ONSITE WASTEWATER DISPOSAL SYSTEMS

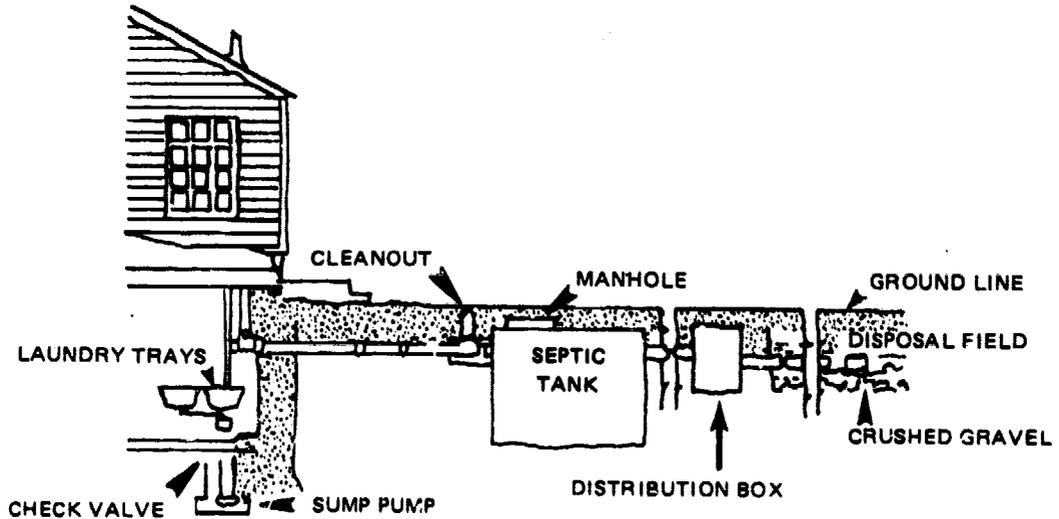
During the last 30 years, many Americans moved to suburban residential areas where domestic wastewater disposal was handled largely by onsite systems, using septic tanks, incinerators, lagoons, aerobic units, and small package plants. The most common type of system--85 percent of all onsite systems--is the septic system.

Conventional septic systems are relatively simple. Treatment is usually performed by a septic tank which traps and stores solid particles and returns the liquid portion of the wastes to the soil.

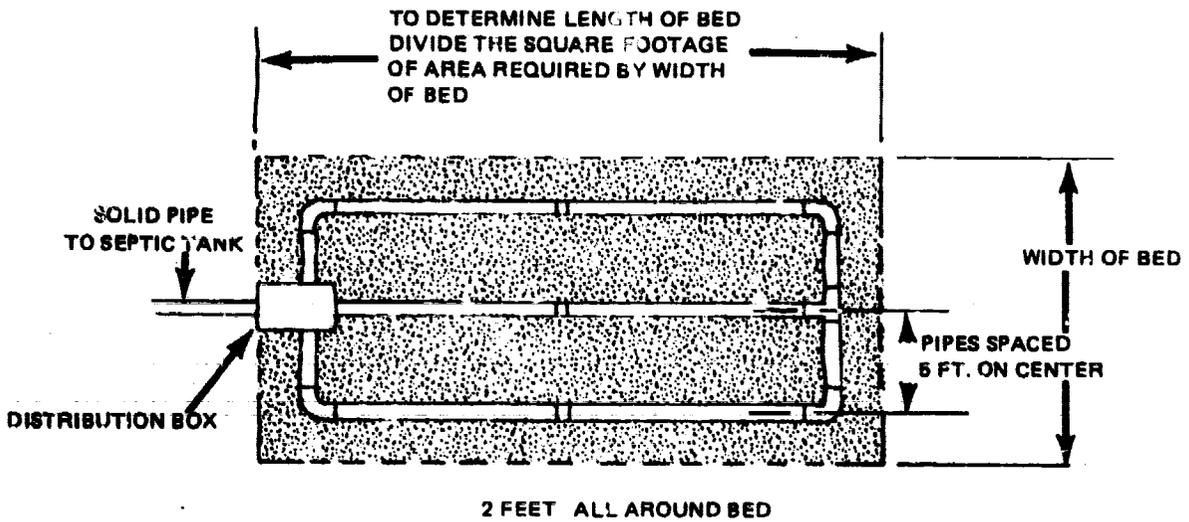
In operation, wastewater is discharged from the house into a tank. Larger solids then settle to the bottom, and grease, oil, and other floating particles rise to the top. The septic tank also biologically breaks down the waste, thereby reducing the volume of solids in the tank.

The liquid portion of household wastewater flows from the septic tank to the leaching system, or soil absorption field, for further treatment and disposal. In the field the liquid is distributed to the soil and is purified as it percolates through the soil. The following drawings illustrate septic system and absorption field operation.

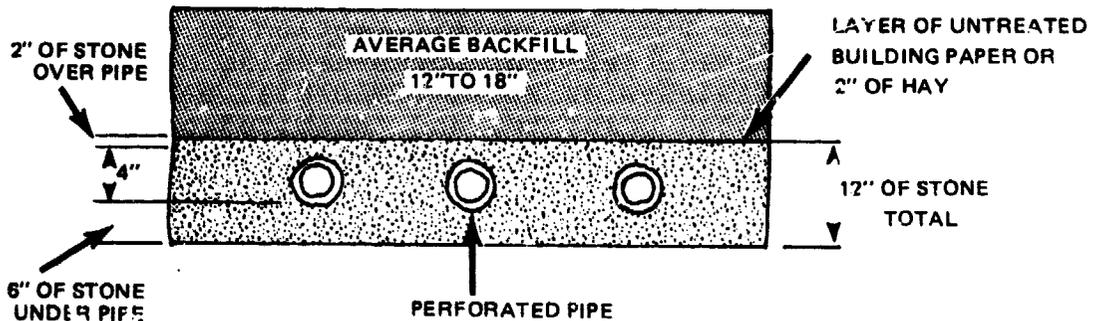
SECTION SHOWING A TYPICAL SEWAGE DISPOSAL SYSTEM



TYPICAL ABSORPTION BED



TYPICAL CROSS SECTION OF ABSORPTION BED



Source : GUIDE FOR THE SUCCESSFUL DESIGN OF SMALL SEWAGE DISPOSAL SYSTEMS
NEW HAMPSHIRE WATER SUPPLY AND POLLUTION CONTROL COMMISSION
DECEMBER 1974

EPA CONSTRUCTION GRANT PROGRAM

The Federal Water Pollution Control Act Amendments of 1956 (Public Law 84-660) created the wastewater treatment construction grant program. The act authorized grants for constructing publicly owned treatment facilities to prevent untreated or inadequately treated sewage or other waste discharges into waterways. Grant recipients, usually municipalities received Federal assistance of 30 percent of eligible project costs. Subsequent amendments to the act increased the Federal share of project costs to a maximum of 55 percent, and the 1972 Federal Water Pollution Control Amendments (Public Law 92-500) established the Federal share at 75 percent of eligible costs. The Clean Water Act of 1977 (Public Law 95-217) increased the Federal share to 85 percent of construction costs for grants made during fiscal years 1979 through 1981 for projects using innovative or alternative wastewater treatment processes and techniques which now must be fully studied and evaluated under section 201(g)(5) of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251).

The 1972 amendments provided \$18 billion for constructing waste treatment facilities. Public Law 94-447--dated October 1, 1976--and Public Law 95-26--dated May 4, 1977--provided additional construction grant funds of \$480 million and \$1 billion, respectively. The Clean Water Act of 1977 authorized construction grant funding of \$4.5 billion for fiscal year 1978. The Congress appropriated this amount in March 1978 and appropriated \$5 billion annually for fiscal years 1979 through 1982.

Section 201 of the Federal Water Pollution Control Act, as amended, provides for the construction funding of privately owned septic systems, it states:

"A grant may be made under this section to construct a privately owned treatment works serving one or more principal residences or small commercial establishments constructed prior to, and inhabited on the date of enactment of this subsection where the Administrator finds that--

- (1) a public body otherwise eligible for a grant under subsection (g) of this section has applied on behalf of a number of such units and certified that public ownership of such works is not feasible;

- (2) such public body has entered into an agreement with the Administrator which guarantees that such treatment works will be properly operated and maintained and will comply with all other requirements of section 204 of this Act and includes a system of charges to assure that each recipient of waste treatment services under such a grant will pay its proportionate share of the cost of operation and maintenance (including replacement); and
- (3) the total cost and environmental impact of providing waste treatment services to such residences or commercial establishments will be less than the cost of providing a system of collection and central treatment of such wastes."

The Environmental Protection Agency (EPA) awards grants by initially preparing facility plans, then developing detailed designs and specifications, and finally constructing the facility. Facility planning is the most important phase. During this phase, the municipality--usually through a contract with its consulting engineer--identifies the water pollution problems, analyzes alternative solutions, and selects the most cost-effective, environmentally sound alternative within EPA and State guidelines and regulations.

During the facilities planning stage, basic decisions are made regarding the best solution to a municipality's pollution problem. EPA regulations require that, where deemed appropriate by Regional Administrators, facility plans initiated after April 30, 1974, must include a cost-effectiveness analysis of alternatives on which selection of the treatment system is to be based.

To further encourage the use of individual systems, the Clean Water Act of 1977 provides that EPA may make construction grants for privately owned treatment works serving one or more principal residences or small commercial establishments in existence on December 27, 1977, where costs are less than a system of sewers and centralized treatment. Construction grants for privately owned treatment systems are allowed where a public agent applies for a number of such units, assuring EPA of their proper operation and maintenance. The act also provides that for fiscal year 1979 and thereafter, rural States shall have 4 percent of their construction allotment set aside for alternative and unconventional wastewater treatment systems for places of 3,500 population or less or for highly dispersed areas of larger communities.

SCOPE OF REVIEW

We reviewed selected wastewater treatment facility plans and studied numerous technical reports to determine the feasibility, environmental soundness, and cost-effectiveness of alternatives to central treatment facilities. We also interviewed experts and researchers in the field of wastewater treatment, consulting engineers and appropriate Federal, State, and local officials. We reviewed projects administered by EPA, the Department of Housing and Urban Development (HUD), and the Farmers Home Administration (FmHA) in Massachusetts, Connecticut, Arkansas, and Louisiana.

CHAPTER 2

SEPTIC SYSTEMS AS VIABLE, LESS COSTLY WASTEWATER TREATMENT ALTERNATIVES

Because septic systems have performed ineffectively, they have come to be regarded as temporary methods of wastewater treatment. Septic systems, however, generally fail as a result of human error or neglect. Where suitable land in sufficient quantity is available, and when properly designed, constructed, and operated, septic systems are effective long-term tools for wastewater disposal and are potentially less costly than sewers and central treatment facilities.

SEPTIC SYSTEMS ARE ENVIRONMENTALLY AND TECHNOLOGICALLY SOUND AND CAN BE A PERMANENT METHOD OF TREATMENT

Properly designed, constructed, operated, and maintained septic systems should not fail and can be as permanent as central treatment systems. The causes of septic system failures are controllable. Moreover, alternative septic system technologies are available to overcome soil, geological, and hydrological conditions which may limit the use of conventionally designed septic systems. These alternative systems can (1) provide as good or better treatment than central systems, (2) use less energy and, (3) provide an additional benefit by replenishing groundwaters.

Environmental soundness of septic systems

Septic systems are often more ecologically sound than sewers and central facilities. Properly operating septic systems can provide a high level of wastewater treatment. University of Connecticut researchers told us that after septic system effluent has been absorbed and treated by about 5 feet of soil, it is as good or better than the effluent produced by conventional central treatment plants. Although some adverse health and environmental effects have been associated with nitrate pollution from septic systems, researchers at the Universities of Wisconsin, and Connecticut, and the EPA Municipal Environmental Research Laboratory in Cincinnati told us that if septic systems are properly sited, designed, installed, and maintained, nitrate pollution should not be a problem. These researchers stated, however,

that more study is needed to develop a low-cost means of improving septic system nitrate removal.

Compared to centralized facilities, septic systems are more environmentally advantageous because they

--dispose waste over wider areas, allowing the environment to assimilate waste discharges more readily;

--recharge groundwater supplies;

--use less electricity, thereby conserving energy resources; and

--do not discharge pollutants into waterways.

Septic systems can function effectively at least as long as the normal 20- to 40-year design life used for central treatment facilities. Researchers at the Universities of Wisconsin and Connecticut told us that properly designed, installed, operated, and maintained septic systems could last from 25 to 50 years.

A Fairfax County, Virginia, Health Department analysis of septic system survival for 1952 to 1972, shows that, of 230 systems installed in 1952, 94 percent were still functioning 20 years later. Further, on about 1,500 systems installed since 1966 no failures had occurred by 1971. The study also shows that properly designed septic systems were surviving 20 to 30 years. Since 1973 the County has required that all new systems have two absorption fields which can be alternated for use and imposed mandatory maintenance practices, including regular cleanings, county officials believe that these new systems can perform without failure for 30 to 50 years or indefinitely.

An analysis of septic system longevity in Glastonbury, Connecticut, made by the New Haven, Connecticut, Agricultural Experiment Station also produced similar results. The study reported that 69 percent of the systems should survive at least 20 years, and 50 percent of the systems were expected to survive for 27 years or longer.

Septic systems are technologically sound

A University of Wisconsin study identified the major causes for septic failures, including

- poor site evaluation,
- inadequate system design,
- failure to follow design specifications during construction,
- poor construction procedures,
- inadequate inspection procedures by regulatory agencies, and
- lack of good operation and maintenance practices.

Siting the design problems

Proper performance of a septic system depends upon the ability of soil to absorb viruses, strain out bacteria and filter wastes. A proper site evaluation requires accurate measurement of soil permeability, degree of slope, position of the water table, and the depth of bedrock or other impermeable material.

The most widely used indicator of soil permeability is the percolation test which measures the capability of the soils to absorb water. Researchers generally agree that using the percolation test alone does not provide adequate information to properly design septic systems. Further, percolation test results taken in the same soil can vary as much as 50 percent from (1) differences in the time of year the soil is tested, (2) testing procedures used, and (3) interpretation of the results by the tester.

Consulting engineers, researchers, and local regulatory officials stated that code standards and restrictions can inhibit the proper design of systems to meet specific site conditions. Massachusetts law, for example, does not permit moundings (above ground) septic system installation. Because State codes change slowly, they can also restrict or prohibit the use of available alternative septic system technologies and modern design criteria.

Improved designs exist to maximize soil purification ability and lengthen septic system life. A variety of technologies also exist to make septic systems viable under different soil, geological, and hydrological conditions. For example, to overcome poor site conditions, such as seasonally high groundwater or shallow topsoil over rock,

soil absorption beds can be raised by building them in mounds of sand. Septic systems can also be constructed with pressurized distribution systems to provide periodic dosing and uniform distribution of effluent to enhance purification, reduce leaching field clogging, and maximize leaching field life.

Construction problems

A primary cause of septic system failures, especially within the first 3 years of service, is poor quality construction overlooked by regulatory agencies during site inspections. State and local officials stated that, in addition to making construction errors, contractors sometimes (1) do not follow septic system design specifications, (2) modify designs which they do not understand, or (3) do not install systems at the proper locations on lots. These actions can lead to early septic system failures.

In 1976 we identified some causes of septic system failures in a HUD-approved single-home development in Merrimack, New Hampshire ^{1/}. We evaluated several malfunctioning systems, finding that the systems had failed because of improper installation and poor design. One septic system had been designed and constructed with a leaching area too small for soil conditions and wastewater flow from the home. Another system failed because the absorption bed was built on fill composed primarily of muck, stones, and tree stumps. A third system absorption bed was only about 1 foot above groundwater and was built in a fill material that had been compacted by the contractor's heavy equipment.

HUD minimum property standards and State requirements governing septic system siting, design, and construction had been violated in all cases examined. Moreover, septic system designs submitted to HUD were questionable and construction inspections by HUD and local inspectors were inadequate.

By June 1977, HUD had identified 51 homes in the development with septic system problems. HUD officials in Washington evaluated problems in the development and offered Merrimack a \$658,000 grant to extend sewer service to the entire development. As of December 1977 the town had not accepted the grant.

^{1/} GAO Report "Construction Problems With County Club Estates, Merrimack, New Hampshire - A Section 235 Housing Project," CEDD 76-148, October 20, 1976.

Operation and maintenance problems

Neglect of necessary septic system operation and maintenance is another major cause of problems and failures. When the septic tank is not periodically cleaned, solids build up and enter the underground soil absorption field, blocking the flow of effluent into the soil. Maintenance of a septic system, however, is relatively simple involving periodic pumping to remove accumulated solids from the tank.

Maintenance of the system is a homeowner responsibility. Homeowners usually do not know how their systems work or how to properly operate and maintain them. State and local officials told us that homeowners frequently neglect pumping septic systems--causing failures or problems--because they are not aware of maintenance needs. Homeowners can also cause system failures and problems by excessive water usages which overload systems beyond designed capacities.

SEPTIC SYSTEMS CAN BE MORE COST EFFECTIVE THAN CENTRAL FACILITIES

Sewers and centralized wastewater treatment facilities are expensive to build and operate. As part of another on-going study, ^{1/} we reviewed 25 treatment plant projects in EPA regions II, IV, and IX, which ranged in construction costs from \$249,000 to \$1.4 billion, excluding operation and maintenance charges and hook-up and connection fees. We found that the project cost per household, excluding commercial and industrial user firms, ranged from \$837 to \$17,700.

Many small municipalities are encountering financial problems associated with the high cost of constructing, maintaining, and operating sewers and centralized treatment facilities. The high costs place unreasonable financial burdens on medium- and low-income families. The use of septic systems to treat community wastewaters can eliminate the need for costly collection and conveyance systems and result in substantial savings for the Federal Government; the local community; and, in some cases, individual homeowners.

Wastewater treatment specialists maintain that septic systems can be less costly than central treatment facilities. Experts at the University of Wisconsin's Small Scale Wastewater Management Project estimated a 50 percent savings

^{1/} GAO Review of the impact of local financing of waste treatment facilities.

could be realized using septic systems instead of conventional treatment. An Associate Professor at the University of Connecticut's Department of Civil Engineering and an official of the Governor's Office of Appropriate Technology in California also stated that the use of septic systems, instead of sewers and central treatment, could represent a saving of up to 50 percent.

EPA studies have also substantiated that septic systems are a less costly approach than central facilities. A 1977 study prepared for EPA by a consulting engineering firm showed that, in an Idaho community of 550 persons, the repair and replacement of septic systems was 30 percent less costly than providing sewers and central treatment. Another 1977 study prepared by the University of Wisconsin's Small Scale Wastewater Management Project shows that using septic systems to treat wastewater can achieve savings over sewer and central facilities by

- reducing or eliminating costly sewer collection systems which are generally about two-thirds of the cost of providing central treatment,
- using existing properly functioning systems rather than providing new service, and
- reducing the need for mechanical treatment and associated energy costs.

Cost estimates indicate that a homeowner, in one Massachusetts' community could expect to pay from \$2,000 to \$3,700 to install, operate and maintain a conventional septic system over its 27-year service life. An analysis of total costs of connecting 400 homes in the same community to an expanded sewer system showed that the average household cost over 20 years would be \$11,700 to \$12,200--about four times the cost of replacing the septic system.

The real danger of not adequately considering septic systems as a viable way to treat and dispose of wastewater is illustrated by a Greenville, Maine project. That community, with a population of 1,900 established the Moosehead Lake Sanitary Sewer District and constructed an advanced wastewater treatment plant under an EPA grant program. The community consulting engineer considered sewers and various central treatment alternatives but did not consider repairing or replacing septic systems. EPA, several other Federal agencies, and the State of Maine financed the entire \$4 million capital costs of the treatment plant.

In 1972 the estimated annual user charge was \$95, based on 650 potential users. By 1976 the estimated annual per user charge had risen to \$200, but, because the plant was only operating at 20 percent of its design capacity, the 200 actual users faced an annual user charge of \$650. Operation and maintenance costs alone were estimated to be \$130,000--77 percent of the town's annual operating budget, excluding the sewer district.

CHAPTER 3

FEDERAL AGENCIES HAVE REINFORCED AN EXPENSIVE CYCLE OF CENTRAL FACILITY DEVELOPMENT

Millions of dollars may have been needlessly spent because communities with EPA approval have converted septic systems to sewers and central treatment facilities without adequately considering potentially more cost-effective alternatives. Alternatives such as repairing or replacing systems or a combination of septic systems and limited sewerage are rarely recommended by consulting engineers or selected by communities. Consideration of these alternatives has been inhibited because of the lack of financial incentives and the belief that septic systems are temporary and unreliable. Moreover, the loan and grant programs of other Federal agencies are designed to promote the construction of sewers and central facilities and do little to encourage the use of septic systems.

THE TRADITIONAL CYCLE OF CENTRAL FACILITY DEVELOPMENT AND EXPANSION

EPA has promoted a cycle of routinely converting septic systems to sewers and central facilities, through its construction grants program. This cycle has contributed to a commonly held belief that septic systems are unreliable and at best are a temporary method of wastewater disposal.

A program manager in the Washington State Department of Social and Health Services, described the traditional cycle of central facility development as follows:

"Failing septic systems are often cited as justification to obtain EPA grants to construct sewers and central treatment facilities. Because of the high costs of sewers, however, problems attributed to failures are only corrected in one area at a time--usually that area of the community with failing systems and large population. As other areas of the community become more densely populated, it becomes desirable to extend sewer service. The sewer service expansion is again justified by failing systems and EPA funds are again sought to correct the problem."

ALTERNATIVES NOT ADEQUATELY CONSIDERED

Facility planning should involve a systematic comparison of alternatives and combinations of alternatives

to identify the most cost-effective and environmentally sound system to treat each community's total wastewater. Our review of facility plans showed, however, that alternatives, such as the repair or replacement of septic systems or a combination of repairing septic systems and limited sewerage, were rarely considered solutions to a particular community's water quality problems.

Repair or replacement of septic systems not considered

A 1976 survey of 258 facility plans in 49 States showed that, with few exceptions conventional collection and central treatment facilities were recommended to replace onsite systems. Our review confirmed that repair or replacement of failing septic systems was rarely considered.

The facility plans we reviewed for North Carolina, Florida, Massachusetts, Connecticut, Arkansas, and Louisiana communities showed that failing septic systems were cited as justification for constructing treatment facilities. Repair or replacement of septic systems was usually discounted as a feasible alternative on the basis of poor site conditions, such as high groundwater or unsuitable soils. The communities and their consulting engineers selected central treatment systems in all instances. Only one plan recommended that the community also fix failing septic systems not included in the area served by sewers.

Raynham, Massachusetts

In 1970 Consulting engineers recommended a phased \$10 million town-wide collection and treatment program to replace onsite septic systems. As of October 1977 the town was preparing a grant application for the second phase of the program.

The consulting engineers cited strong evidence of pollution in the closely settled areas of town, pollution in waterways and discharges of sewage into the Taunton River as justification for the project. Repair or replacement of septic systems was not considered because the consultant said much of Raynham had unsuitable soil conditions for septic systems. Neither the consulting engineer nor town officials interviewed could document the extent of the pollution to the Taunton River from Raynham. The consultant's report did not identify the pollution sources. A 1970 internal memorandum filed by the engineer, however, stated that Raynham's contribution to the river's pollution was very small compared to the pollution loads from upstream communities.

Articles in local newspapers and public documents stated that the primary purpose of installing sewers in Raynham was to stimulate economic development, not to improve water quality. The Raynham Sewer Committee notice of intent to build sewers filed with the Conservation Commission, said that central disposal would increase development while eliminating minor fecal pollution caused by failing septic systems.

Walker, Louisiana

In the Walker, Louisiana, community of 1,700 persons, the consulting engineer recommended a \$2 million sewer and central treatment system to eliminate water pollution and potential health hazards caused by failing septic systems. EPA awarded a \$70,000 grant for detail design in May 1977.

The consulting engineer told us that septic systems failed because of unsuitable soils and seasonally high groundwater. He based his comments on his personal experience in Walker as city engineer and on general information from Soil Conservation Service maps. The engineer also said that site evaluations were not made to confirm the existence of unsuitable soil or high water tables. Further, he said he made no survey to determine (1) the number and location of failing systems or (2) if the systems failed because of poor design, construction, or operation.

Consideration was not given to septic system repair or replacement, and the consulting engineer told us that the Louisiana health code would not approve the use of mounded systems to overcome poor soil conditions. The Louisiana State Board of Health policy discourages the use of individual facilities and promote community collection and central treatment facilities. On July 28, 1967, the Board of Health adopted the following policy, based on the past unreliability of State septic systems:

****that every effort shall be made by all health officials to prevent the use of individual sewage disposal facilities in land development involving urban size lots unless it can be clearly demonstrated that the individual facilities are temporary and will be replaced with proper community-type facilities within a short period of time****.

The Assistant Director, Louisiana Bureau of Environmental Services stated that high groundwater conditions and tight clay soils in the State precluded the use of septic systems.

Although we recognize that septic systems may have a reputation for unreliability, we believe such problems can be overcome. Septic system design innovations can overcome siting problems, such as high water tables and compacted soils and have the potential of providing wastewater treatment disposal at lower cost than central treatment and sewers. The overall condemnation of septic systems discourages even the consideration of these alternatives.

Magazine, Arkansas

The rural Magazine, Arkansas, community plans to build a \$1.3 million sewer collection and central treatment system to serve 293 of the city's 294 homes. The project, now awaiting construction funding approval, was justified because of malfunctioning septic systems causing public health problems. The consulting engineer said septic systems were failing due to poor soil conditions, but State, county, and local officials said poor design and construction and improper operation and maintenance also had contributed.

Although failing septic systems were cited as the justification for the proposed central system, the extent of the problem was not documented. Local officials estimated that 25 septic systems were failing. However, the county sanitarian stated that he knew of two cases of septic system failures during the last 2 years and both of these failures were commercial establishments.

Consulting engineer reports show little consideration was given to septic systems as an alternative to sewer and central treatment. The use of septic systems was rejected with little or no documentation. No onsite inspections of septic systems were made by the consulting engineer.

Septic system repairs combined with limited sewerage not considered

Repair and replacement of existing septic systems can reduce the need for expensive collection and treatment systems. Many septic systems have been installed, however, which are improperly designed, poorly sited, and inadequately constructed. In high density community areas, the repair or replacement of these systems may not be practical or economically feasible. In low density areas, the costs of providing collection systems may also be prohibitive. A practical, environmentally sound, and cost-effective solution to existing problems is to combine septic system repair with limited sewerage and central treatment.

Using a combination of alternatives offer significant advantages over the construction of traditional sewers and central treatment systems.

- Septic systems which are functioning properly can be utilized instead of providing new services. Homeowners with properly operating septic systems or who recently installed new systems are often required to connect to sewers.
- Less costly collection and treatment facilities can usually be constructed because of the limited service area and smaller flows.
- Energy consumption is lower because of the reduced need for mechanical treatment.
- Groundwater supplies can be recharged using subsurface disposal systems.

Only one facility plan we reviewed in Avon, Massachusetts, however, recommended that the community also (1) upgrade or repair septic systems outside the area to be served by sewers and (2) impose mandatory maintenance requirements for all systems. The initial facility plan for this 5,400-population community recommended a \$7.8 million sewer and central treatment system to serve 94 percent of the population. This alternative was rejected at a town meeting, however, because of the high cost concern for potential secondary impacts, such as population growth. The facility plan was, therefore, revised. Sewering and central treatment were recommended for only the most populated areas of Avon. The plan also recommended that malfunctioning septic systems in other areas be repaired or replaced and that the town establish mandatory operation and maintenance procedures for all septic systems. The estimated cost of this combination alternative was \$5 million--\$2.8 million less than for the sewer program originally recommended. As of February 1978, both the State and EPA were reviewing this version of the facility plan.

PROGRAM FACTORS INHIBITING SERIOUS CONSIDERATION OF THE SEPTIC SYSTEMS ALTERNATIVE

The principal deterrants to serious consideration of communities and their consulting engineering firms for rehabilitation and repair of malfunctioning septic systems have been (1) financial inequities to individual homeowners and (2) negative attitudes about permanent septic systems.

The Federal Water Pollution Control Amendments of 1972 required that treatment facilities be community owned and operated to be eligible for 75 percent Federal financing. According to EPA, this meant that privately owned treatment systems, including individual septic systems were ineligible for Federal funding. Local officials and consulting engineers stated that the ineligibility of individual septic systems for Federal funding deterred recommendation and selection of such treatment systems. Some residents would have to make immediate cash outlays for the entire cost of repairing or replacing their septic systems. As already stated on page 4, the 1977 act has provided for the construction funding of privately owned septic systems.

In addition to the grant eligibility requirements, negative attitudes of Federal, State, and local officials and consulting engineers have inhibited use of septic systems. These officials believe that, (1) septic systems are difficult to control and monitor, (2) are temporary, and unreliable, and (3) are suitable only until population density is high enough to justify the construction of sewers and central facilities.

One Arkansas environmental official told us that the State would not participate in projects using package plants, cluster septic systems, or the rehabilitation of septic systems. A Massachusetts environmental official wrote that, in general, his division did not consider septic tank installation a permanent method of wastewater disposal and considered this type of facility of low priority for Federal and State funding.

Until recently, EPA considered septic systems as only temporary pollution control devices. A July 1976 EPA primer states, "In a rural setting with the right kind of soil and the proper location, the septic tank may be a reasonable and temporary means of disposing of strictly domestic wastes". (Underlining supplied.)

Some Federal and State officials consider central treatment easier to monitor and enforce pollution control requirements. Because the limited number of discharge points are usually under the control of a public agency, it is easier to hold the community responsible for proper operation. Septic systems are more difficult to control because of the number of individual systems and the lack of one entity responsible for proper operation. The concept of community wide treatment utilizing a mix of individual and limited collection systems is also fairly new. Consulting engineers and public officials are generally reluctant to recommend and select new and untried technology.

OTHER FEDERAL AGENCIES ALSO PROMOTE SEWERS AND CENTRAL TREATMENT

When providing loans and loan guarantees under single-family housing development programs, HUD and FmHA impose controls and standards over construction to protect the Government's interest and assure quality housing. Although both agencies have standards for siting, design, and construction of septic systems, they promote the use of sewers and central facilities and consider septic systems a temporary, last resort method of wastewater disposal. Moreover, by not assuring the effective performance of septic systems when used in federally assisted housing developments, these agencies have contributed to converting septic systems to sewers and central treatment facilities.

HUD and FmHA policies and standards for home development loan and loan guarantee programs express a strong preference for public sewers and centralized treatment. Minimum property standards used by both agencies require that to be accepted for assistance, homes in new developments, must, be connected to a public sewer system whenever feasible. When a public system is not available, the standards provide for connection to a privately owned central or community sewerage system. These standards allow the use of individual septic systems only when connection to public or private sewerage systems is not economically feasible.

In Arkansas and Louisiana, HUD policy governing the use of septic systems in HUD-assisted projects is even more restrictive than HUD's general minimum standards. A HUD official in Louisiana told us that policy did not provide financial assistance to housing developments proposing the use of septic systems in the southern portion of Louisiana. The HUD official maintained that predominately wet soils would not support septic disposal. An Arkansas HUD official told us that HUD's policy strongly discouraged new housing development applications proposing the use of septic systems because of poor septic system performances in the past.

Despite HUD and FmHA regulations for design and installation, septic systems have failed in housing developments sponsored by both of these agencies and have been replaced by sewers and central treatment. For example, of a proposed 107 lot housing development, HUD approved 97 lots for construction with septic systems in a Connecticut community. The development was constructed after approval by HUD from 1962 to 1968. In 1977 a joint survey by the community engineering consultant and the

State Department of Environmental Protection found evidence in the development of 42 malfunctioning septic systems. These failures are cited by town officials as partial justification for an EPA-and HUD-funded program to provide sewer service to the development and other parts of the community. Town officials also believe that septic system failures in the HUD development occurred because systems were not designed to meet high groundwater and difficult soil conditions present in that area of the community.

An FmHA-approved 31 home development in Arkansas built from 1969 to 1970 had problems similar to the HUD development. Shortly after being inhabited, homes in the development had septic system failures. FmHA, State, and local officials attributed these failure to poor siting and soil conditions, poor design, and poor construction. Septic system problems in the development were not solved until 1977 when \$64,000 in FmHA grant and loan funds and \$22,000 in local funds were used to build a sewer system to transport development wastewater to a nearby community treatment plant.

Neither HUD nor FmHA regulations require assurance that septic systems in approved housing developments will be properly operated and maintained after acceptance. After septic system installation has been inspected and approved by HUD and FmHA, individual homeowners are responsible for proper operation and maintenance of the systems.

CHAPTER 4

PUBLIC MANAGEMENT OF SEPTIC SYSTEMS COULD MAKE THEM MORE VIABLE ALTERNATIVES

Effective public management of septic systems in the community could reduce failures and prevent water pollution. Federal, State, and local expenditures for converting septic systems to sewers and central facilities could be significantly reduced.

STATE AND LOCAL CONTROLS OVER SEPTIC SYSTEMS ARE INADEQUATE

State regulations and local enforcement codes have not provided effective controls to assure good septic system performance. Most States have regulations and standards for septic systems siting, design, and construction, but they vary widely. Moreover, the authority for enforcing regulations also differs from community to community as well as from State to State. Some States share the authority with local or county health agencies while others maintain enforcement at the State level. Local enforcement has been inadequate because of limited funding and the lack of qualified personnel.

EPA noted in a 1977 publication that existing regulations are not supported by scientific facts. According to the EPA publication, for example, one of the major shortcomings of existing codes relates to the use of the percolation test as the major determinant of septic system absorption field sizes. EPA officials and University of Connecticut and University of Wisconsin researchers have reported that the percolation test is not adequate basis for sizing septic system absorption fields. In a 1977 survey of 44 States, however, a researcher found that more than half the States used the percolation test to size absorption fields.

Although poor operation and maintenance practices are generally recognized as one cause of septic system failures, States generally do not set standards or specific requirements to assure proper operation and maintenance. They generally have regulations applicable to design and construction of septic systems but leave the operation and maintenance responsibility to homeowners.

Enforcement problems at state and local levels

State and local enforcement officials as well as researchers have identified many enforcement problems which have resulted in ineffective management and malfunctioning

septic systems. These enforcement problems include the following.

- Agencies are underfunded and consequently lack time and resources to adequately control septic systems.
- Local sanitarians are sometimes poorly qualified and inadequately trained to do their jobs.
- Local authorities must sometimes depend on the integrity and ability of soil testers and contractors to accurately evaluate sites and design and install systems.
- Local authorities are sometimes subject to pressures to approve septic system construction on poor or marginal sites.

In two Connecticut communities, where failing septic systems will be replaced by sewers, sanitarians told us that, because of weak State code requirements before 1970 and poor local enforcement efforts, septic systems had failed. These officials stated that, if septic systems in the sewer project areas had been properly sited, designed, and constructed, sewerage would not be necessary today. Moreover, both sanitarians stated that developers had pressured them into allowing septic systems in poor or marginal sites.

A district supervisor of an Illinois county health department reported that few public health personnel in that State have any formal training in septic system rehabilitation repair. Connecticut health and environmental officials told us that smaller towns in Connecticut have part-time or underqualified sanitarians who do not have enough time or training to assure that septic systems are properly designed, sited, and constructed.

We found similar problems in Massachusetts. The health agent responsible for septic system code enforcement in one community, for example, had no formal training in sanitation. His college background was in English education, and he had previous work experience as an office manager for a construction company. In a second Massachusetts community, the health agent worked part time and was a former police officer who had been hired for his knowledge of court procedures. Town officials wanted his experience to aid in cleaning up local restaurants.

PUBLIC MANAGEMENT WOULD ELIMINATE
MANY OF THE EXISTING PROBLEMS

Public management of decentralized systems, such as septic systems, is receiving more State and local attention because of the high costs of central collection and treatment. Two states have already done preliminary work in establishing public entities to control septic systems.

California and Washington States have established guidelines to provide authority for controlling septic systems. The University of Wisconsin has also done research on the management of decentralized systems. Public entities must have the authority to totally control septic systems. These essential controls and the corresponding authority are shown below.

control element

authority needed

Siting and design

To enter property and do indepth site evaluations,

To set design standards, design septic systems, and review designs

Installation

To develop inspection criteria, inspect installation, and stop and demand correction of faulty construction,

Operation and maintenance

To enter property to routinely inspect and assure proper operation and maintenance,

Problem correction

To require and enforce repair or replacement of failing systems.

The types of entities capable of managing a decentralized wastewater treatment system would vary from State to State. Determining which type would be best would require analysis of constitutions, statutes, and administrative rules and regulations in each State. University of Wisconsin research shows some entities which may be able to manage decentralized wastewater treatment systems including municipalities, counties, townships, electric cooperatives, and special districts.

Public management entities in California

While public management of septic systems is a relatively new idea, several such entities have been established in California. Although they do not meet all the requirements considered necessary for an effective total system, these entities can help reduce failures by controlling septic system design, installation, and operation.

Georgetown Divide Public Utility District

The district was established in 1949 as a public entity to provide irrigation and domestic water supplies to an area of El Dorado County, California. In 1971, at the request of the county and the developer, the district assumed responsibility for managing all decentralized wastewater treatment systems in the Aubuen Lake Trails Subdivision--a development of about 1,800 lots of which only 150 lots have been developed. The district is presently responsible for managing systems only in this subdivision, although it could extend this responsibility to new subdivisions developed within its boundaries.

The district staff

- performs site evaluations on subdivision lots,
- designs systems to serve individual sites,
- controls the installation of systems through inspection,
- inspects systems in operation and recommends maintenance and repairs when needed, and
- monitors the effects of septic systems on water quality.

Septic system management services are financed through monthly charges of 85 cents per lot for the 1,800-lot subdivision and a general tax of \$1.20 per \$100 of assessed value on the subdivision's 150 constructed properties. The wastewater from 8 of the 150 developed lots is treated by a cluster septic system under district management.

Santa Cruz County Septic Tank Maintenance District

This district was created by county ordinance in 1973 to manage a mandatory inspection and maintenance program for septic systems installed in new subdivisions. The district is administered by the county Environmental Health Service.

Maintenance and inspection services are provided by a registered sanitarian who is an independent contractor. For a one-time fee of \$25 and a monthly charge of \$3.58, the district provides biannual inspection and mandatory septic tank pumping every 3 years. Septic system failures and problems are reported to the county Environmental Health Service to assure repair or replacement of the system at owner expense. Although the District provides only inspection and maintenance services, the county Environmental Health Service administers the district, through county codes, for septic system siting, design, and construction.

Bolinas Community Public Utility District

At the request of the State Regional Water Quality Control Board this District assumed responsibility in 1974 for managing all wastewater treatment systems in this small California community of Bolinas. The District's management program for onsite systems was developed to avoid a costly sewer system project which was opposed by local residents. At the Board's request the district assumed management responsibility for a sewer system serving the most densely populated area of the community and individual onsite systems in the less densely populated area.

To meet its management responsibilities for onsite systems, the district

- reviews and approves site evaluations and designs before construction,
- reviews and approves plans for system repairs and rehabilitation work, and
- inspects all existing systems every 2 years and recommends pumping and repair of the system as needed.

Should homeowner not comply with the district recommendations to pump or repair a specific system, the district can report the problem system to county health authorities which can require the necessary corrective actions.

Officials of these entities believe public management will reduce septic system failures. Although a relatively new idea, public management of septic systems is being accepted as a method to improve controls over the design, installation, and operation of septic systems. With proper authority, a public management entity could assure the use of septic systems as an effective tool to prevent water pollution.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS AND AGENCY COMMENTS

CONCLUSIONS

Through programs and policies, EPA can encourage use of septic systems as a viable and less costly alternative to waste treatment plants. Unless States and communities develop more effective techniques to manage and control septic system design, construction, and operation, however, the expense of converting septic systems to central facilities will continue. Federal, State, and local governments will continue to absorb the environmental costs associated with ineffective septic system performance. Moreover, some homeowners will pay twice for wastewater disposal--once for the cost of septic systems and again for connecting to sewers and central facilities.

Septic systems can function as effectively and permanently as central facilities and are generally more cost effective. Failures caused by the lack of effective control and management of septic system siting, design, installation, and operation, however, have made septic systems seem unreliable. These failures are the result of human error or neglect and are controllable.

Converting septic systems to sewers and central treatment systems has resulted in millions of Federal, State, and local expenditures which may not have been necessary. Federal programs such as those administered by FmHA and HUD discourage the use of septic systems and promote construction of central facilities. Before the passage of the 1977 Clean Water Act, communities, with EPA approval, built sewers and central treatment facilities without fully considering more cost-effective alternatives, such as repairing or replacing septic systems or providing limited sewerage and septic system repair. Moreover, central treatment systems have been selected without determining the contribution of failing septic systems to water quality and health problems, as well as the expected improvement in water quality.

Federal agencies, especially EPA, can help States and communities establish the necessary controls to assure proper design, construction, and operation of septic systems. Effective management controls could reduce failures of septic systems, prevent water pollution problems and reducing the associated Federal, State, and local expenditures.

RECOMMENDATIONS

We recommend that the Administrator, Environmental Protection Agency,

- revise regulations to require that facility plans consider water pollution problems in all community areas, including a comprehensive strategy to control pollution throughout the community;
- encourage States and communities to obtain the authority necessary to establish effective public management programs for septic systems;
- establish minimum standards for public management of septic systems; and
- emphasize to public entities that the major rehabilitation and upgrading of septic systems is eligible for grant assistance.

We also recommend that the Administrator work with the Secretaries of Agriculture and the Department of Housing and Urban Development to insure that similar guidelines and requirements are developed for public management for wastewater disposal systems, funded by HUD and FmHA.

AGENCY COMMENTS

Matters in this report were discussed with EPA officials who generally agreed with most of the conclusions and recommendations. These officials stated that the report was technically very accurate. Our recommendations will be included in interim regulations to implement the Clean Water Act of 1977. An EPA guidance memorandum is being prepared.