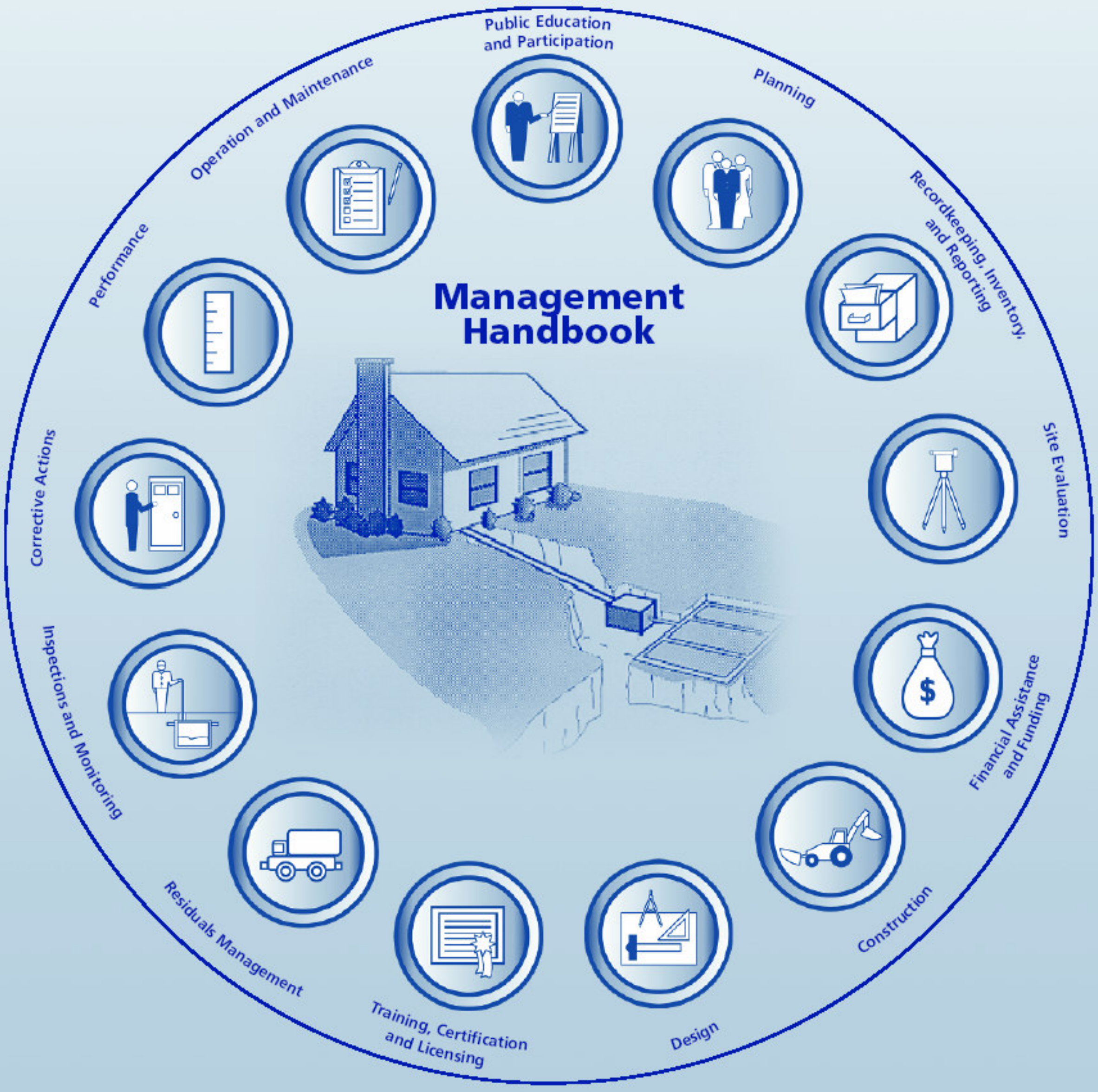
DRAFT

Handbook for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems



Handbook for Management

of Onsite and Clustered

(Decentralized)Wastewater Treatment Systems

PA 832-D-03-001 February 2003

Additional copies can be obtained from:

U.S. EPA Publications Clearinghouse
P.O. Box 42419
Cincinnati, OH 45242
Telephone:800-490-9198
Fax: 513-489-8695

Office of Water
U.S. Environmental Protection Agency

Recycled/Recyclable
Printed with vegetable-based ink on paper that contains a minimum of 50 percent post-consumer fiber content processed chlorine-free.

Foreword

This *Management Handbook* for onsite and cluster (decentralized) wastewater treatment systems is designed to assist state and local officials, service providers, and other interested parties with improving existing and new decentralized system performance in a sustainable, long-term manner. Individual and small cluster systems currently serve approximately 25 percent of the U.S. population, treating and releasing about 4 billion gallons of wastewater per day. Managing these systems to ensure long-term protection of public health and water resources, however, is a relatively new concept because the systems were originally installed with the idea that they would receive little, if any, management.

Many new rural and suburban residents are not aware of the need for proper operation and maintenance of their onsite wastewater treatment systems (OWTS). Sensitive environmental conditions, poor soils, high water tables, increasing system densities, and the expanded use of mechanical components (e.g., electric pumps and switches) require improved *regulation* and *management*. Regulation, as prescribed by state and local codes, is typically performed by a *regulatory authority* such as a county health department or water quality agency. The more robust set of management activities—planning, system performance requirements, site evaluation, design, construction, operation/maintenance, residuals management, training and certification, public education and involvement, inspection and monitoring, compliance enforcement, record keeping and reporting, and financial assistance—can be undertaken by an enhanced regulatory authority, independent service provider, other public agency, or a public and/or private *responsible management entity* with the necessary powers and charged with responsibility for ensuring that these functions are properly carried out. In most cases, managing decentralized systems will be handled by a *cooperative management program*. Cooperative management programs can be developed by the regulatory authority or other entity (e.g., water resource agency, planning department) by organizing local resources into a web of service providers, agencies, and private entities that can ensure protection of public health and the environment. Under this approach, management activities are defined and distributed among involved partners through a formal or informal cooperative program designed to meet the needs of local communities.

> "Septic systems are no longer considered the temporary solution they once were, and many towns are realizing that they need to maintain their on-site systems as long-term, reliable options."
>
> William Heigis, Data Management Systems for On-Site System Management, 2000

The structure and operational processes local management programs will depend on the unique circumstances, capabilities, resources, and commitment of each community. Many communities will develop management programs through the involvement of several organizations, such as traditional regulatory authorities, planning departments, approved service providers, environmental agencies, design professionals, and so on. Some might opt for a more comprehensive program that vests most management responsibilities in a sanitation board, service district, or other responsible management entity that might own, maintain, or operate a number of decentralized or even centralized wastewater systems. The nature of local management programs will vary greatly across the Nation. All management programs, however, must be sustainable and responsible for ensuring the protection of human health and water resources from disease-causing bacteria, nitrates in groundwater, high nutrient levels, and other potentially harmful pollutants.

The approach discussed in this *Management Handbook* is based on a few simple but essential concepts:

- The creation and maintenance of descriptive and historical inventories of all systems
- Management, operation, and maintenance to ensure protection of public health and the environment
- Increased management for systems with mechanical components, systems installed at high densities, and systems located in sensitive (high-risk) environmental settings

This *Management Handbook* offers guidance on how to plan and implement a successful management program. Chapter 1 gives background information on the *Management Handbook* and describes the current status of wastewater treatment system management. Chapter 2 explains the five model management programs, and chapter 3 describes the essential elements of a management program. Chapter 4 provides guidance on planning and implementing a management program, from identifying key problem areas and assessing management needs through planning for implementation. The *program elements* for managing decentralized treatment systems are listed below. The activities associated with each program element should be based on local resources and capabilities, but must always address public health needs and environmental protection requirements. Under the approach discussed in this handbook, local communities are encouraged to find the appropriate mix of activities required within each program element to meet their health and environmental goals. Tools to aid this process can be found in this handbook and obtained through the organizations listed in the *Resources* section.

Elements of a Decentralized Wastewater Management Program

Public education and participation to communicate risks and develop appropriate responses.

Planning based on cumulative and other impacts on human health and water resources.

Performance requirements to ensure appropriate system design and technology selection.

Site evaluation and wastewater characterization to guide system sizing and design.

Designs that consider site conditions, cumulative loadings, and performance requirements.

Construction practices that ensure compliance with design, siting, and performance criteria.

Operation and maintenance functions that focus on performance and minimize risk.

Residuals management programs that protect health and water resources.

Training and certification/licensing of regulators and all service providers.

Inspections and monitoring to assess and document performance and initiate remediation.

Corrective actions and enforcement to ensure compliance and address failing/failed systems.

Record keeping, inventory, and reporting to support planning, management, and oversight.

Financial assistance and funding to support installation, repair, and overall management.

Contents

Tables

Figures

Chapter 1 Introduction

1.1 Purpose of the management handbook

This *Management Handbook*, which supports the U.S. Environmental Protection Agency (USEPA) *Voluntary Guidelines for Management of Onsite and Cluster (Decentralized) Wastewater Treatment Systems*, has been developed to improve the performance of decentralized wastewater systems through better management. Decentralized wastewater treatment systems include individual onsite systems (commonly called septic systems, private sewage systems, or individual sewage systems) and cluster systems serving one or more homes or businesses not connected to centralized sewer service. Proper management is necessary for all of these systems to consistently meet site-specific performance requirements, i.e., to protect public health and water resources. USEPA has proposed a set of voluntary national guidelines to improve the quality of management programs for decentralized systems, establish minimum levels of activity, and institutionalize the concept of management.

USEPA continues to support the most cost-effective approach to wastewater treatment which meets environmental and public health goals, whether it be centralized or decentralized. This handbook will help communities understand and implement management programs that can effectively meet their own water quality and public health goals, provide a greater range of options for cost-effectively meeting wastewater needs, and protect consumer investments in homes and businesses.

> Although adoption of the guidelines or any management approach is voluntary, USEPA encourages states and local communities to consider the guidelines as a basis for their decentralized wastewater management programs because of the continuing public health and water resource threats posed by poorly performing, unmanaged onsite systems.

The Guidelines contain a set of management approaches that rely on coordinating the responsibilities and actions of the regulatory authority, the management entity, service providers, and system owners. These approaches – presented as five model management programs – are structured to address an increasing need for more comprehensive management as the sensitivity of the environment, the number and density of system installations, and the degree of system complexity increases. The five model management program suggested in the Guidelines (which are presented in the Appendix of this handbook) describe essential program elements, which range from planning and recordkeeping to operation/maintenance needs. The management program's responsibilities increase progressively from Model Program 1 through Model Program 5, reflecting not only the increased level of management activities needed to achieve more stringent water quality and public health goals, but also the increased capability needed to properly manage larger numbers of more complex technologies in more vulnerable watersheds.

Although adoption of the Guidelines or any management approach is voluntary, USEPA encourages states and local communities to consider the Guidelines as a basis for their decentralized wastewater management programs. A small investment in improved management of onsite and cluster systems might prevent the need for subsequent—and much larger—investments in centralized wastewater facilities or in continued repair/replacement of decentralized systems that fail because of lack of management attention. The Guidelines can be applied to both existing and new systems serving residential and commercial facilities.

1.2 What is management?

Management of decentralized systems is implementation of a comprehensive, life-cycle series of elements and activities that address public education and participation, planning, performance requirements, site evaluation, design, construction, operation and maintenance, residuals management, training and certification/licensing, inspections/monitoring, corrective actions and enforcement, recordkeeping/inventorying/reporting, and financial assistance and funding. Therefore, a management program involves, in varying degrees, regulatory and elected officials, developers and builders, soil and site evaluators, engineers and designers, contractors and installers, manufacturers, pumpers and haulers, inspectors, management entities, and property owners. Establishing distinct roles and responsibilities of the partners involved is very important to ensuring proper system management.

The voluntary management guidelines apply to both existing communities and to areas of new development that use onsite and cluster systems of any size for residential and commercial wastewater treatment and dispersal. Centralized collection and treatment facilities are not addressed here. Industrial wastewater treatment systems are also not addressed, since many industrial wastes are prohibited by federal and state regulation from using onsite treatment and dispersal, because of the potential to interfere with wastewater treatment, and/or pollute ground water resources.

The management guidelines are not intended to be used to determine appropriate or inappropriate uses of land. The information in the Guidelines is intended to be used to help select appropriate management strategies and technologies that minimize risks to human health and water resources in areas where connections to centralized wastewater collection and treatment systems are not considered appropriate. The determination of appropriate siting requirements, system density restrictions or required technologies is a state, tribal or local decision.

1.3 Why is management needed?

The performance of onsite and cluster wastewater treatment systems is a national issue of great concern to USEPA. Onsite and cluster wastewater treatment systems serve approximately 25 percent of U.S. households and approximately 33 percent of new development. Onsite and cluster systems can provide a high level of public health and natural resource protection if they are properly planned, sited, designed, constructed, operated and maintained. Unfortunately, many of the systems currently in use do not provide the level of treatment necessary to adequately protect public health and/or surface and ground water quality. Many were initially sited and installed as temporary solutions as a result of the perception that centralized treatment and collection would soon replace them. Comprehensive, life cycle management did not play a role in the approval and/or in the ongoing operation of many systems. More than half the existing onsite systems are over 30 years old, and surveys indicate at least 10 percent of these systems backup onto the ground surface or into the home each year. Other data has shown that at least 25 percent of systems are malfunctioning to some degree.(2) In a majority of cases, the homeowner is not aware of a system failure until it backs up in the home or breaks out on the ground surface. In many areas of the country, the local authority lacks records of many of the systems within the service area.

In the National Water Quality Inventory, 1996 Report to Congress, state agencies designated the top ten potential contaminant sources which threaten their ground water resources. The second most frequently cited contamination source is septic systems. The report states that "improperly constructed and poorly maintained septic systems are believed to cause substantial and widespread nutrient and microbial contamination to ground water." Other contaminant sources identified by states included underground storage tanks, landfills, large industrial facilities and numerous other activities. States have also identified over 500 communities in the 1996 Clean Water Needs Survey as having failed septic systems that have caused public health problems. In 1996, septic systems were reported by states as a leading source of pollution for more than one-third (36 percent) of the impaired miles of ocean shoreline surveyed. Other leading sources included urban runoff/storm sewers, municipal sewer discharges, and industrial point sources. In U.S. classified shellfish growing areas, closures and harvest restrictions have occurred primarily because of "the concentration of fecal coliform bacteria associated with human sewage and with organic wastes from livestock and wildlife." The 1995 National Shellfish Register indicated that the most common pollution source cited for shellfish restrictions was urban runoff (principal or contributing factor in 40% of all harvest-limited growing areas), followed by unidentified upstream sources (39%), wildlife (38%) and septic tanks (32%). Onsite wastewater systems also may be contributing to an overabundance of nutrients in ponds, lakes and coastal estuaries, leading to overgrowth of algae and other nuisance aquatic plants. For example, the 45,000 septic systems in Sarasota County, Florida, contribute four times more nitrogen to the Bay than the City of Sarasota's advanced wastewater treatment plant.

Onsite and cluster wastewater systems also contribute to contamination of drinking water sources. USEPA estimates that 168,000 viral and 34,000 bacterial illnesses each year occur as a result of consumption of drinking water from systems which rely on improperly treated ground water. The contaminants of primary concern in USEPA's study of ground water-based drinking water systems are waterborne pathogens from fecal contamination. Malfunctioning septic systems are identified as a potential source of this contamination; other sources could include leaking or overflowing sanitary sewer lines, as well as stormwater runoff. A recent example of contamination involved nearly 800 visitors to a fair in Washington County, New York, who became ill after consuming water from a well source which was likely contaminated by a septic system at an adjacent dormitory. Other examples in which septic systems were attributed to be the pollution source include 82 cases of shigellosis resulting from a contaminated well in Island Park, Idaho in 1995, 46 cases of hepatitis A from a privately-owned water supply in Racine, Missouri, and 49 cases of hepatitis A in Lancaster, Pennsylvania in 1980. USEPA is also concerned with the presence of nitrates in groundwater, particularly in rural areas where residents must rely on individual wells and onsite systems to serve relatively small lots.

While it is difficult to measure and document specific cause-and-effect relationships between onsite wastewater treatment systems and the quality of our water resources, it is widely accepted that improperly managed systems (resulting from inadequate siting, design, construction, installation, operation and/or maintenance) are contributors to major water quality problems. As documentation becomes available concerning the source of impairments, USEPA will be better able to determine the extent of the relationship. It is already evident that improved operation and performance of onsite and cluster systems through better management practices will be essential if the nation's water quality and public health goals are to be attained.

1.4 What are the benefits of a management program?

Benefits of a management program are accrued by both the communities developing effective management programs and the individual property owners and include:

<u>Protection of public health and local water resources</u>: Although unquantified, septic system failures in the form of yard backups have been recognized as a public health hazard and an insult to natural resources for many years. Improved management practices will minimize the occurrence of failures by ensuring (with proper planning, siting, design, installation, operation and maintenance, and monitoring) pollutants are adequately treated and dispersed into the environment, thereby reducing risks to both public health and local water resources.

<u>Protection of property values:</u> There are many documented instances over the last few decades of the increased value of property in areas formerly served by failing onsite systems after the area has been sewered. Management programs offer an opportunity to obtain the same level of service and aesthetics as

sewered communities at a fraction of the cost, thus providing property appreciation and cost savings.

Ground water conservation: A well managed onsite system will contribute to groundwater recharge. Many areas of the United States which have undergone rapid development and sewering are experiencing rapidly declining water tables and/or water shortages because ground water is no longer being recharged by onsite systems.

Preservation of tax base: A well managed onsite system will prevent small communities from having to finance the high cost of centralized sewers. Many small communities have exhausted their tax base at the expense of other public safety and education programs to pay for those sewers. Many communities then entice growth in an effort to pay for these systems, thus destroying the community structure which originally attracted residents.

Life-cycle cost savings: There is a clear indication that, in many cases, management may pay for itself in terms of lower failure rates and alleviating the need for premature system replacement; however, this will depend on the types of systems that are employed and the management program chosen. Documentation of that savings is only now being initiated.

1.5 Handbook audience and use

This handbook is intended to provide a basic understanding of important elements of management programs for decentralized wastewater systems and to provide options, examples, and case studies that can help local communities address their management needs. The primary audiences for this handbook are state, tribal and local regulators that are responsible for regulating decentralized systems. Secondary audiences include service providers (designers, installers, pumpers, haulers and inspectors), elected officials, and others interested in improving the management of small wastewater systems.

USEPA recognizes that management programs will vary widely across the Nation. Some communities will elect to adopt a cooperative management program that organizes and coordinates the activities of the regulatory authority, water resource agency, planning department, service providers, and other interested parties (e.g., volunteer monitoring groups, homeowner associations, sanitation districts, etc.). Other jurisdictions might have the resources to develop a responsible management entity (RME) with the technical, managerial, and financial capacity to ensure long-term, cost-effective management, operation, and maintenance of all systems within the designated service area. The exact configuration of local management programs will be based on the resources available, the nature of public health and water resource threats posed by onsite systems, and the creativity and commitment of the regulatory authority and other interested parties.

In developing a management program, it is important to identify those interested parties vital to the success of any decentralized management program. These include not only members of the community served, local elected officials, regulators, and local service providers, but also local lenders, land developers, real estate professionals, planners, and others who are affected by the nature and vitality of the community and its environment. For example:

- *Residents* are concerned about the public health of the community, the cost of the alternative solutions, and how the program chosen will affect the quality of their daily lives and their property values.
- *Regulators* are also primarily concerned about public health and the quality of the water resources that are affected by the community.
- *Local officials* are most concerned about the economic well-being of the community and the

impact of any wastewater problems, as well as community support for the program.

- *Service providers* that perform operation and maintenance on existing systems are concerned about the impact of the management program on their livelihood.
- *Land developers* want to know what areas are available for development and what wastewater treatment infrastructure requirements will be placed on those areas.
- *Lending institutions* and real estate professionals need to know how the management program will assure proper treatment and the impact of a management program on property values.
- *Planners* are concerned about land use issues, such as where development can occur and any specific performance requirements necessary for wastewater treatment in different areas.

Stakeholders and other interested parties can use the chapters that follow to develop a better understanding of the range of management program structures and operational processes. Local community leaders are encouraged to refer to the Resources section for further details on specific program elements and to be creative, cooperative, and patient in developing a management program suited to their particular circumstances.

Table 1-1. Types of decentralized wastewater treatment systems

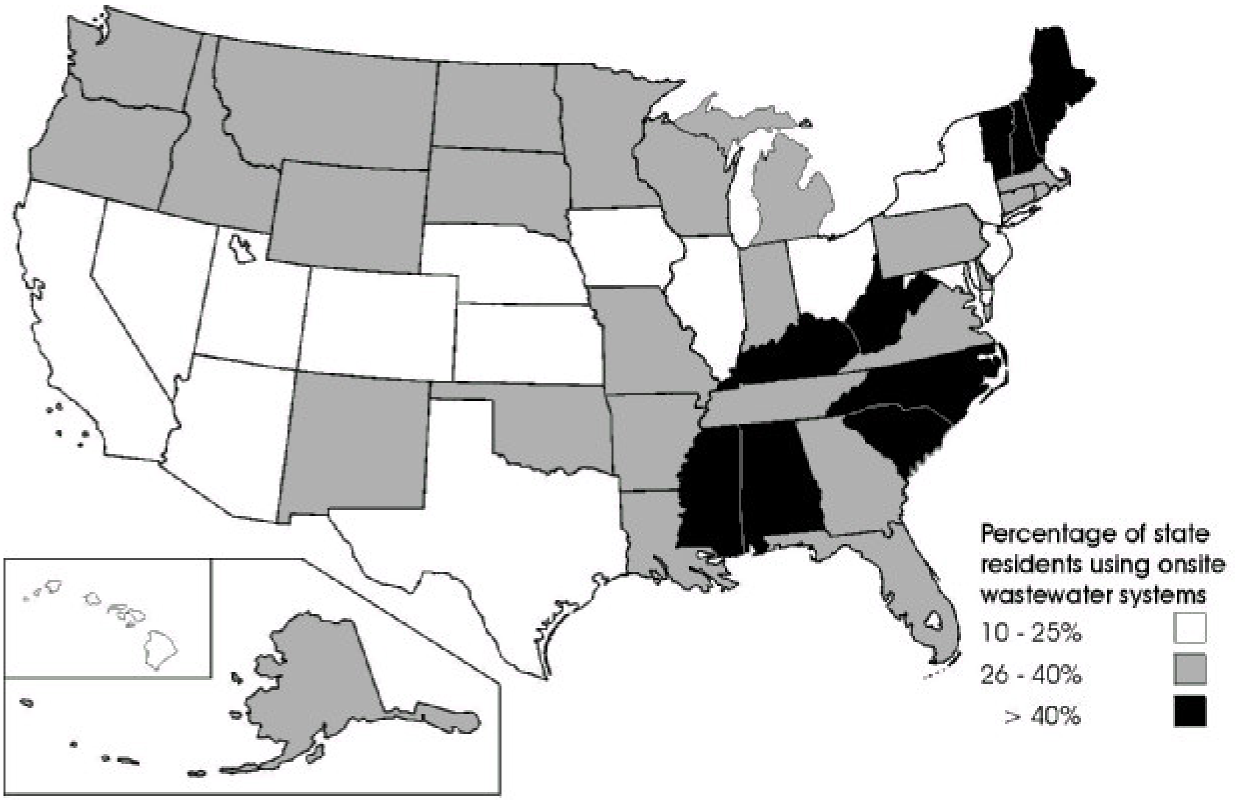
Type of system	Description
Individual onsite systems	Systems that serve an individual residence and can range from conventional septic tank/drainfield systems to systems composed of complex mechanical treatment trains.
Cluster systems	Wastewater collection and treatment systems that serve two or more dwellings or buildings, but less than an entire community, on a suitable site near the served structures.
Commercial, residential, institutional, and recreational facilities	Systems designed to treat larger and sometimes more complex wastewater sources from commercial buildings (e.g., restaurants), apartments, or institutional or recreational facilities.

1.6 Background on decentralized wastewater systems

Historically, the design and siting of onsite wastewater treatment systems has been an inconsistent process. Conventional septic tank and gravity-fed leach field systems were installed based on economic factors, the availability of adequate land area, and simple health-based measures aimed primarily at preventing direct public contact with untreated or inadequately treated wastewater. Outside of the establishment of vertical and horizontal setbacks, little attention has been devoted to mitigating the impacts of these systems on local ground and surface water resources. Only recently has there been an understanding of these issues and potential problems associated with failing to manage onsite systems in a comprehensive, holistic manner.

The common misperception that has served as a major barrier to advancement of the decentralized approach—that onsite systems are inferior, old-fashioned, less technologically advanced, and not as safe as centralized wastewater treatment systems—has caused many small communities to construct very expensive centralized sewage collection and treatment systems (USEPA, 1997). The greater distances between residences, the high cost of deep excavation and regularly spaced manholes, and the high cost of operating and maintaining lift stations and urban treatment facilities have made these systems a burden on many of those communities. These costs may be unaffordable for many, if not most, small communities and rural areas. Even when it is affordable, centralized wastewater collection and treatment systems might not be the most environmentally sound option for all situations.

Figure 1-1. Onsite treatment system distribution in the United States

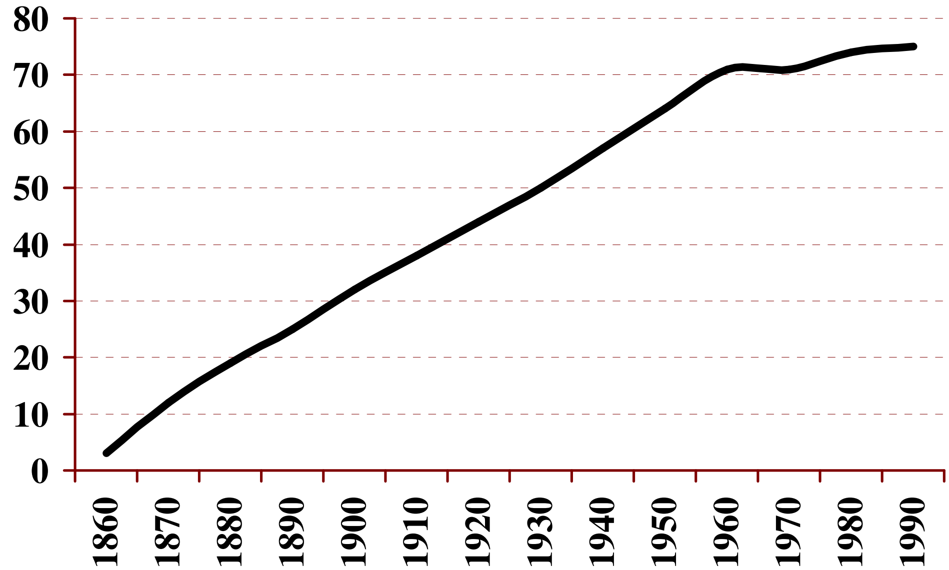


Source: U.S. Census Bureau, 1990

Conventional centralized sewers transport wastewater and often infiltrating ground water away from its natural location, thus lowering ground water tables. The frequent loss of the ability to finance other community needs because of the high capital sewage treatment costs has had irreversible negative impacts on the economic vitality of some smaller communities that have opted for these systems. In addition, centralized treatment systems have a greater capacity to contribute to unpredicted, unplanned growth and development that can cause increased pollution from storm water runoff. Finally, the consolidation of many small wastewater streams into one large one at one treatment facility increases the possibility of catastrophic damage to sensitive receiving environments when treatment or collection system failures occur.

As development patterns change and increased development occurs in rural areas and on the urban fringe, many communities are evaluating whether they should invest in centralized sewers and sewage treatment plants or continue to rely on onsite systems. Investment by small communities in conventional collection and treatment systems increases taxes and costs to consumers and may induce unwanted growth and negative impacts on water quality and society. During the 20th century the percentage of people served by centralized sewage treatment increased steadily, ultimately reaching about 75 percent by 1990 (see figure below). This was due in part to urban public works investments that were financed to a large degree by federal funds. The lure of 50 percent or more in matching funds was difficult for local authorities to resist, especially because the prevailing beliefs were that (1) the entire country would eventually be sewered and (2) sewers stimulate growth of the local economy.

Figure 1-2. Percentage of U.S. residents served by centralized treatment



Source: U.S. Census Bureau

> Although onsite wastewater disposal is a valid alternative to public sewers, particularly in rural areas; without proper design, construction, maintenance and management these systems can cause ground water or surface water contamination.
>
> Fred Bowers
> *NJ Regulator*

During the 1980s it became clear that the federal grant program might be impeding the development of cost-effective wastewater systems for smaller communities, which were at the bottom of the population-based priority system for grant monies. Also, many local governments found that for every dollar they spent on sewer extensions, less than a dollar came back in the form of increased revenues. In some cases the unplanned growth and development inducements resulting from efforts to increase the tax base to pay for the centralized sewer resulted in uncontrolled growth and additional environmental damage (NCCF, 1997). The Construction Grants Program that provided most of these funds was eventually terminated in 1990. The present distribution of onsite systems in each state is illustrated in Figure 1-1. Recent statistics indicate that the unsewered percentage of the population will rise in the near term, given that more than 32 percent of all new housing being built today is served by onsite wastewater systems (U.S. Census Bureau, 1999). The Management Guidelines and this handbook are therefore timely, especially in light of the relative cost to homeowners of central sewers and treatment facilities for smaller communities. For example, Kreissl and Otis (1999) found that centralized treatment for smaller communities costs two to four times more per customer served than treatment in urban areas for the same technologies.

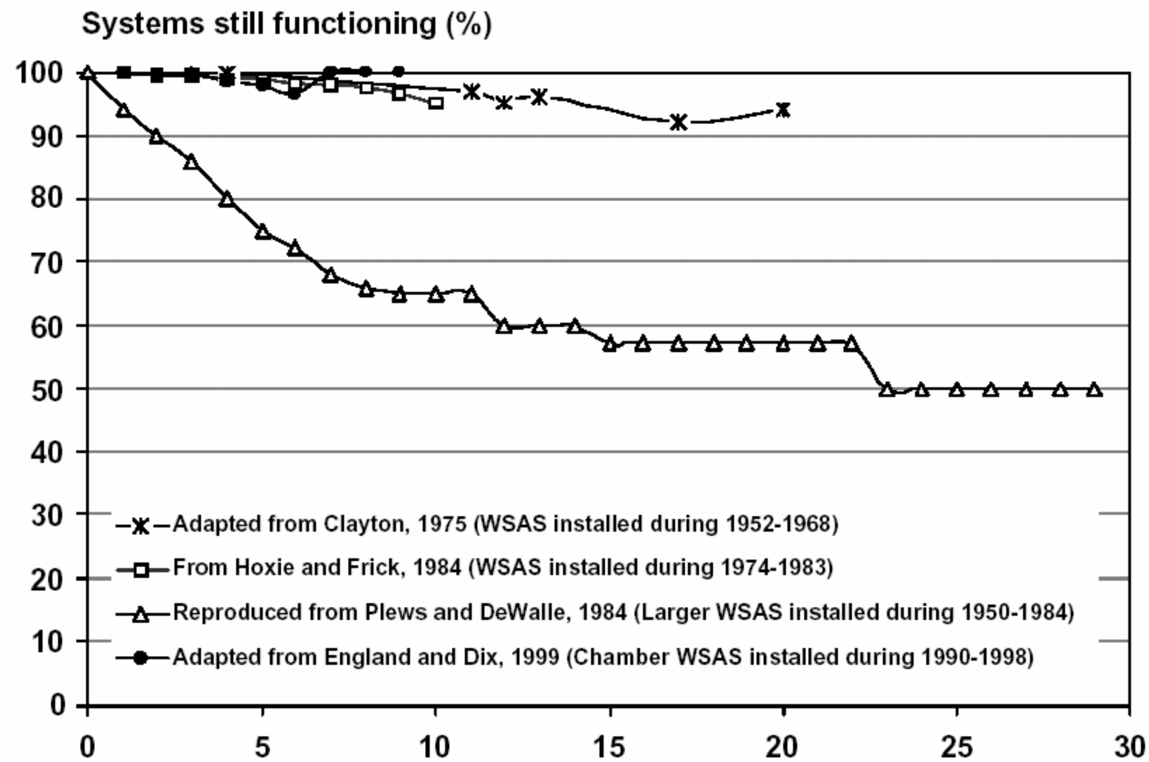
The points discussed previously beg the question of why small communities and rural developments abandon existing onsite wastewater systems and invest in expensive central collection and treatment systems. In many cases it is because partially treated effluent from some of the old onsite systems began to back up or surface, resulting in aesthetic problems and public health risks. In other cases, attractive financing packages or a lack of familiarity among consultants regarding newer, better-performing decentralized treatment options resulted in the selection of centralized service.

Table 1-2. Common definitions for OWTS failures

Type of failure	Evidence of failure
Hydraulic	Untreated or partially treated sewage pooling on ground surfaces; sewage backup in plumbing fixtures; sewage breakouts on slopes
Chemical pollutant contamination of ground water	High nitrate levels in drinking water wells; taste or odor problems in well water caused by untreated, poorly treated, or partially treated wastewater; presence of toxic substances (e.g., solvents, cleaners) in well water
Microbial contamination of ground and surface water	Shellfish bed bacterial contamination; recreational beach closures due to high bacterial levels; contamination of down-gradient drinking water wells with fecal bacteria or viruses
Nutrient contamination of surface water	Algal blooms, high aquatic plant productivity, low dissolved oxygen concentrations in nearby freshwater and marine water bodies

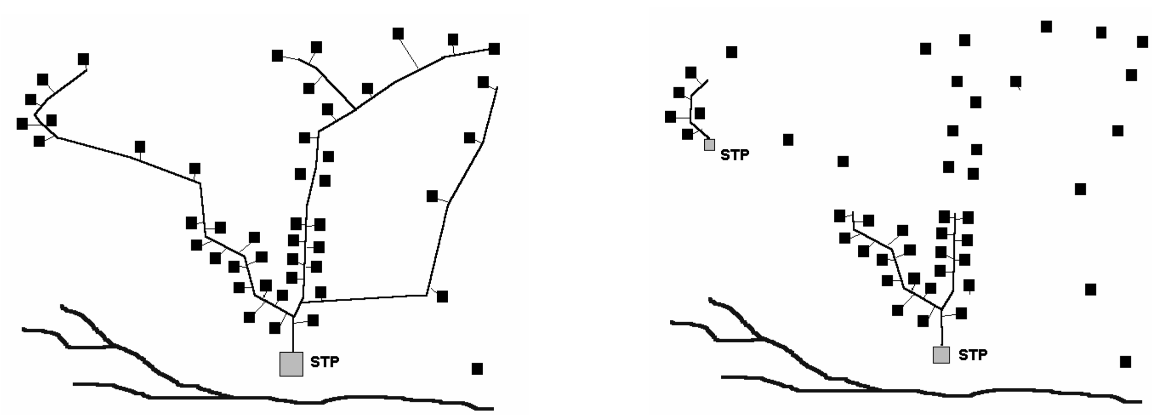
The belief that onsite systems are prone to failure has also motivated smaller communities to opt for centralized sewage collection and treatment. The actual failure rate for onsite systems varies widely across the Nation. The percentage of hydraulic backups to the surface is claimed to vary from less than 1 percent to 10 percent annually in various state studies (see Figure 1-3). Herring (2001) suggested even higher failure rates in a recent review of management program case studies. Some studies have concluded that onsite systems were contaminating otherwise potable ground water or nearby surface waters with nitrate, nutrients, and/or bacteria. For example, the New York Department of Environmental Conservation estimated in 1993 that OWTSs were the primary cause of impairment for 180 water bodies and the secondary cause for impairment in several hundred others (Herring, 2001).

Figure 1-3. A sample of studies comparing system functionality with system age



The development of modern onsite treatment technologies and comprehensive management programs, however, is starting to reverse these trends. The onsite wastewater treatment industry, state regulators, technical support organizations (e.g., National Small Flows Clearinghouse), and professional associations (e.g., National Onsite Wastewater Recycling Association) have made tremendous progress over the past 10 years in addressing the economic, technical, and managerial challenges associated with decentralized wastewater treatment. The task for implementing the treatment technologies and management programs resulting from this work is now in the hands of local communities.

Figure 1-4. Centralized wastewater treatment vs. the decentralized approach.



Centralized wastewater treatment

Decentralized approach

Decentralized wastewater management: a challenge for America's communities

The benefits of managing decentralized wastewater treatment systems are directly linked to pollution prevention. The overall strategy of a management program is to ensure that appropriate system planning, design, installation, operation, maintenance, produces treated effluents that meet local water quality requirements. Demonstrating the costs of contaminated surface or ground water can be difficult. However, consideration of the individual and cumulative impacts of treatment failure provides some context for quantifying *cost avoidances* related to preventing pollution rather than addressing the often cascading impacts that can follow.

A number of high-profile incidences of failure which caused significant impacts have been identified. In addition. state and regional studies can be found throughout the Nation which indicate the importance of preventing health and water resource threats posed by inadequate wastewater treatment. For example:

- A waterborne *E. Coli* outbreak at the 1999 Washington County Fair in New York resulted in two deaths and 71 hospitalizations. A New York State Health Department investigation concluded that the outbreak may have resulted from contamination of a drinking water well by a dormitory septic system on the fairgrounds (New York Department of Health, 2000).
- Septic system failures have been documented by a counties, local health departments, regional planning commissions, and planning organizations in Colorado. Numerous reports have shown groundwater contamination and potential health risks, particularly at the subdivision level of development (Colorado Department of Public Health and Environment, 1999).
- Septic systems in Maine directly discharge the largest volume of wastewater into the subsurface environment, including contaminants such as nitrates, bacteria, viruses, and toxic chemicals from household products (Maine Department of Environmental Protection, 2002).
- A survey conducted by the Idaho Farm Bureau in three counties showed that about 4 percent of the wells sampled failed to meet the drinking water standard for nitrate. Septic systems were cited as among the three likely sources of contamination (Mahler, et.al., 2000).
- In Wayne County, Michigan, studies conducted for the Rouge River National Demonstration Project documented rapid migration of septic system effluent to nearby surface waters, particularly among older systems (Wayne County Department of Public Health, 1997).
- The Southern California Coastal Water Research Project found that bacteria from septic systems and other sources contaminates more than half of the region's shoreline, especially after heavy rains (Cone, 2000).

The high rate of failure in some communities is linked to poor system management and improper application of onsite wastewater treatment technology rather than an overall inability of onsite systems to adequately treat and disperse wastewater. Indeed, the onsite treatment industry has developed a variety of treatment units and system components capable of meeting even the most stringent performance requirements on sites with significant design limitations. However, the availability of advanced treatment technology cannot guarantee performance in the absence of effective management programs that address the full range of onsite wastewater treatment considerations. Management is the key to meeting performance requirements and protecting human health and water resources from pollutants of concern. A list of typical pollutants is provided in Table 1-3.

Table 1-3. Typical pollutants of concern from onsite systems

Pollutant	Reason for concern
Suspended Solids (TSS)	In surface waters, TSS can result in the development of sludge deposits that smother benthic macroinvertebrates and fish eggs and can contribute to benthic enrichment, toxicity, and sediment oxygen demand. Excessive turbidity can block sunlight, harming aquatic life (e.g., by blocking sunlight needed by plants) and contribute to decreased dissolved oxygen in the water column. In drinking water, turbidity is aesthetically displeasing and interferes with disinfection.
Biodegradable organics (BOD, COD, TOC)	Biological stabilization of organics in the water column can deplete dissolved oxygen in surface waters, creating anoxic conditions harmful to aquatic life. Oxygen-reducing conditions create taste and odor problems in drinking water and allow metals to leach from soil and rock in ground and surface waters.
Pathogenic organisms (virus, bacteria, parasites)	Parasites, bacteria, and viruses can cause communicable diseases through direct/indirect body contact or ingestion of contaminated water or shellfish. A particular threat when partially treated sewage pools on ground surfaces or migrates to recreational waters. Transport distances of some pathogens in ground or surface waters can be significant.
Nitrogen (N)	Nitrogen is an aquatic plant nutrient that can contribute to eutrophication and dissolved oxygen loss in surface waters, especially in lakes, estuaries, and coastal embayments. Algae and aquatic weeds can contribute trihalomethane (THM) precursors to the water column that might generate carcinogenic THMs in chlorinated drinking water. Excessive nitrate-nitrogen in drinking water can cause methemoglobinemia in infants and pregnancy complications. Livestock also can suffer health impacts from drinking water high in nitrogen. Ammonia in surface waters can be toxic to fish.
Phosphorus (P)	Phosphorus is an aquatic plant nutrient that can contribute to eutrophication of inland and coastal surface waters and reduction of dissolved oxygen.
Toxic Organic Compounds	Toxic organic compounds present in household chemicals and cleaning agents can interfere with certain biological processes in conventional and alternative OWTSs and can be persistent and bioaccumulative in the aquatic environment. They can cause damage to ecosystems and human health directly or through ingestion of contaminated aquatic organisms (e.g., fish, shellfish).
Heavy metals	Heavy metals (e.g., lead, mercury) in drinking water can cause human health problems. In the aquatic ecosystem, they also can be toxic to aquatic life and accumulate in fish that might be consumed by humans, resulting in metal toxicity health threats.
Dissolved Inorganic Compounds	Chloride and sulfide can cause taste and odor problems in drinking water. Boron, sodium, chlorides, sulfate, and other solutes might limit reuse options (e.g., irrigation).

Source: Adapted in part from Tchobanoglous and Burton, 1991.

1.7 Current status of decentralized wastewater management

In 1997 USEPA issued the *Response to Congress on Use of Decentralized Wastewater Treatment Systems*. This report was a milestone: USEPA acknowledged for the first time that sewering the entire country was not feasible and that decentralized wastewater systems were a viable alternative to centralized facilities. The report also described the inherent benefits of properly managed decentralized wastewater systems:

- More cost-effective than central sewer alternatives, except in densely populated urban centers.
- Longer service lives for managed onsite systems vs. unmanaged systems.
- Faster response to problems; smaller problem impacts.
- Increased opportunity for better watershed management.
- Better ground water protection and management capabilities.
- Increased property values.

The process of developing a cooperative or stand-alone management program is beneficial because it involves participatory action – community visioning, long-term planning and stakeholder information exchanges – and complements other wastewater planning needs. Management programs also promote professionalism among service providers, offer the opportunity for performance-based rather than prescriptive regulation, provide a vehicle for funding needed services, and make enforcement approaches more flexible. Despite the inherent advantages of properly managed decentralized systems, however, five major barriers continue to inhibit full utilization of alternative wastewater management systems:

- Lack of knowledge of the benefits and potential uses of decentralized systems on the part of regulatory and technical practitioners and local governments and citizens.
- Legislative and regulatory constraints that inhibit optimum use of decentralized systems.
- Lack of management programs that can optimize performance of decentralized technologies.
- Liability and engineering fees that discourage consideration of these alternatives.
- Financial barriers that inhibit the application of decentralized systems.

Overcoming these barriers will require significant effort on the part of federal, tribal, state, and local regulatory authorities and the management programs needed to support them. USEPA has identified the following actions as essential in addressing the barriers listed above:

- Improved education of technical practitioners, including engineers, service providers (those responsible for site evaluation, installation, and operation/maintenance), regulators, local citizens, and political leaders who need to understand how these systems work, how they should be managed, and how they affect public health and water quality. Efforts by the U.S. Department of Agriculture (USDA), USEPA, the National Decentralized Water Resources Capacity Development Project (NCDP), National Small Flows Clearinghouse (NSFC), National Environmental Services Center (NESC), National Environmental Health Association (NEHA), National Association of Counties (NACO), National Association of Waste Transporters (NAWT), and other national organizations are underway to improve education of engineers, service providers, regulators, and others who assist small communities.

- Improved state and regional regulatory programs based on system performance rather than use of restrictive codes which rely on assumptions that certain site characteristics will protect public health and water resources. USEPA, the National Onsite Wastewater Recycling Association (NOWRA), and some states are seeking to develop management models to expand the range of technical options to address existing onsite wastewater problems.

- Development of effective management programs to ensure that performance requirements are met. The USEPA management guidelines and this handbook are part of a major effort by USEPA, NSFC, NESC, and the NCDP to gather and share information on successful management approaches that enable small communities to protect public health and environmental quality in an affordable, cost-effective manner.

- Establishment of financing programs that assist local communities in creating and implementing effective management programs. USEPA, USDA, and other organizations have developed programs to assist small communities, but more creative financing approaches are needed. For example, New York State has announced a "one stop shopping" program for all assistance programs for use by communities seeking financial assistance.

Benefits of improved decentralized wastewater management

USEPA has documented the benefits of a well managed decentralized wastewater treatment system. Benefits accrued by communities developing onsite wastewater management programs include:

- Protection of public health and local water resources by ensuring pollutants are adequately treated and dispersed into the environment;
- Protection of a homeowner's investment in property and the ability to build home equity;
- Protection of a community's image;
- Elimination of the need to use a community's tax base to finance community wide wastewater infrastructure;
- Cost savings over the life of a system, alleviating the need for premature system replacement; and
- Elimination of the potential for major impacts due to system malfunctions and reduction in the vulnerability to system upsets.

1.8 Overview of management program structure and function

In most state, tribal, and local onsite wastewater control systems, a regulatory authority or agency is designated by statute or code to handle permitting, installation inspection, complaint response, enforcement, and other functions. Regulatory authority is typically delegated by the state agency to local health departments, but in some jurisdictions these duties may be executed by water resource agencies, planning and zoning programs, or other governmental organizations. The regulatory role usually involves permitting a system based on site conditions, executing a brief inspection, and expecting it to perform without any further intervention until a complaint is filed. The homeowner is responsible for all operation and maintenance required. This system of "benign neglect" has worked fairly well for the past century, i.e., it has addressed hydraulic failure with some regard for environmental consequences. However, any improvement in protecting public health and the environment can only be accomplished by developing management programs that address the key elements of system management, operation, and maintenance.

Management services may be provided by an enhanced regulatory authority, a group of public or private entities organized under a cooperative management program, or a responsible management entity. The management program can be supported by cooperating partners, service fees, special property assessments or other assessments, or funding from other sources. Depending on state, tribal, and/or local codes, revised enabling legislation or special agreements might be required for a responsible management entity to assume responsibility for certain program elements, such as permitting, permit holding, supplemental training/certification/licensing, monitoring, and system ownership.

The regulatory authority and the management program or entity must ensure that all onsite and cluster wastewater systems in the management jurisdiction meet the *performance requirements* established for protection of public health and ground and surface water resources. Performance requirements can be numeric (e.g., effluent nitrate concentrations must be below 15 mg/L) or narrative (e.g., no visible sewage on the ground surface or objectionable odors), or they can be based on compliance with prescriptive codes that are presumed to meet public health and water resource protection goals.

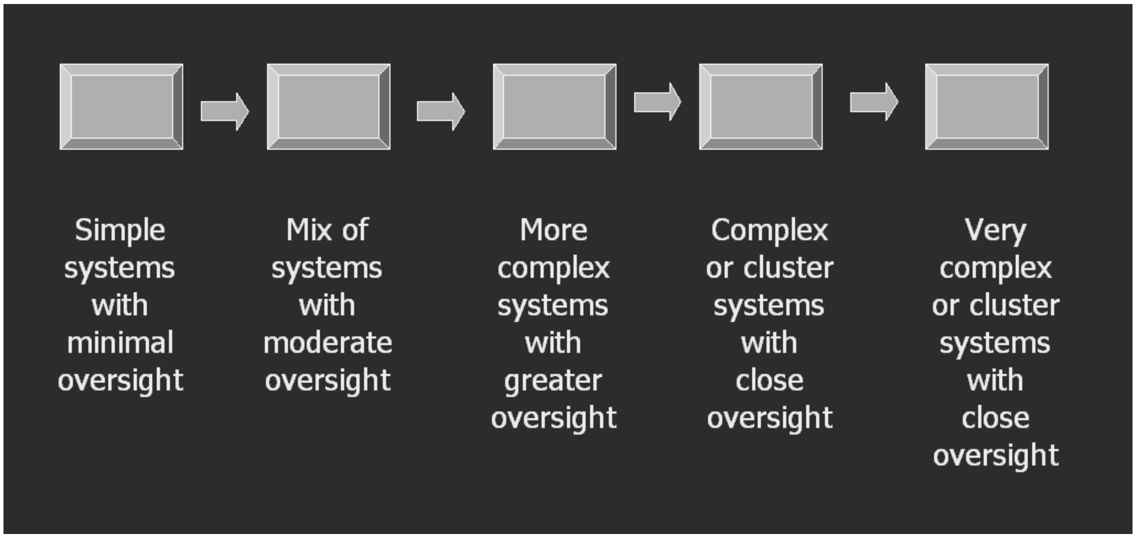
> "The benefits of good management of your wastewater system include:
> - Reduced costs for repairs, maintenance and replacement
> - Longer system life
> - Improved system performance
> - Increased reliability and overall satisfaction"
>
> *Small Community Wastewater Solutions: A Guide to Making Treatment, Management and Financing Decisions*

An example of how a performance-based program might function would be a jurisdiction where a local/regional cooperative management program works with the regulatory authority and state water and natural resource programs to assess surface and ground waters, identify areas where water quality criteria (i.e., under the federal Clean Water Act) are not being met, and designate critical areas where decentralized systems pose elevated risks (e.g., sites with poor soils, high water tables, high densities of existing systems, near sensitive surface waters, or in floodplains). The management program would then work with the regulatory authority and the community to develop onsite system performance requirements tailored to mitigate potential decentralized wastewater treatment system impacts on the receiving waters. The regulatory authority might choose to retain its power to issue system construction and operating permits, but delegate responsibilities for system design, inspection, and operation and maintenance to a management entity that could collect fees, enter into contracts, or receive funding for their services through other means. In all cases, the management entity must of itself or in concert with its partners have the required powers listed below to effectively accomplish its goals. For example, a stand-alone responsible management entity might be charged with:

- Authority to own, purchase, lease and rent both real and personal property;
- Right of access to the systems it governs by covenant, ordinance, or other suitable instrument;
- Eligibility for loans and grants for construction of facilities;
- Ability to enter into contracts and to undertake debt obligations, either by borrowing or issuing stocks or bonds;
- Authority to set and collect charges for system usage and/or oversight, set the value of such benefit, and assess or collect the cost from each property owner that is benefited;
- Power to make rules and regulations regarding use of on-site/small-scale systems; and
- Power to require the abatement of malfunctioning systems.

Management programs that requires system owners to assume full responsibility for operation and maintenance have proven to be largely ineffective (Herring, 2001). Therefore, the management models presented in the USEPA voluntary guidelines recommend system inventories and maintenance reminders to system owners as the foundation upon which management programs should be built. At the other end of the management continuum, the guidelines suggest a program wherein a sanitation district or other entity owns, operates, and maintains onsite and cluster systems and charges users a monthly fee in a manner similar to conventional sewage collection and treatment operations. The middle ranges of the management continuum recommend required maintenance contracts for higher risk systems and revocable, renewable operating permits where appropriate. Again, the key consideration in developing, implementing, and sustaining a management program is protecting public health and water resources.

Figure 1-5. The decentralized wastewater management continuum.



Local communities can tailor their management approach in accordance with their resources, management capabilities, and the necessary level of protection for health and sensitive water resources as expressed by statutes, codes, and community input. The decentralized management continuum can accommodate a wide range of program activities as long as each of the program elements are addressed during the planning and periodically throughout the implementation phase. A matrix that can be used to match program elements (see Chapter 2 for description) to entities partnering in the management program is presented as Table 1-4. This table is valuable for assessing the status of management at the start of management program planning, checking the management options chosen for consideration, and reviewing the program periodically to determine the need for changes.

Figure 1-6. Management intensity as a function of environmental sensitivity and resource value.

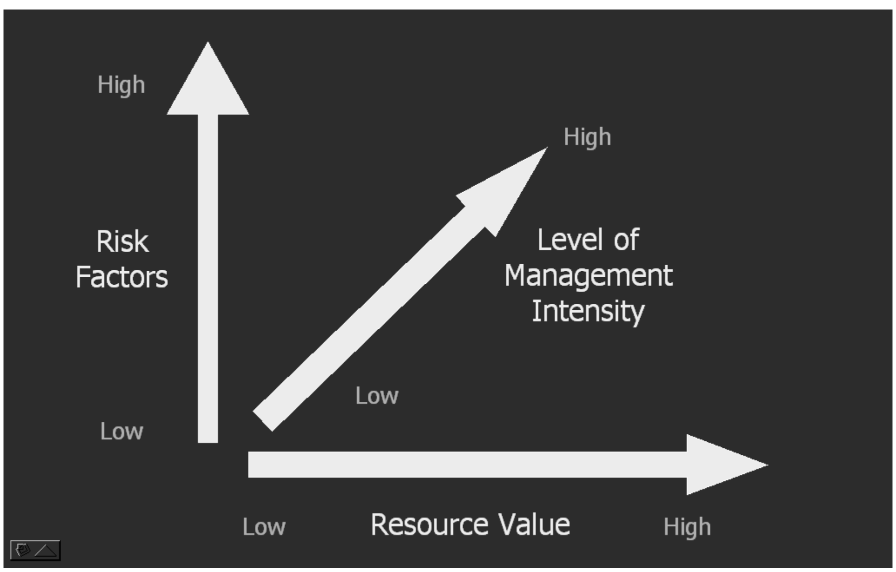


Table 1-4. Management program elements and suggested entities to support management activities.

	State Health Dept.	State Water Agency	District/County/ Local Health Dept.	County or Local Government Office	Local/Regional Planning Office	Public/Private Management Entity	System Owner (Homeowner)	Private Contractor or Service Provider
Public Education and Participation								
System owner/operator education and training								
Public outreach, education, involvement programs								
Planning								
Stakeholder and partner agency involvement process								
Watershed and groundwater assessments								
Sensitive and critical area designations								
Performance Requirements								
Public health and water resource protection goals								
General requirements for all systems								
Requirements for systems in sensitive/critical areas								
Training, Certification and Licensing								
Type of staff and service providers covered								
Certification/licensing requirements								
Training for staff and service providers								
Site Evaluation								
Wastewater characterization procedures								
Site investigation and suitability analyses								
Design								
Prescriptive or performance-based criteria								
Design review and approval process								

Construction								
Permitting requirements and process								
Construction and/or installation oversight								
Operation and Maintenance								
Owner/operator requirements								
Performance certification approaches								
Residuals Management								
Residuals removal/disposal requirements								
Tracking and reporting system								
Inspections and Monitoring								
Routine and emergency inspections								
Targeted surface and ground water monitoring								
Corrective Actions and Enforcement								
Compliance schedules and enforcement program								
Repair, upgrade, or replacement oversight								
Record Keeping, Inventory, and Reporting								
Existing and new systems inventory								
Tracking system for permits, inspections, maintenance								
Financial, administrative, and program management								
Financial Assistance and Funding								
Funding source development								
Administration/management funding								
Installation and O&M assistance								