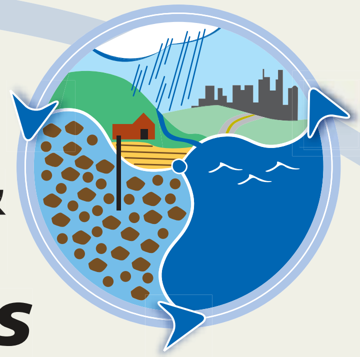
Ground Water & Onsite Wastewater Treatment Systems



Key Message

Onsite wastewater treatment systems (septic systems) have the potential to contaminate ground water and surface water resources, including drinking water supplies, with nitrates and other nutrients, chemicals, pathogens, and pharmaceuticals. However, when properly located, designed, constructed, and maintained, septic systems provide an effective and efficient means of treating domestic sewage and protecting water quality. Furthermore, there are economic and ecological advantages to managing wastewater within the watershed where it is produced.

Thousands of unsewered communities and rural residences will continue to depend on onsite systems for wastewater treatment and disposal. Today, as the population migrates farther from metropolitan areas, about one-third of all new development is served by decentralized treatment systems (USEPA, 2004). Onsite systems allow communities to develop while providing them with the means for adequately handling wastewater. To minimize the impacts of these systems on ground water, we need to:

- Ensure that onsite systems are properly designed, installed, and maintained.
- Take full advantage of innovative designs and sound science.
- Adopt effective management solutions.
- Actively educate the public on what wastes should not be put into their systems, and how these systems should be maintained.

Curlew Lake in northern Washington State showing eutrophication along the shore near densely spaced septic systems. (Photo from Curlew Lake Eutrophication Study, 1986, Washington State University.)

Minimizing the Impacts of Onsite Systems on Ground Water

"David Hayward came home one summer day to find brown, swampy puddles in his front yard. As he puzzled over the brown ooze, his neighbor strolled over and identified the problem: 'Looks like your septic system went.' Until that day, David didn't know septic systems died—he thought of his system as a simple underground tank that just made wastewater disappear."

Carol Steinfeld | "Septic System Basic" | *Mother Earth News* | October/November 2002

why Onsite Wastewater Treatment matters to ground water and surface water…

Nationwide, decentralized wastewater treatment systems (septic systems, private sewage systems, onsite sewage disposal systems) collect, treat, and release about 4 billion gallons of effluent per day from an estimated 26 million homes and businesses (USEPA, 2002). More than half of these systems were installed over 30 years ago, when rules were nonexistent, substandard, or poorly enforced. The percentage of homes and businesses served by these systems varies from state to state, from a high of about 55 percent in Vermont to a low of about 10 percent in California (USEPA, 2002).

Of concern is the fact that an estimated 10 percent to 20 percent of septic systems fail annually (USEPA, 2002), increasing the risk that pathogens (e.g., viruses, bacteria, cryptosporidiosis), nutrients (e.g., nitrates, phosphorus), pharmaceuticals, personal-care products, and household cleaning products will enter drinking water sources. Contamination of surface waters by fecal coliform bacteria is often associated with septic system infiltration. In fact, in USEPA's *Response to Congress on Use of Decentralized Wastewater Treatment Systems* in 1997, state agencies listed septic systems as the second most common threat to ground water resources. In November 2006, USEPA issued its final Ground Water Rule to provide increased protection against microbial pathogens in public water systems that use ground water sources. Microbial pathogens include disease-causing viruses and bacteria, such as E. coli and reach ground water from a variety of sources including failed septic systems. (See *http://www.epa.gov/safewater/disinfection/gwr/index.html*.)

A recent USGS Water Quality Assessment Program study on volatile organic compounds (VOCs) in ground water and drinking water supplies (Zogorski et al., 2006) found that VOC occurrence is widespread and can be attributed to the ubiquitous nature of many sources (including septic systems) and the

Photo: http://ndep.nv.gov/photo/carson.htm

Nevada's ground water protection strategy includes protecting all ground water as a potential source of drinking water and using strict contaminant source controls and monitoring. Ground water quality in Nevada is generally good enough for most uses. There have been relatively few detections of contaminants introduced by human activities in public water systems served by ground water. Even fewer systems have had detections that exceeded drinking water standards—nitrate is the most common contaminant found. Sources of nitrate include septic systems and livestock in suburban areas. Carson Valley has experienced rapid growth in areas that are outside those served by public water and sewage systems. This growth has led to the installation of septic systems at a rate of over 1,000 every 10 years.

vulnerability of many aquifers. Many people don't realize that some household products that are thoughtlessly tossed down the drain or flushed down the toilet contain VOCs or chemicals that form VOCs when added to water. Once in the environment VOCs tend to persist and migrate in ground water, potentially to drinking water supply wells.

The USGS study found that the factors describing the source, transport, and fate of VOCs were all important in explaining the widespread occurrence of VOCs. For example, the occurrence of perchloroethylene (PCE) was statistically associated with the percentage of urban land use and density of septic systems near sampled wells (source factors), depth to top of well screen (transport factor), and presence of dissolved oxygen (fate factor).

FACTORS MOST COMMONLY ASSOCIATED WITH VOCS IN AQUIFERS

SOURCE FACTORS

- Septic systems
- Urban land
- Resource Conservation and Recovery Act (RCRA) hazardous-waste facilities
- Gasoline underground storage tank and leaking underground storage tank sites

TRANSPORT FACTORS

- Climatic conditions
- Depth to top of well screen
- Hydric (anoxic) soils

FATE FACTOR

- Oxic ground water (dissolved-oxygen concentration greater than or equal to 0.5 milligram per liter)

INDETERMINATE

- Type of well

Table 1. *Source: Zogorski et al., 2006*

SOURCES OF WATER-SUPPLY WELL CONTAMINATION

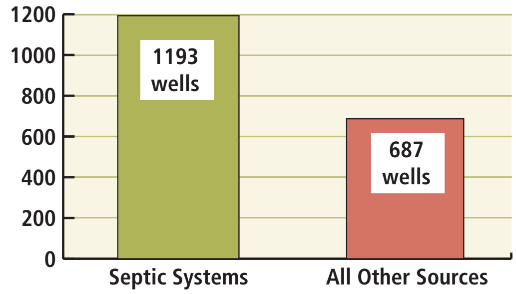


Figure. 1. *New Mexico Water-Supply Wells Contaminated by Onsite Septic Systems versus All Other Sources, Combined. (Modified from WQCC, 2002a)*

PCE, a chlorinated hydrocarbon solvent that can be found in numerous household products, moves easily through soil and ground water. While it does not dissolve easily in water, it can over time dissolve such that it can be a health risk (e.g., liver/kidney damage, liver/kidney cancer, leukemia). It is also very difficult to clean up PCE-contaminated ground water.

Despite the fact that these septic systems are known potential sources of ground water contamination, they are, as a whole, inadequately monitored and studied. In general, legal authority for regulating onsite systems rests with state, tribal, and local governments, and regulation may be divided in a variety of ways among jurisdictions. For example, the health department may regulate single-family systems, while the environmental agency may have jurisdiction over multiple-family or industrial septic systems.

ONSITE WASTEWATER TREATMENT IN THE NATURAL SYSTEM

During the operation of a septic system, household wastewater is flushed into a large underground multicompartmented holding tank, where the solids settle to the bottom of the tank. Bacteria in the tank help break down some of the solids. The liquid effluent flows out of the tank and into a leachfield (drainfield) consisting of a series of parallel, underground, perforated pipes that allow wastewater to percolate into the surrounding soil, where the wastewater treatment actually occurs.

Through various physical and biological processes, most bacteria and viruses and some nutrients in wastewater are consumed as the effluent travels through the soil layers. By design, these systems allow water from the drainfield to percolate into the underlying soil layers and potentially into ground water. Proper design and placement of these systems help prevent nitrates from exceeding the assimilative capacity of the ground water. Some states and local jurisdictions are using advanced system design for vulnerable areas (e.g., mound systems) and increased monitoring schedules for larger systems.

Photo: DCvision2006 - http://www.flickr.com/photos/dcvision2006/534708375/in/set-72157594312514342/

View inside a septic system with clogged drainage.

For an onsite system to function properly and effectively, appropriate land conditions (e.g., soil, geology, hydrology) and system design, installation, and main-

EFFECTS OF CONCENTRATED HOUSING ON GROUND WATER LEVEL

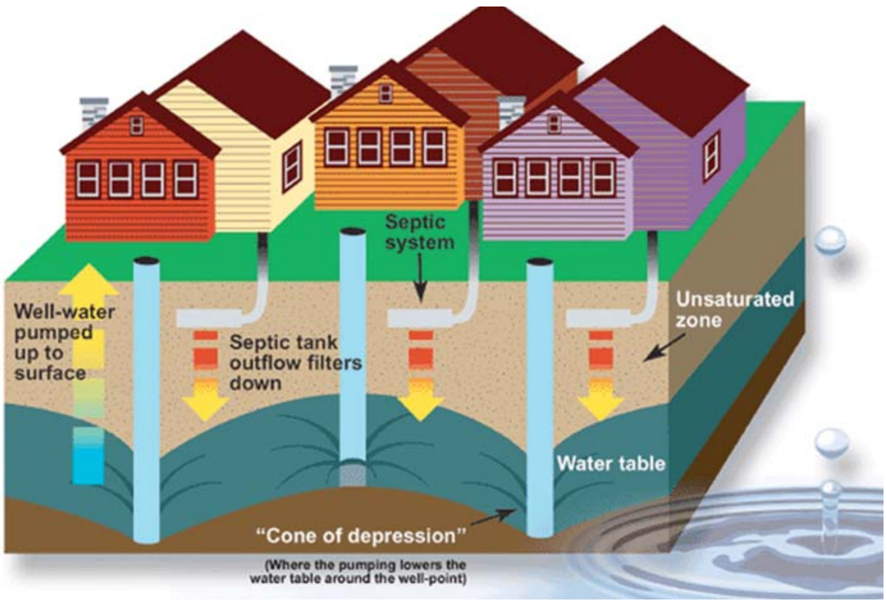


Figure 2. *Many onsite sewage disposal system regulatory programs have requirements for the setback distance between wells and onsite systems, minimum percolation rates, and/or absorption-field sizing to provide adequate dilution and attenuation of chemical and biological contaminants in order to prevent contamination of ground water and drinking water supplies. Housing developments with small lots and individual wells exist in many rural areas. If the aquifer is low yielding so that pumping causes a large drawdown, a cone of depression will develop around each well. Thus, several domestic wells close together can create a steady lowering of the water table if pumpage exceeds the natural recharge to the system (unless the withdrawn water is returned to the aquifer through septic systems).*

Source: http://cobweb.ecn.purdue.edu/~epados/septics/density.htm tenance are necessary. Effluent must move slowly through aerated soil or rock so organisms can feed on the drainfield effluent to remove the pathogens. Septic system technology now favors placing leaching structures so they are shallow enough to allow for higher oxygen availability and the benefit of evapotranspiration through root uptake to help treat the effluent. If the effluent moves through the soil or rock too quickly, the organisms cannot adequately digest it, and the wastewater can contaminate the aquifer underneath.

Improperly functioning systems pose a contamination risk to ground water and surface waters. Ground and surface water pollution is closely linked, since the baseflow of streams draining to lakes, ponds, and wetlands comes from ground water contributions.

Septic system function is typically impaired by:

- Improperly maintained, unpumped, sludge-filled septic tanks, which eventually cause clogged absorption fields and hydraulic overloading.
- Poorly or improperly sited leachfields (e.g., too many per acre, seasonally high ground water, unsuitable geology, poorly drained soils).
- Discharged wastes (e.g., solvents, chemicals, household hazardous wastes) that can wipe out bacterial treatment processes.

The issue of septic systems and water quality is especially significant to ponds, lakes, and coastal estuaries. During wet periods, when water tables are high, a septic system may be more likely to contribute poorly treated sewage and nutrients to a water body. Water bodies contaminated by wastewater moving from ground water to surface water pose a health threat to people and aquatic life. Disease-causing organisms present in wastewater can cause dysentery, cholera, typhoid, and hepatitis A. Nitrates can contaminate drinking water and lead to illness in humans (for example, blue-baby syndrome, which affects an infant's ability to carry oxygen in its blood). Other nutrients, primarily phosphorous, can promote algae and weed growth in lakes, depleting oxygen levels and killing fish. (Tri-State Water Quality Council, 2005)

PHARMACEUTICALS AND PERSONAL-CARE PRODUCTS—AN EMERGING CONCERN

A 2002 USGS study (Kolpin et al., 2002) found that, of 130 waterways surveyed in 30 states, 80 percent contained trace amounts of pharmaceuticals and personal-care products (PPCPs). These products include prescription and over-the-counter drugs such as painkillers, antidepressants, lipid regulators, and contraceptive pills, as well as substances such as nicotine, caffeine, food supplements, cosmetics, sunscreen, antibacterial soaps, and cleaning products.

One of the largest sources of PPCPs is the typical household (NESC, 2007). PPCPs enter the environment primarily though household waste disposal systems—human excrement (e.g., ingested drugs), flushing of unwanted or expired pharmaceuticals, washing off externally applied drugs and chemicals. Septic systems are typically not designed to treat many of these products, and little is known about what PPCPs are doing to septic system performance. A disruption in the balance of bacteria in the system can affect performance and cause system failure.

Photo: Ken Erney - http://www.flickr.com/photos/cryptik/302980912/

Installation of a drip irrigation system in Virginia. In addition to some control electronics in the house, the system includes the tanks you see in the photo as well as about an acre of land dedicated to a drain field. The drain field uses shallow buried tubing to disburse the treated water, in contrast to the standard depth fields used in conventional systems. The system is designed to handle about 600 gallons of sewage per day. The state estimates the size of the system based on the number of bedrooms at a rate of 150 GPD per bedroom.

Photo: Powell River Project, Virginia Tech

Certain onsite systems are regulated under the Underground Injection Control (UIC) Program if they (a) accept only sanitary wastes and are used by a multiple dwelling, community, or regional system; (b) accept only sanitary wastes, are used by a nonresidential establishment, and have the capacity to serve 20 or more people per day; or (c) accept anything other than sanitary waste, regardless of system size. Discharges from these onsite systems are authorized as long as they do not endanger underground sources of drinking water.

LARGE-CAPACITY SEPTIC SYSTEMS

Large-capacity septic systems are regulated as underground injection control (UIC) program Class V wells that receive solely sanitary waste and have the capacity to serve 20 or more people (e.g., schools, multiple dwellings, churches, office buildings, shopping malls). These systems fall within the federal UIC program, as authorized under the Safe Drinking Water Act of 1974, 1986, 1996, and regulated by UIC programs at the state or federal level. USEPA recognizes that different governmental offices in different states regulate septic systems of varying sizes. The UIC program is responsible for ensuring that these non-UIC programs meet UIC program requirements when regulating large-capacity septic systems.

In a May 2001 determination, USEPA concluded that federal regulations under the UIC requirements were not necessary at that time for large-capacity septic systems. The only onsite wastewater systems regulated under the Class V category are large-capacity cesspools, which are now illegal.

USEPA noted that existing state and local requirements are specifically tailored to local hydrogeologic conditions and therefore more effective than any additional federal UIC rules could be. The agency felt that any gap in environmental protection associated with large-capacity systems is due to a lack of effective and proper implementation, not a lack of standards, and encouraged local authorities to implement existing standards in an efficient and effective manner.

LIVING WITH SEPTIC SYSTEMS

Septic systems are sometimes considered to be temporary installations that will eventually be replaced by complex and expensive centralized wastewater treatment facilities. This mind-set has been eclipsed by the reality that in many places onsite systems are likely to be permanent approaches to treating wastewater for release and reuse in the environment.

Whether onsite systems are temporary or permanent wastewater treatment installations, each must be designed, operated, and maintained to ensure that it is going to function effectively and do no harm to human health and the water environment as long as it is in service. Approval of each proposed new system must take into account the cumulative impact of existing and future systems.

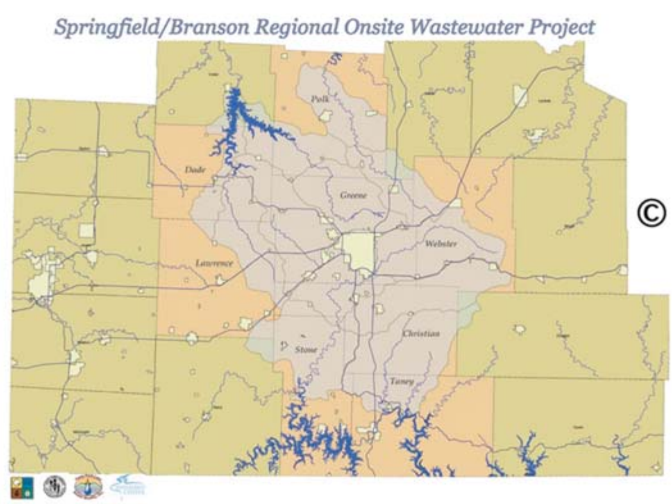


Figure 3. *The Watershed Committee of the Ozarks (WCO) is currently working with Table Rock Water Quality Incorporated (TRLWQ) to demonstrate the remediation of onsite wastewater treatment systems that have failed and pose a contamination threat to ground water. This project will provide design and installation services for the introduction of an alternative type of wastewater treatment system that can serve up to twenty homes in targeted areas to replace existing failing onsite systems.*

Source: Watershed Committee of the Ozarks

As stated in USEPA's voluntary national guidelines: "Although 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 contribute to major water quality problems."

Septic Systems—a Local Concern

While design and construction standards for decentralized systems are typically established by state environmental agencies, responsibility for onsite wastewater oversight typically rests with local or regional boards of health, health directors, or sanitarians. Responsibility for ensuring the integrity of a septic system in the environment begins with approving the design of the system—will it function properly in a given subsurface environment?—and then overseeing the installation of that system according to design specifications. Many states have certification programs for installers. However, most communities do not routinely oversee septic system operation and maintenance or detect and respond to changes in wastewater loads that can overwhelm a system.

Responsibility for potential impacts on ground water from onsite systems also rests to some extent with local planning and zoning entities, whose zoning and subdivision requirements may or may not take into account the ability of the land to support a desired development density in a given area. Most health districts now restrict septic systems in vulnerable areas and have rules about spacing and density per acre. However, too few of these entities take into account the incremental effect of additional decentralized wastewater systems within a given water supply region or watershed. While the nutrient load from one septic tank system may be insignificant, the cumulative effect of adding more systems may trigger problems. Nutrients can build up in the soil and ground water over time to unhealthy levels. When surface runoff or ground water flow carry these pollutants to surface water, they can create an environment ripe for algal growth.

On the Home Front

Perfectly good septic systems can fail because the homeowner isn't giving them the attention they require. Examples of septic system abuse include:

- Failure to pump the tank on a regular schedule.
- Damage to the drainfield from compaction (e.g., caused by driving vehicles or performing construction activities on the drainfield), animal burrowing and tunneling in the leachfield, or tree and shrub roots.

Figure 4. *"Community" leaching fields serving multiple single-family homes, with their open space, environmental and aesthetic benefits, are now fully approvable in most states. This plat shows a proposed community leaching field in Connecticut that will be assessed by the Department of Environmental Protection for approval of the hydraulics of the proposed system, the treatment of nitrogen and pathogens, and the mixing of treated wastewater into the area's ground water system. The location of the proposed system's leaching fields, affected soils, the supporting ground water system, and adjacent uses are factors that will influence the design and feasibility of the system.*

The Biocycle system shown here is a full-treatment system comprised of two primary settlement chambers, two secondary-treatment tanks incorporating secondary settlement, and a final storage tank from which the wastewater is pumped periodically into a percolation area.

MANAGED DECENTRALIZED SYSTEMS PUT THE ONUS ON THE EXPERTS

The high rate of onsite wastewater treatment system failures is typically the result of poor system siting, design, and maintenance—not the inability of these systems to adequately treat and disperse wastewater. A septic system management program offers the best hope for ensuring that these decentralized systems do their jobs without harm to ground and surface water resources. Some communities have such programs but most do not. If a community does not want to take this responsibility on because of the cost, then a utility approach can provide a cost-effective solution by financing septic management services through collection of a dedicated fee assessed to system owners.

A septic utility can handle such activities as ensuring proper system siting, design, installation, performance, and operation and maintenance; providing public education and training and planning; and handling record keeping/reporting, financial assistance, and funding responsibilities. It can inspect and monitor systems regularly, pump out on an appropriate schedule, and make repairs in a timely fashion. The utility can also enforce existing regulations and establish any other necessary regulations.

Septic system utilities can be operated by local governments or by private entities. For example, the first regulated onsite system public utility company in Tennessee, Tennessee Wastewater Systems, Inc,, was established in 1993 to manage cluster-type wastewater systems across the state. In this case, developers pay the capital cost to put the systems in place and then the utility takes over from there.

- Disposal of household chemicals (e.g., paint thinner) into the system.
- Overloading the system by using a garbage disposal.
- Inability of the system to support the number of people in the household.
- Use of septic tank additives, drain cleaners, or harsh household chemicals.
- Planting inappropriate vegetation (e.g., trees, shrubs) over the drainfield.

Photo: Aaron Vincent

First cleanout for this septic system, which was installed in 1978. While it is difficult to measure and document specific cause-and-effect relationships between onsite systems and the quality of our water resources, it is widely accepted that improperly operating systems (resulting from inadequate siting, design, construction, installation, operation, and/or maintenance) contribute to major water quality problems. Improved operation and performance of onsite systems through better management will be essential if the nation's water quality and public health goals are to be attained.

The Management Approach to Wastewater

Since, for the most part, responsibility for conventional gravity-based septic systems rests with homeowners, who are often uniformed about the potential health risks of these systems, USEPA is promoting a management approach to ensure that septic systems perform effectively. Many community-development strategies are headed in this direction as an alternative to traditional centralized water and sewer lines that are costly and can give rise to unwanted sprawl, traffic congestion, and environmental degradation.

To promote the effective performance of any type of septic systems, state and local governments need to develop effective strategies that consider critical elements such as planning, site soil conditions, risk factors, system design, operation and maintenance, periodic inspections, monitoring, and financial support. Some neighborhood associations now impose annual fees to help support septic system maintenance.

Photo: sappyroo – http://www.flickr.com/photos/20018463@N00/1599982685/

A malfunctioning septic tank that is being cleaned out and repaired.

This new waste management paradigm involves a cooperative, coordinated, integrative approach to protecting public health and water resources. It includes the use of performance-based management techniques, rather than prescriptive code requirements (which don't take into account the potential for environmental degradation) for system siting, design, and operation.

Some communities are experimenting with performance-based approaches, in which onsite systems are designed for specific sites to protect water quality and public health. Many continue to rely on the more traditional but less flexible prescriptive requirements for technologies that have proven to be effective under a wide range of site conditions. Newer, or "alternative," onsite treatment technologies are often more complex than conventional systems, and incorporate pumps, recirculation piping, aeration, and other features that require periodic monitoring and maintenance.

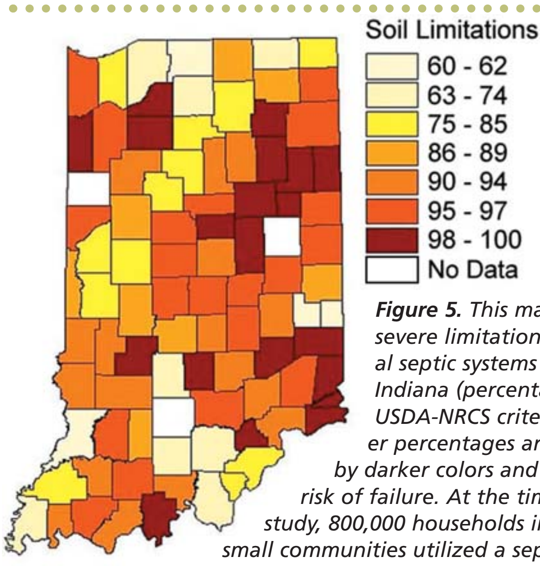


Figure 5. *This map shows severe limitations for traditional septic systems by county in Indiana (percentages based on USDA-NRCS criteria). The higher percentages are represented by darker colors and mean greater risk of failure. At the time of this study, 800,000 households in rural and small communities utilized a septic system. About 15,000 onsite wastewater disposal permits were approved annually, and county sanitarians estimated that failure rates were as high as 70 percent and that about 200,000 systems were operating inadequately. It is likely that such conditions have not improved since then, in Indiana or elsewhere.*

Source: C. Taylor, J. Yahner, and D. Jones. 1997. An Evaluation of Onsite Technology in Indiana. Purdue University, West Lafayette, IN.

ELEMENTS OF AN EFFECTIVE DECENTRALIZED WASTEWATER MANAGEMENT PROGRAM

Local and regional governments or groups such as watershed associations can protect ground water resources and public health by adopting comprehensive decentralized wastewater management programs, including:

- Establishing permit and inspection requirements to ensure proper installation.
- Educating the public about septic system use and care.
- Establishing a septic system maintenance ordinance.
- Banning hazardous additives or cleaners for septic systems.
- Connecting homes and businesses to central sewers or decentralized treatment systems, such as package plants or cluster systems, when feasible.
- Requiring additional treatment, such as a sand filter, when needed.
- Establishing standards for design, installation, and siting new septic systems.
- Training and certifying/licensing septic system professionals.
- Requiring performance-based system monitoring.
- Establishing financial assistance and funding programs.
- Ensuring that septic systems undergo technical review during land-use planning and subdivision approval.

Source: USEPA. February 2002. Onsite Wastewater Treatment Systems Manual. EPA/625/R-00/008.

A SAMPLING OF STRATEGIES FOR MANAGING ONSITE SYSTEMS

Minnesota's 10-Year Plan to Upgrade and Maintain Onsite Treatment Systems

In Minnesota, approximately 86% of the state's full-time residents are served by onsite systems. In February 2004, the Minnesota Pollution Control Agency (MPCA) presented the state legislature with the *10-Year Plan to Upgrade and Maintain Onsite Treatment Systems,* in response to the legislature's charge to the agency to develop a plan to:

- Identify and upgrade all noncompliant Onsite Treatment Systems (ISTSs) within a 10-year period.
- Develop a maintenance oversight system that ensures that all ISTSs remain in compliance requirements of Minnesota Rules.
- Recommend enhanced funding mechanisms to assist homeowners in making necessary upgrades.

MNPCA identified the following activities, which are now being implemented, that would be necessary to meet these goals:

- Identify unsewered properties.
- Improve professional competency of ISTS professionals.
- Enhance baseline county programs (where standards are developed and program oversight and funding takes place).

For more information on the plan, go to: http://www.pca.state.mn.us/publications/reports/lrwq-wwists-1sy04.pdf.

Effluent Quality Requirements and Operating Permits in St. Louis County, Minnesota

In St. Louis County, many of the soils are very slowly permeable lacustrine clays, shallow to bedrock, and often near saturation—poorly suited for application of traditional onsite treatment systems. The state minimum code restricts onsite systems to sites that have permeable soils with sufficient unsaturated depths to maintain a 3-foot separation distance to the saturated zone. To allow the use of onsite treatment, the county adopted performance requirements that may be followed in lieu of the prescriptive requirements where less than 3 feet of unsaturated, permeable soils are present. In such cases the owner must continuously demonstrate and certify that the system is meeting these requirements, which is achieved through the issuance of renewable operating permits based on evaluation of system performance.

Permit renewal requires that the owner document that these requirements have been met. If the documentation is not provided, a temporary permit is issued with a compliance schedule. If the compliance schedule is not met, the county has the option of reissuing the temporary permit and/or assessing penalties. The permit program is self-supporting through permit fees.

The county has also adopted a performance code that establishes effluent requirements for systems installed where minimum standards cannot be met. For example, where the natural soil has an unsaturated depth of less than 3 feet but more than 1 foot, the effluent discharged to the soil must have no more than 10,000 fecal coliform colonies per 100 mL. On sites with 1 foot or less of unsaturated soil, the effluent must have no more than 200 fecal coliform colonies per 100 mL. These effluent limits are monitored prior to final discharge at the infiltrative surface but recognize treatment provided by the soil. If hydraulic failure occurs, the county considers the potential risk within acceptable limits. The expectation is that any discharges to the surface will meet at least the primary contact water quality requirements of 200 fecal coliform colonies per 100 mL. Other requirements, such as nutrient limitations, may be established for systems installed in environmentally sensitive areas.

Source: http://www.epa.gov/ORD/NRMRL/pubs/625r00008/625R00008chap3.pdf.

The Massachusetts Onsite Treatment System Inspection Program

In 1996, Massachusetts mandated inspections of Onsite Wastewater Treatment Systems (OWTSs) to identify and address problems posed by failing systems (310 CMR 15.300, 1996). The intent of the program was to ensure the proper operation and maintenance of all systems. A significant part of the program is the annual production of educational materials for distribution to the public describing the importance of proper maintenance and operation of onsite systems and the impact these systems can have on public health and the environment.

Inspections are required at the time of property transfer, a change in use of the building, or an increase in discharges to the system. Systems with design flows equal to or greater than 10,000 gallons per day require annual inspections. Inspections are to be performed by state-approved persons.

A system is deemed to be failing to protect public health, safety, and the environment if the septic tank is made of steel; if the OWTS is found to be backing

A SAMPLING OF STRATEGIES FOR MANAGING ONSITE SYSTEMS (continued from page 10)

up or if it is discharging directly or indirectly onto the surface of the ground; if the infiltration system elevation is below the high ground water level elevation; or if the system components encroach on established horizontal setback distances. The owner must make the appropriate upgrades to the system within two years of discovery. Failure to have the system inspected as required or to make the necessary repairs constitutes a violation of the code.

Source: Title V, Massachusetts Environmental Code.

Limiting Nitrogen from Onsite Systems by Performance Requirements in Massachusetts

Massachusetts also has requirements for nitrogen-sensitive areas. These areas are defined in state rules as occurring within Interim Wellhead Protection Areas, one-year recharge areas of public water supplies, nitrogen-sensitive embayments, and other areas that are designated as nitrogen-sensitive based on scientific evaluations of the affected water body (310 Code of Massachusetts Regulations 15.000, 1996). Any new construction using onsite wastewater treatment in these designated areas must abide by prescriptive standards that limit design flows to a maximum of 440 gallons per day of aggregated flows per acre. Exceptions are permitted for treatment systems with enhanced nitrogen removal capability.

Source: Title V, Massachusetts Environmental Code and http://www.epa.gov/ORD/NRMRL/pubs/625r00008/625R00008chap3.pdf.

Monitoring Requirements in Washington State

The state of Washington Department of Health has adopted a number of monitoring requirements that OWTS owners must meet. Because such requirements place additional oversight responsibilities on management agencies, additional resources are needed to ensure compliance. Among the requirements, the system owner is responsible for properly operating and maintaining the system and must:

- Determine the level of solids and scum in the septic tank once every three years.
- Employ an approved pumping service provider to remove the septage from the tank when the level of solids and scum indicates that removal is necessary.
- Protect the system area and the reserve area from cover by structures or impervious material, surface drainage, soil compaction (e.g., by vehicular traffic or livestock), and damage by soil removal and grade alteration.
- Keep the flow of sewage to the system at or below the approved design both in quantity and waste strength.
- Operate and maintain alternative systems as directed by the local health officer.
- Direct drains, such as footing or roof drains, away from the area where the system is located.

Areas of special concern are those where the health officer or department determines additional requirements might be necessary to reduce system failures or minimize potential impacts upon public health. Examples include shellfish habitat, sole-source aquifers, public water supply protection areas, watersheds of recreational waters, wetlands used in food production, and areas that are frequently flooded.

Source: Washington Department of Health, 1994 and http://www.epa.gov/ORD/NRMRL/pubs/625r00008/625R00008chap3.pdf.

Onsite System Inspection/Maintenance Guidance in Rhode Island

In 2000, the Rhode Island Department of Environmental Management published the *Septic System Checkup: The Rhode Island Handbook for Inspection,* an inclusive guide to inspecting and maintaining septic systems. The handbook, available to the public, is written for both lay people and professionals in the field. The guide is an easy-to-understand, detailed protocol for inspection and maintenance and includes newly developed state standards for septic system inspection and maintenance.

The handbook describes two types of inspections: a maintenance inspection to determine the need for pumping and minor repairs, and a functional inspection for use during property transfers. The handbook also includes detailed instructions for locating septic-system components, diagnosing in-home plumbing problems, flow testing and dye tracing, and scheduling inspections. Several Rhode Island communities use *Septic System Checkup* as their inspection standard. The University of Rhode Island offers a training course for professionals interested in becoming certified in the inspection procedures. The handbook is available free on-line at *http://www.dem.ri.gov/pubs/regs/regs/water/isdsbook.pdf*

Source: Rhode Island Department of Environmental Management.

In the document *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems (http://www.epa.gov/owm/septic/ pubs/septic_guidelines.pdf)*, USEPA recognizes that the disparate governmental units that regulate onsite systems need "a flexible framework and guidance to best tailor their management programs to the specific needs of the community and the needs of the watershed."

USEPA's guidelines include the following voluntary management models:

- **Model 1: The Homeowner Awareness Model**
  Ensures systems are sited, designed, and constructed in compliance with prevailing rules, and includes inventory and documentation of all systems by regulatory authority with voluntary maintenance. Appropriate for conventional systems in areas of low environmental sensitivity.
- **Model 2: The Maintenance Contract Model**
  This builds on Model 1 by ensuring that property owners maintain maintenance contracts with trained operators, including tracking and reporting functions to ensure that requirements of maintenance contracts are fulfilled. Appropriate for more complex wastewater treatment systems, small clusters, or restrictive site conditions.
- **Model 3: The Operating Permit Model**
  This builds on Model 2 by issuing limited-term renewable operating permits to individual system owners. Provides continued oversight of system performance (this may include scheduled inspections). Appropriate where large-capacity onsite systems or systems treating high-strength wastewaters exist, and in areas of heightened environmental concern (lakes, estuaries, or drinking water supplies).
- **Model 4: The Responsible Management Entity (RME) Operation and Maintenance Model**
  Similar to Model 3, except that after systems are constructed, operating permits are issued to a management entity that performs operation and maintenance activities. This model is appropriate where large numbers of onsite and clustered systems must meet specific water quality requirements because environmental sensitivity is high (e.g., shellfish waters or wellhead protection areas).
- **Model 5: The Responsible Management Entity (RME) Ownership Model**
  Similar to Model 3, except that the RME owns, operates, and manages the decentralized wastewater treatment systems in a manner analogous to central sewerage. This is appropriate where new or existing high-density development is proposed or exists near sensitive receiving water.

USEPA's website, *http://cfpub.epa.gov/owm/septic/home.cfm,* provides an excellent array of documents that communities can download to learn about managing decentralized wastewater treatment systems.

National Performance Code in the Works

The National Onsite Wastewater Recycling Association (NOWRA) is currently developing a model onsite system performance code to assist states and local regulators in addressing existing conflicts with the permitting and use of decentralized systems. This work is intended to accomplish the following objectives.

- Promote the rationalization of regulations across political boundaries with performance- and science-based code provisions.
- Establish an efficient method with which to evaluate and deploy new onsite wastewater treatment processes.
- Create a methodology to integrate decentralized wastewater treatment standard setting mechanisms within the USEPA Total Maximum Daily Load (TMDL) program.
- Advance the professionalism of industry participants through education, training, and certification.

Those involved in this process represented all geographic regions of North America, and the regulatory, service, and manufacturing segments of the industry. Funding for this effort was provided by self-funded volunteers, grants from USEPA, and contributions from business, industry, and state onsite associations. For more information, go to: *http://www.model-code.org/*

Recommended Actions

To USEPA and the Research Community:

- Fund and conduct demonstration projects to test the applicability of the various management models described in USEPA's *National Guidelines for Management of Onsite and Cluster (Decentralized) Wastewater Treatment Systems* (EPA 832-B-03-001) within a wide range of hydrogeologic and institutional settings (e.g., economic, legal, administrative, regulatory), including utilities that would install, manage, operate, and monitor performance-based septic systems located in areas of high-priority aquifers.
- Commission additional research regarding onsite system residuals, including emerging/unregulated contaminants such as pharmaceuticals, and the extent to which they are migrating to ground water, and compile and evaluate the latest advances in onsite wastewater treatment science and technology.

To USGS and State Geological Surveys:

- Conduct additional hydrogeologic and aquifer-vulnerability mapping at a scale that allows use by local and state governments for the purpose of siting onsite wastewater treatment systems and determining the need for advanced treatment for specific contaminants, including unregulated contaminants and pharmaceuticals and personal-care products.

To State and Local Agencies:

- Develop coordination protocols among all potentially involved agencies to promote more consistent regulatory oversight of both domestic and commercial onsite wastewater treatment systems.
- Encourage effective septic system siting, installation, inspection, and maintenance as described in USEPA's *National Guidelines for Management of Onsite and Cluster (Decentralized) Wastewater Treatment Systems,* and recommend that communities use one or more of the management models described in the guidelines.

To Homeowners:

- Operate your waste-disposal system according to recommended practices.
- Maintain your system on a regular schedule.
- If you sell your home, inform the new owner about your septic system and share maintenance records.

Section 8 References: Ground Water and Onsite Wastewater Treatment Systems

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A newly installed septic tank at a lake-side cabin. The tank has been installed in a hillside, which requires tall and short access points to facilitate periodic inspection and maintenance and accommodate slope.