Where Sheep Do Quietly Graze

Innovative Wastewater Treatment in the Great Northwest

STAFF WRITER
Natalie Eddy

Elkton, population 180, is a small hamlet in southwestern Oregon, nestled on the banks of the Umpqua River. Life in Elkton, according to the city manager, is relatively simple and easy. And their choice of a recirculating sand filter to treat the city's wastewater fits their lifestyle—the drainfield is a sheep meadow.

"It works perfectly for us," said Linda Higgins, city manager for the past 17 years. "We are very happy with it. It's pretty much maintenance free, works well with our public works schedule, and falls within our income guidelines. It fits us to a T."

The recirculating sand filter system provides treatment for the entire community, including 16 businesses, two schools, three restaurants, a recreational vehicle (RV) park, several churches, and 66 residences.

Ten years ago, Elkton had a problem with failing septic systems polluting the groundwater and threatening the river. "There were just individual septic systems. Some people just had 55-gallon drums in the ground," she said. "Things were really terrible."

The problem of failing septic systems had been ongoing for many years. The city adopted new setback regulations in the early 1980s to combat the problems caused by failing septic systems. With the new setback requirements, however, came a new problem: no one could build on the lots because of space limitations. City officials realized that without adequate wastewater treatment, any future development was jeopardized.

The river is an important part of the community, so its protection also was a priority. Higgins said that the river is used mostly for recreational activities, such as fishing, boating, and swimming. In addition, the city now gets its water supply from it.

Although the water quality of the river was never tested, Higgins said contamination of the river was likely and a great concern to many at the time. "I am sure it was polluted at some point," she said. "But I think the problem of not being able to build any new housing or replace what you have was the driving force behind us taking action."

The Choice Was Easy

Higgins said the choice for the wastewater treatment system was relatively easy. "It was suggested by our engineer because of the size of the community and the fact that we have no trained personnel," said Higgins.

Higgins said since Elkton is so small, it only employs one part-time maintenance worker for three hours per day. In those three hours, the worker is able to take care of the water system, the streets, the community building, and the sewer system.

Higgins said they did not have to persuade the public that a wastewater system was necessary. "Everyone was in favor of installing the system," she said. "It was a needed thing for Elkton. And this system is pretty much maintenance-free."

Another plus for the recirculating sand filter system was the significantly lower installation cost compared to other options. Orenco Systems Inc. of Sutherlin, Oregon, provided design assistance

Photo by Rhonda Zosel

Sheep graze atop Elkton, Oregon's community drainfield. Elkton's elementary school is in the background. The meadow is safe for use by the public (and the sheep).

and equipment for Elkton's system and continues to provide lab services.

How the System Works

Wastewater is pretreated and screened in individual septic tanks. One-third of these are septic tank effluent gravity (STEG) units with the remaining two-thirds using septic tank effluent pump (STEP) units to move effluent from the septic tanks to the central recirculating sand filter system.

From the septic tanks, effluent is transported by an effluent sewer collection system to the recirculating sand filter and drainfield for final treatment and dispersal. After passing through the filter media, recirculated effluent enters the flow-splitter, which returns 80 percent to the recirculation tank and sends 20 percent to the drainfield. A float switch in the recirculation tank signals the solenoid valve to close during low-flow periods, and 100 percent of the flow recirculates.

Final disposal of the treated wastewater takes place in 11,000 linear feet of trench, dosed by three, one-half-horsepower pumps. The disposal system is divided into 12 zones and is dosed sequentially.

Higgins said the 60 by 120-foot recirculating sand filter is designed to treat approximately 30,000 gallons per day. The wastewater entering the sand filter averages 141 milligrams per liter (mg/L) BOD (biochemical oxygen demand) and 32 mg/L TSS (total suspended solids). The treated sand filter effluent, which is dosed to the drainfield, has averages of 6 mg/L BOD and 6 mg/L TSS.

City officials realized that without adequate wastewater treatment, any future development was jeopardized.

Show Me the Money

Total installation cost of the system was nearly $960,000, according to Higgins. Approximately 70 percent of the funding came from a grant from the Rural Economic Development Association (REDA), then known as the Farmer's Home Administration. The remaining 30 percent was funded through a loan from the REDA, which is being paid back through user fees, Higgins said.

According to the 1990 Census Report, more than 40 percent of Elkton's residents are retired. Median household income in 1990 was $22,000, making low operating costs important, according to Higgins.

There is a $400 sewer connection fee, and residents pay $20 a month for the first 5,000 gallons of water and 60 cents per thousand gallons for additional usage. Usage is based on average use from October to March. Higgins said that allows people to feel free to water their lawns and gardens in the summer months. The school, RV park, and largest restaurant have the highest monthly bills, averaging $175 per month.

Oregon's property tax system is primarily a

Photo courtesy of Oreco Systems, Inc.

Aerial view of Elkton's recirculating sand filter system

rate-based system with a limit on assessed value. Higgins said Elkton's property tax base is $15,000, which significantly limits their operating budget.

Operation and Maintenance

Higgins said the small amount of time allotted for the city worker has proved to be more than adequate to keep the wastewater treatment system running smoothly.

Terry Bounds, Orenco's excecutive vice president and one of the system's designers, agrees. "We have been monitoring the progress of Elkton's system for 10 years. On average, there are fewer than four service calls per year, and some years there are none.

"Most of the limited maintenance time is spent on the recirculating sand filter. It consists of daily readings of flow meters, elapsed time meters, counters, and monitoring of the seven pumps. It even includes weeding of the sand filter. And the system has been performing extremely well," Bounds said. "The residential septic tanks were monitored for sludge and scum accumulation after six years, and to date, not one has required pumping."

Hidden in Plain View

While location is everything in real estate, with this recirculating sand filter, location is not a big problem. "Our wastewater treatment system is not like many other towns' systems," Higgins said. "It's located right behind the elementary school, next to the school's playing field, and you would never know it. The sheep run on the drainfield."

According to Bounds, the drainfield is "completely safe, both for the public and for the sheep, and is used to grow grass for grazing." He added that the field is surrounded by a low sheep fence, and the sheep do no damage to the drainfield.

"The subsurface dispersal system was intentionally buried lower than it needed to be so that it would be below plowing level. The farmer plows the field, provides supplemental irrigation with river water, and keeps the field mowed," Bounds said.

For additional information, contact Higgins at (541) 584-2547 or Bounds at (800) 348-9843, extension 218. SF

Vacuum Sewer Technology Comes of Age

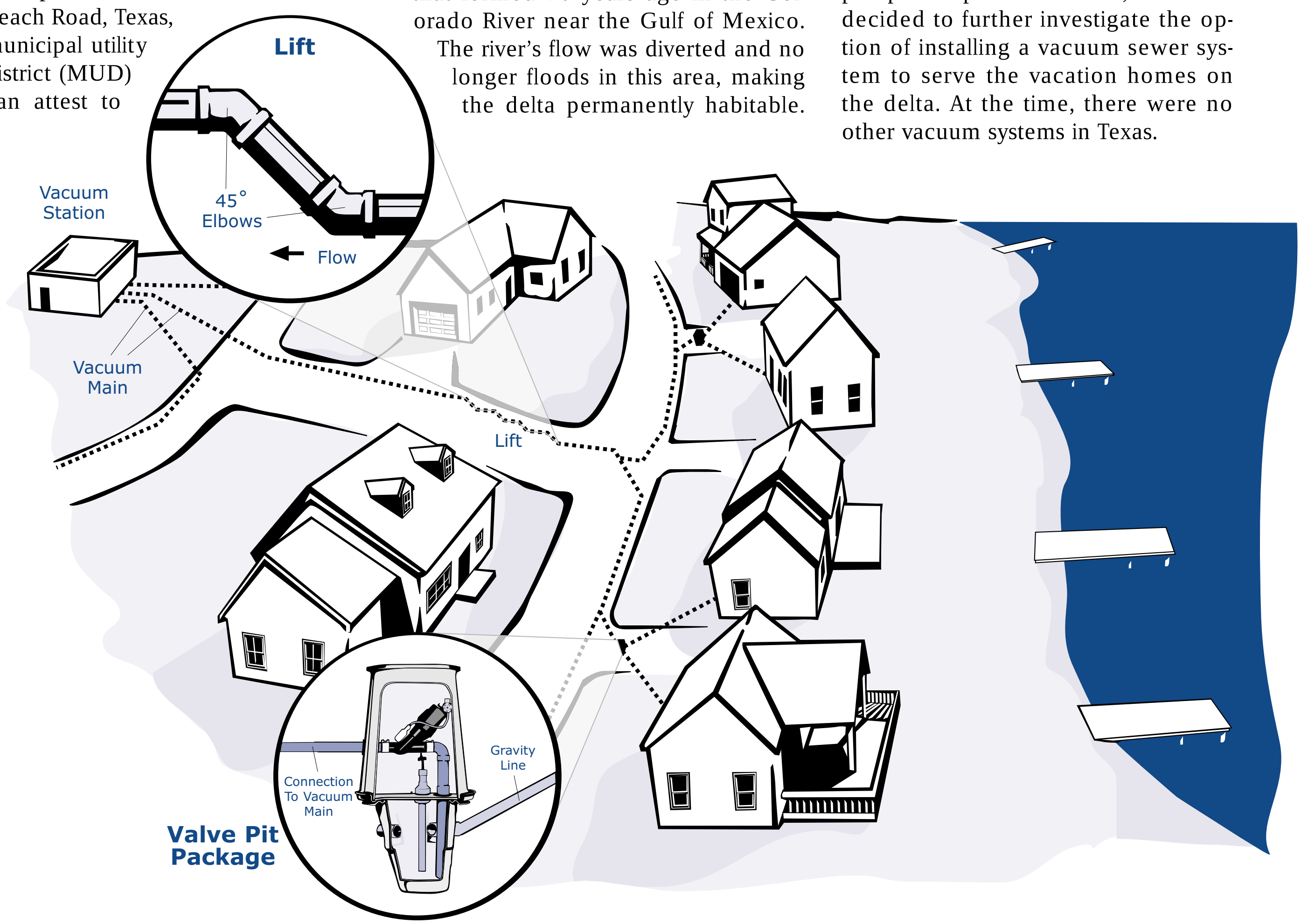
SFQ ASSOCIATE EDITOR
Cathleen Falvey

Editors Note: This is the first of a series of articles that will focus on alternative wastewater collection systems (sewers) for small communities.

Life in a vacation community isn't always simple and carefree. Jim Gann, former president of the Beach Road, Texas, municipal utility district (MUD) can attest to this fact. In 1991, he and his neighbors began the difficult task of evaluating different wastewater collection and treatment systems to replace failing septic systems in their tiny resort town.

The community of Beach Road is located near Matagorda, Texas, on a delta that formed 70 years ago in the Colorado River near the Gulf of Mexico. The river's flow was diverted and no longer floods in this area, making the delta permanently habitable. However, the delta is located in an environmentally sensitive area and at an elevation of only one to four feet above sea level, which severely limits the community's wastewater options.

After looking at different collection system technologies, including grinder pumps and pressure sewers, the MUD decided to further investigate the option of installing a vacuum sewer system to serve the vacation homes on the delta. At the time, there were no other vacuum systems in Texas.



"Vacuum sewers looked great to us on paper, but we felt that they were an unknown, unproven technology," said Gann. "We needed to find out more about how well the systems actually worked before making a decision."

The MUD's board members decided to research their vacuum system by requesting a complete client list from the manufacturer, developing a questionnaire, and sending it to every community on the list. The survey asked for basic information about the age and performance of the systems, and whether the communities would install vacuum sewers again if given the choice. The responses were overwhelmingly favorable.

"Almost every community that responded to the survey was happy with its vacuum system," said Gann. "We also got great advice from the communities. For example, we knew it was important to take great care designing the system, selecting the contractor, and providing oversight during installation."

Beach Road MUD installed their vacuum system in 1996. According to Gann, residents are "just happy that they don't have any more sewage problems."

Photos courtesy of Beach Road M.U.D.

Photos above show the Beach Road Municipal Utility District's (MUD) ground-breaking ceremony for the new vacuum sewer system and vacuum station building.

Vacuum Technology Advances

Vacuum sewer technology has advanced considerably over the years and in the ten years since the Beach Road MUD first investigated their system.

Although they were first patented in 1888 and have been used for commercial applications since 1959, vacuum sewers are still considered by many to be a new or experimental technology. But this view is rapidly changing.

Today, there are approximately 200 municipal vacuum systems operating in the U.S. alone, and there are many systems in Germany, France, Australia, and other countries around the world. The technology has improved as its application has expanded.

Early vacuum systems often had problems due to such factors as improperly planned vacuum main profiles, too-large liquid slug volumes, and the lack of full understanding of system hydraulics. These early problems forced the industry to pursue design and component improvements and develop operation and maintenance guidelines. System performance improved, and energy requirements for operation were reduced (Smith, 1999).

Vacuum sewers are gradually entering into the mainstream as more communities recognize them to be a reliable, environmentally safe, and cost-effective alternative to conventional gravity sewer systems.

Which Communities Should Consider a Vacuum System?

Traditionally, vacuum sewers have been viewed as a small community technology. They are practical for use in low-lying areas, such as in lakeside or coastal communities, or in areas with very flat or variable grade where the cost of constructing gravity sewers would be prohibitive. They also are a good option for areas with high groundwater, bedrock, or other subsurface difficulties. Any community considering centralized collection and treatment should investigate a vacuum system as an option.

Although the majority of vacuum systems are located in small communities, some large communities use them as well. A portion of Albuquerque, New Mexico's, residents are on vacuum sewers. Other large systems include Sanford, Florida, with approximately 2,000 connections, and Ocean Shores, Washington, with 12,000 connections.

The city of Sanford chose vacuum sewers for a portion of the city to separate combined sewers that were overflowing into Lake Monroe. Factors that contributed to their decision to install vacuum sewers in this particular area were the condition of the streets, the small lot sizes, the large number of other utilities present in the alleyways, and lack of hydraulic gradient. The streets were made of brick, which would make a conventional construction project more expensive (CPH Engineers, 1990).

Because vacuum sewers employ narrow pipes buried in shallow trenches and do not depend on gravity to transport sewage, less extensive excavation is necessary for their installation. Engineers also can more easily adapt the configuration of the sewer lines to accommodate unforeseen obstacles and tight spaces.

In addition, vacuum systems are entirely enclosed systems. They have no manholes and operate under negative pressure. Both these factors greatly minimize inflow, infiltration, and exfiltration—problems common in conventional gravity sewers. For these reasons, vacuum sewers are often an option for environmentally sensitive areas.

How Vacuum Systems Work

Vacuum systems generally consist of three major components, the valve pit package (also called the service), the piping network, and the vacuum station. (Refer to the illustration on page 32.) Design and system components vary from manufacturer to manufacturer and occasionally are adapted for specific applications.

Because Airvac, Inc., has manufactured almost all of the vacuum systems currently operating in the U.S., for practical purposes, the following discussion about system components and operation is based on their proprietary design. In no way is this meant to be an endorsement of this particular system. (A list of the three companies that manufacture vacuum systems or have sales representatives working in the U.S. is provided on page 35.)

The Valve Pit Package

Typically, vacuum systems are designed so that sewage from individual homes flows through gravity lines to a buried, sealed collection sump, which is part of the valve pit package. Depending on the manufacturer, valve pits may serve one home or two or more homes.

Components of the valve pit design most commonly used in the U.S. include a sewage holding sump, a pit bottom, a valve pit that contains a three-inch vacuum interface valve, an in-sump breather unit, and a cast-iron manhole cover. (Refer to the illustration on

Photos Courtesy of Airvac, Inc.

The vacuum station for Beach Road MUD's vacuum system is the same as pictured above. The photos at left show construction of the vacuum station building, the station arriving at the community on skids, and the station being lowered into the building.

page 32.) The three-inch valve size is adequate for conveying diapers and the oversized items typically flushed down a toilet by mistake without clogging the system. (Some state standards suggest a minimum three-inch valve size.)

When 10 gallons of raw sewage accumulate in the sump, air trapped in the empty two-inch diameter sensor pipe pushes on a diaphragm in the valve's controller sensor unit to provide a signal to the valve to open. The vacuum interface valve automatically opens, and the sewage is sucked out of the sump.

Differential air pressure propels the sewage through the valve into the vacuum sewer network. The vacuum interface valve is pneumatically controlled and operated so no electricity is needed in the valve pit. The atmospheric air needed for sewage transport enters through a screened air intake on the homeowner's gravity line.

The Sewer Network

The vacuum sewer mains are four-inch, six-inch, or eight-inch polyvinyl chloride (PVC) pipes laid in shallow, narrow trenches. PVC pressure fittings are used for directional changes and for the crossover connections from the service lines to the main line. Lifts or vertical profile changes are used for uphill transport. A "saw-tooth" configuration typically is employed to provide lift to the flow, keep sewer lines shallow, and prevent the sewage from blocking pipes during low-flow periods. (The detail of a "lift" in the graphic on page 32 illustrates the saw-tooth profile.)

During low-flow periods, sewage lies at the lower areas of the pipes in the saw-tooth layout until more valves in the system open. As valves open and air enters the system, atmospheric pressure is admitted to the piping network, which is under negative pressure. The resulting pressure differential propels the sewage toward the vacuum station.

Sewage velocities of 15 to 18 feet per second in vacuum systems scour the piping and keep it free of obstruction. Because of this velocity and the saw-tooth configuration, flow in vacuum sewers can be uphill although there are limits to the amount of lift possible. The practical limit of uphill transport in vacuum systems historically has been 15 to 20 ft (4.5 to 6 m), although systems requiring higher lifts are being tested (EPA, 1991). Lift stations may be necessary for steep grades, adding to the cost of systems in these areas.

The Vacuum Station

The third component of a vacuum system is the vacuum station. One manufacturer prefabricates the vacuum station and ships it to the community on skids. The community must provide a facility to house the station. The vacuum station functions and has components similar to a lift station in a gravity system with the addition of the vacuum pump, which creates the negative pressure in the system.

Vacuum stations contain an enclosed collection tank, sewage pump, vacuum pump, and electrical controls. When the collection tank fills to a predetermined level, a sewage pump conveys the sewage from the station to treatment and disposal (Airvac, 1998).

Computer programs are available from manufacturers to help engineers design vacuum systems for specific applications. Manufacturer representatives also take an active part in project planning and design and overseeing construction and installation of the systems.

Operation and Maintenance

Vacuum systems have the somewhat undeserved reputation of having intensive operation and maintenance requirements. However, they do require a well-trained, part-time or full-time operator, depending on the size of the system. Therefore, operation and maintenance costs for a vacuum system may be higher than for some conventional gravity sewer systems. Reduced construction costs sometimes offset costs for system operation and maintenance.

One advantage of vacuum systems is that malfunctions usually are noticed and addressed rather quickly by the operator. This is in contrast to conventional sewer systems in which major inflow and infiltration problems can go undetected for years, resulting in backups, collapsed streets, and expensive repair projects.

Vacuum system manufacturers offer extensive operator training and provide equipment manuals. Some communities may have the option of contracting with local manufacturer representatives for system operation and maintenance.

Operators must know how to troubleshoot systems. On a daily basis, they should visually check the gauges and charts, record pump run times, and check the oil and vacuum station controls. They must regularly perform preventive maintenance on the systems, such as inspecting and testing division valves, vacuum valves, and alarms, and inspecting vacuum and sewage pumps for wear.

Vacuum valve malfunctions do sometimes occur. If a valve fails in the open position (the most common occurrence), problems will be evident by reduced vacuum conditions in the system. Operators learn how to locate the valve by observing and isolating different parts of the system. Manufacturers provide information for valve troubleshooting and servicing, and some valves can be manually cycled and tested by the operator. Some valves are designed to be partially unscrewed if an object were to become lodged in them.

Valves that fail in the closed position can cause system backups and usually are immediately detected when homeowners call for service.

Beach Road MUD learned the importance of hiring a good operator early on. Gann recommends having the plant operator attend the manufacturer's training school and be on-hand during construction as a member of the construction team.

"The operator should be solely dedicated to the project initially, until the system has operated for at least one year," Gann said. "During this period, start-up problems can be worked through, and owners can become familiar with their systems."

Gann also recommends educating system owners. "Some homeowners removed the system air vent from their backyards because they didn't know what it was for," said Gann. "After all, it's a new type of system. System owners need to be informed."

Vacuum System Advantages and Disadvantages

Some advantages of vacuum sewers for communities include the following:

- vacuum sewers reduce treatment costs by reducing or eliminating inflow and infiltration;
- no manholes are necessary;
- field changes in system configuration can be made easily as unforeseen underground obstacles are encountered;
- shallow installation reduces project costs and environmental impact;
- high sewage transport velocities reduce the risk of blockages and keep wastewater aerated and mixed;
- the enclosed system eliminates odors, protects the environment, and minimizes health risks to operators;
- major leaks are detected and addressed immediately, which protects the environment and the community's infrastructure investment;
- only one source of power (at the vacuum station) is typically necessary; and
- exfiltration is eliminated.

Potential disadvantages of vacuum systems include the following:

- the amount of lift possible is limited in steeply graded areas;
- are generally not cost-effective for fewer than 50 connections;
- may have difficulty accepting very large flows of 120 gallons per minute or more at a single connection;
- a site and facility is required to house the vacuum station; and
- a full- or part-time operator is required (Smith, 1999).

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Manufacturers

The following three companies manufacture systems or have sales representatives working in the U.S.

Airvac, Inc.
4217 North Old U.S. 31
P.O. Box 528
Rochester, Indiana 46975
Phone: (219) 223-3980
www.airvac.com

Iseki Utilities Services, Inc.
Avonbrook House
Masons Road
Stratford-upon-Avon
WAR CV37 9LQ
England
Phone: 44 1789 292436
www.iseki-vacuum.com

Roediger Pittsburgh, Inc.
3812 Rt. 8
Allison Park, Pennsylvania 15101
Phone: (412) 487-6010
www.roediger.com

Costs

Capital costs for vacuum systems vary depending on site conditions and manufacturers' prices. The installed cost of vacuum sewer mains is very site specific but may be as much as 60 percent lower than gravity mains and 10 percent higher than pressure sewer mains. Valve pits range from $2,500 to $3,500 installed. Two homes typically share one valve pit, making the cost per home $1,250 to $1,750.

The cost of vacuum stations range from $200,000 to $450,000 and serve from 50 to 1,500 homes. Larger stations benefit from economies of scale and may cost as little as $300 per home. The smallest vacuum stations may cost up to $4,000 per home.

Overall, vacuum systems range from $2,500 to $7,500 per connection (Smith, 1999).

The low costs for equipment and installation are advantages of vacuum sewer systems. However, communities must consider whether these initial savings in capital costs are offset by operation and maintenance costs over the life of the system. A detailed discussion of vacuum system life-cycle costs and strategies for estimating costs are offered in the EPA manual *Alternative Wastewater Collection Systems* (EPA, 1991).

For More Information

In addition, the National Small Flows Clearinghouse (NSFC) offers several documents on vacuum sewers, including the items mentioned in the references listed below and in the list of NSFC products beginning on page 57. When requesting materials from the NSFC, please be sure to refer to them by both title and product number.

Communities also should contact vacuum system manufacturers directly to request more information about their systems and to obtain a complete list of communities using these systems. SF

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Vacuum Collection Systems. 1998. Omni Productions for Airvac, Inc. Videocassette.

Practical Pointers
for Onsite System Inspectors

CONTRIBUTING WRITER
Patricia Miller, Ph.D.

Across the U.S., inspection of existing septic systems is becoming increasingly more common and more important in onsite wastewater management programs. If you are an onsite system inspector, you face certain legal, regulatory, and procedural concerns in addition to the many technical issues involved in the practice of evaluating onsite systems. Although these concerns will vary from place to place depending on local codes and practices, I have attempted to list the important ones here.

Onsite system inspectors need to be aware of legal issues in advance to avoid lawsuits, penalties, or loss of certification, and to maintain good relationships with the client and the code officer. To this end, this column includes some questions you should ask your local code officer and your lawyer.

Follow Contracts Carefully

A major source of legal disputes in some states involves completion of work stated in the contract for an inspection. If you state in a contract that you will perform certain inspection procedures (e.g., pump and inspect the inside of a septic tank), make sure that you do so. Do not make statements or record information about any parts of a site or system that you have not actually observed.

Before preparing any contracts, consult with your lawyer about appropriate procedures for sites where part or all of a system is inaccessible for inspection (e.g., vicious dog in the yard or patio built over septic tank access).

Check Local Codes! Check Local Codes!

You cannot overstate the importance of checking local onsite system codes. Questions you should ask your local code officer include the following:

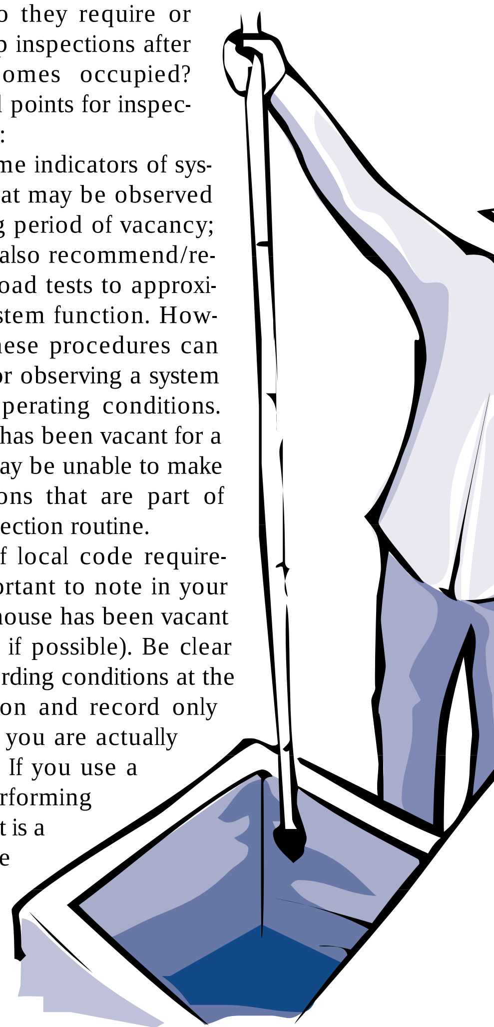
- Who is authorized to conduct inspections? (Engineers? Sanitarians? Private inspectors?)
- Are there any restrictions on who performs certain procedures or levels of inspections? (Load tests or soils evaluation may require certain designated experts. Your codes may require that sand filters, aerobic treatment units, or other advanced treatment systems be inspected only by an engineer, or that a certified inspector complete additional specialized training before inspecting these systems.)
- What are the certification requirements? Are there specific local requirements? Are there state or national programs (e.g., National Association of Waste Transporter [NAWT] or NSF International) that your locality accepts? Are training courses, exams, and/or spot field checks by a code officer required? Must you meet certain required standards for insurance coverage to obtain certification? Are there requirements for continuing education or recertification?

Check Requirements for Long-Vacant Homes

Local codes may require or recommend specific procedures for inspecting systems at residences that have been vacant for a long time. For example, do they require or suggest follow-up inspections after the house becomes occupied? There are several points for inspectors to note here:

There are some indicators of system problems that may be observed even after a long period of vacancy; some programs also recommend/require hydraulic load tests to approximate normal system function. However, none of these procedures can truly substitute for observing a system under normal operating conditions. For a house that has been vacant for a long time, you may be unable to make many observations that are part of your normal inspection routine.

Regardless of local code requirements, it is important to note in your reports that the house has been vacant (note how long, if possible). Be clear that you are recording conditions at the time of inspection and record only those items that you are actually able to observe. If you use a checklist in performing your inspection, it is a good idea to note "not observed" for any item



you were unable to observe.

Check with your code office and your lawyer beforehand about what to do if, during an inspection of a long-vacant house, you observe so little that you feel uncomfortable making an evaluation.

Know Your Role as Inspector

What do your local codes say about the inspector's responsibility for observations, judgments, and recommendations? Find out if your codes specifically require or prohibit the following from the inspector:

- observations of obvious problems,
- warnings of potential problems,
- recommendations for further evaluation,
- recommendations for preventive maintenance, and
- cautions regarding changes from current wastewater loadings or household habits.

In addition, it is important for inspectors to know whose role it is to state whether a septic system is acceptable/conditional/unacceptable, or satisfactory/unsatisfactory. Is the inspector expected to identify a "failed" system, and, if so, how does the local code define "failure"? Even if you cannot pronounce a system "failed," are you expected to report certain signs of failure or factors leading to failure? What is your role and responsibility in recommending corrective measures?

These issues vary widely among local codes, and it is important to clarify your legal role and responsibilities. For instance, in some localities, the inspector is expected to make observations about the condition of the system, judge whether the system is satisfactory or unsatisfactory, and recommend corrective measures if needed. In other jurisdictions, the inspector is required to make detailed observations about the system, but the local environmental health officer determines "pass-fail" and necessary corrections.

What If Systems Require Repair?

Special questions apply to systems needing repair. Are repair permits required, and, if so, are they required for any repairs or only for specific major repairs? For many minor repairs (e.g., replacing a broken tee), you may feel that you can save the homeowner time and money by doing the repair at the time of inspection. However, you should determine beforehand if such repairs are considered a conflict of interest, or if your locality has a list of minor repairs considered acceptable at the time of inspection. If minor repairs are allowed, determine if you need any special permission (such as a phone call to the local health department) and if you must follow specific reporting procedures about the repair.

You should know how your locality addresses systems that are in acceptable condition but do not meet current codes. Do you make this judgment or does a local health official? Can the system be left as is? If so, must you provide cautions about a "noncompliant" system? Or must the system be upgraded to current code? How do you inspect and report on cesspools, drywells, privies, or other systems that may be completely outlawed by modern codes?

Know Your Liabilities and Protect Yourself

Inspectors should be aware how liability is divided among the parties involved in an inspection (i.e., the inspector, regulatory agency, seller, buyer, etc.). What are your particular liabilities? Is liability insurance required or recommended?

In addition, it is wise to develop a quality assurance/quality control protocol for your inspection business. This documented procedure can be invaluable in the event of audits or legal proceedings.

Local requirements for reporting will vary. You should know if you are required to submit a checklist, a written report, or both. Are there specific forms that you must use and/or certain information that you must include? Who should receive copies of the report? If you must report inspection results to a local agency, what are the required time frames and deadlines?

There are several other documents that may clearly define your responsibilities to the client and may be useful in the event of a legal dispute. If the documents are required by local code, your code officer may have certain forms that you must use or information that must be included in your own forms. If they are not required by local code, you may want to consult your lawyer or professional organization regarding format and use of these documents:

- *Terms and Conditions and Scope of Services* commonly specifies terms, conditions, procedures used, and limitations of the inspection. If you are conducting the inspection as part of a regulatory requirement, reference the appropriate ordinance or code.
- *An Inspection Authorization Form* acknowledges that you will be on the property, conducting the procedures needed to complete an inspection (including any required excavations), for certain agreed costs. It should include access to the interior of the house as needed for inspection procedures. It may also include permission to disclose any records of past history and permission to contact any previous pumpers or inspectors.
- *Disclaimers* clarify that observations made are based on the condition of the system on the day of inspection and that no warranties are implied concerning future functioning of the system. They also may state that no evaluation will be attempted for parts of the system inaccessible at the time of inspection.

Because cultural, political, and financial factors vary among states, counties, towns, and watersheds, inspection programs may be tailored to meet local concerns. While this variation may seem frustrating and illogical to some in the technical community, it is important to remember that local acceptance of these programs is a critical step toward onsite system management. SF

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JURIED ARTICLE

A Survey of Home Aerobic Treatment Systems Operating in Six West Virginia Counties

CONTRIBUTING WRITERS

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ABSTRACT: This article summarizes the findings of a 1998 survey of ATU systems (home aerobic treatment unit plus chlorination) in West Virginia. ATU systems in six counties were evaluated to determine whether the units were meeting health and environmental regulations. Of the 419 ATUs examined, 85 were sampled for additional laboratory analyses, which included biochemical oxygen demand (BOD), total suspended solids (TSS), and fecal coliforms (FC). Approximately 150 units were tested for chlorine residual and turbidity. Data from the study will be used to guide state policy with regard to the monitoring of ATUs on existing sites and the permitting of ATUs for use in new construction sites.

Since 1983, home aerobic treatment units (ATUs) have been installed in many counties in West Virginia to correct existing septic system failures. These units are designed to aerobically treat domestic wastewater flows of 600 gallons per day (gpd) or less and employ chlorination as a final disinfection step. More than 4,000 ATUs that discharge into rivers, streams, and other surface water drainage areas have been installed in West Virginia. Approximately 800 new ATU installation permits are issued in the state each year.

Currently, the West Virginia Bureau of Public Health requires that every ATU "system" (treatment unit plus chlorination) meet the National Sanitation Foundation Standard 40 Class I standards (monthly average of 30 mg/L five-day biochemical oxygen demand [BOD_5] and 30 mg/day for total suspended solids [TSS]) (NSF, 1990) and the West Virginia state standard for chlorine disinfection (maintenance of 0.5 mg/L residual in the discharge) (WV DNR, 1991). However, it should be noted that tablet chlorinators are add-on devices on most ATUs and are not included in the NSF Class I Standard.

Included in the NSF standard is a requirement for a two-year operation and maintenance contract from the ATU distributor. After two years, the homeowner is responsible for ensuring maintenance is performed on the system. Despite this requirement, routine maintenance beyond the mandated two-year period may not always be performed.

This article summarizes the findings of a 1998 survey of ATUs in West Virginia. ATU systems in six counties were evaluated to determine whether the units were meeting health and environmental regulations. Most units were originally installed to replace failed systems. The type of unit installed varied by county according to the availability of distributors in that area.

OBJECTIVES

Of the 419 ATUs examined, 85 were sampled for additional laboratory analyses, which included BOD, TSS, and fecal coliforms (FC). Approximately 150 units were tested for chlorine residual and turbidity. The survey was performed by the Environmental Services and Training Division and the Environmental Microbiology Laboratory, both at West Virginia University (WVU), and six county health departments, and with assistance from the West Virginia Bureau of Public Health.

The project objectives were to survey existing ATUs for proper operation and maintenance and to determine the chemical and microbiological quality of their effluents. The following questions were considered:

- Are the West Virginia state requirements for disinfection of ATU effluents being met?

- After the two-year maintenance contract expires, are West Virginia ATU systems meeting state division of environmental protection discharge requirements?
- Should mandatory maintenance of ATUs be required beyond two years in West Virginia?
- How satisfied are homeowners with their ATUs?
- Could turbidity be used as an indicator of ATU failure?

Data from the study will be used to guide state policy with regard to the monitoring of ATUs on existing sites and the permitting of ATUs for use in new construction sites.

MATERIALS AND METHODS

ATU Selection

A full list of permits for ATUs in the West Virginia counties of Cabell, Kanawha, Lincoln, Jackson, Marion, and Monongalia was compiled. One hundred permits from each county were selected at random by the West Virginia Bureau of Public Health. All records were checked for completeness. Recently permitted units (i.e., those permitted less than one year before the survey) were excluded. Each set of 100 files was distributed to the appropriate county sanitarians who selected ATUs for inspection.

Field Inspections

Field inspections were performed on a total of 419 units by a National Onsite Demonstration Program (NODP) staff person in conjunction with a county sanitarian. The field inspection procedure began with an interview of the homeowner when possible. Homeowners were asked about their system, if it had malfunctioned, if they were pleased with it, and if it was still under service contract. Each ATU was inspected to determine if it was running, if pumping was needed, if operational problems were observed, and if the chlorinator was functional. Problems were noted on an inspection report. Typically, 12 to 15 systems were inspected per day.

Of the inspected ATUs, field measurements of residual chlorine and turbidity were performed on effluent from approximately 150 units. Effluent from 85 of these units was obtained for laboratory analyses (approximately 15 per county). In the absence of a detectable ATU discharge, the homeowner was asked to flush a toilet several times and run water through a tap prior to sample collection.

Following the collection and disposal of approximately 750 mL, triplicate samples (750 mL each) of ATU effluent water were aseptically collected in sterile one-liter Nalgene bottles containing three mL of 10 percent sodium thiosulfate. Samples were packed on ice in insulated coolers for immediate transportation to the WVU laboratory, then refrigerated. They were processed within 24 hours of their collection in the field and were equilibrated at room temperature for approximately 30 minutes prior to testing.

Total Suspended Solids (TSS)

TSS were determined according to state standard procedures (WV DNR, 1991). A dried glass filter disk (Gelman glass fiber disk) was weighed and used to filter a 50-mL sample. Following rinsing, the filter was dried overnight at 120°C and reweighed. Total suspended solids were calculated by difference in filter weights.

Fecal Coliforms (FC)

FC were enumerated according to *Standard Methods* (American Public Health Association, 1995). Samples were suspended in 0.1 percent peptone buffer, and passed through a 0.45 µm filter (Millipore). Samples were plated on Bacto mFC agar (Difco) and incubated in a water bath at 44.5°C for 24 hours. FC were enumerated as dark blue colonies forming on these plates. Plates with 20 to 60 but no more than 200 colony-forming units (CFUs) were countable. Phenol red mannitol broth was used to confirm that selected colonies were coliforms; those producing gas in this medium were considered positive.

Five-Day Biochemical Oxygen Demand (BOD_5)

BOD_5 was determined as described in *Standard Methods* (American Public Health Association, 1995). Samples (1, 5, or 10 mL) were added to standard BOD bottles (300 mL), which were then filled with aerated phosphate buffer solution, and incubated in an incubator at 25°C. Initial and five-day dissolved oxygen readings were determined using a Clark-style oxygen electrode (Orion model 97-08-00). BOD_5 was calculated using the following equation:

$$BOD_5 = (\text{initial DO} - \text{final DO}) / (\text{mL sample}/\text{total mL})$$

where: DO = dissolved oxygen

A mathematical correction to remove the contribution of chemical oxygen consumption by thiosulfate contained in the original sample collection bottles was employed.

Turbidity and Residual Chlorine

Turbidity was measured in the field using a Hach Pocket Turbidimeter, which allowed turbidity measurements ranging between 0 to 400 Nephelometric turbidity units (NTU). ATU effluent (5 mL) was collected in the sample cell, and a stable turbidity reading obtained. Cross-contamination between samples was avoided by cleaning the sample cell with Liqui-Nox detergent, sterile cotton swabs and distilled deionized water. Accuracy of the Hach Pocket Turbidimeter is ≤5 percent or ±0.1 NTU (whichever is greater) when calibrated using StablCal Standards. The resolution is 0.1 NTU below 100 NTU and 1 NTU from 100 to 400 NTU.

Residual chlorine in 25 mL of ATU effluent was determined colorimetrically (Hach model CN-80) using a Hach free and total chlorine kit. Between samples, glassware was cleaned as described above.

Survey

The 85 samples analyzed above were part of a larger study in which 419 ATU systems were examined in six counties. Inspectors attempted to complete a questionnaire for each of the 419 systems [1]. Homeowners, if present at the time of the visit, were given the opportunity to express their opinions and satisfaction or dissatisfaction with their ATU by answering a series of questions. These questions included rating the system, based on the homeowners satisfaction with the system, between 1 and 5 (1 being unsatisfied and 5 being very satisfied). Other questions determined how often the system had malfunctioned, how many times the system had been pumped, and explanations of malfunctions and dissatisfactions.

Data Analysis

All water samples were analyzed individually and the three replicate values were used to calculate means reported in the tables and figures. All statistical and regression analyses were performed using Microsoft Excel 97 and JMP 3.1.5 (SAS Institute Inc.).

RESULTS

The West Virginia Division of Environmental Protection's (WV DEP) Office of Water Resources (OWR) has proposed a new general permit for domestic sewage disposal systems that have design flows of 600 gpd or less and serve individual residences. This permit targets the installation of new ATUs and requires a concurrent maintenance contract for a period of five years. Owners of previously installed ATUs were required to carry a service contract for only two years and will be required to have perpetual maintenance in the future due to new guidelines adopted by the West Virginia Bureau of Public Health. The proposed discharge limitations of the new permit are summarized in table 1.

Because grab samples were used in the present study, ATUs whose effluent values exceeded 75 mg/L BOD_5, 75 mg/L TSS, and 500 FC/100mL were determined to be noncompliant. These "failure" limits are more generous than the NSF Standard 40 Class I standard (i.e., 60 mg/L BOD_5 and 100 mg/L TSS as maxima for individual grab samples). In addition, the NSF Class I standard requires no maximum value for FC.

Laboratory Analyses

Mean values were determined from three consecutive effluent samples from 85 ATUs for TSS, BOD_5, and FC as well as for turbidity and residual chlorine. Mean values were compared to limits established for individual grab samples (table 1). The percent exceeding the proposed limits are presented in table 2a with 92 percent exceeding the limit for grab samples in at least one parameter.

The percentage of sampled ATUs exceeding the proposed limits for TSS, FC, and BOD_5 are summarized in table 2a. Histograms representing the distribution of sample values for these measurements are summarized in figures 1 to 3. Table 2a shows that of the measured parameters, ATUs best met the guidelines for TSS. Only 27 percent of the samples measured exceeded the individual grab sample limit of 75 mg/L for TSS. Some of the higher TSS measurements were associated with unusual problems, such as the presence of insect larvae in the effluent.

ATUs were much less successful when evaluated by their ability to meet the limits established for FC and BOD_5. Grab sample limits were exceeded by 89 percent and 40 percent of ATUs for FC and BOD_5 measurements, respectively. Twenty-four percent of the BOD_5 values measured were similar in magnitude to those obtained from primary clarified effluent (Hench, 1997) and septic tank effluent values reported in EPA, 1980. Lack of sufficient primary settling, inadequate aeration of the activated sludge, and inadequate flocculation of microbial biomass after secondary treatment all could contribute to high BOD_5 values.

Currently, ATUs in West Virginia are required to be under a maintenance contract for the first two years (as per NSF Standard 40 Class I requirements). Despite the fact that they are maintained under ATU distributor contracts, table 2b indicates that only two of the 12 units sampled with age ≤ 2 years meet the proposed WV DEP guidelines.

Data indicating high numbers of FC bacteria are probably best explained by inadequate disinfection (chlorination) of the effluent stream. Data in table 3 show that most samples (62 of 85) had no appreciable residual chlorine in the effluent and inspection of the ATUs indicate that problems existed with the tablet chlorinators installed on many units. Of the 84 units field tested for chlorine residual, 74 percent of the units had no measurable chlorine residual. The remaining units had chlorine residual values ranging from 0.1 to 0.9 parts per million (ppm). Only three of the units had a measurable

Table 1

Proposed WV DEP/OWR Standard Discharge Limitations for ATUs

	Average Monthly	Maximum Daily	Maximum Individual Grab Sample
TSS	30mg/L	60 mg/L	75 mg/L
FC	200 per 100mL	400 per 100mL	500 per 100mL
BOD_5	30 mg/L	60 mg/L	75mg/L

Table 2a

Percentage of Measured Samples Exceeding Proposed WV DEP/OWR Limitations (n=85)*

	Average Monthly	Maximum Daily	Maximum Individual Grab Sample
TSS	48%	29%	27%
FC	93%	92%	89%
BOD_5	69%	46%	40%
Percentage exceeding one or more limitations	95%	94%	92%

*see table 1

Table 2b

Percentage of Measured Samples (age < 2 years) Exceeding Proposed WV DEP/OWR Limitations (n=12)*

	Average Monthly	Maximum Daily	Maximum Individual Grab Sample
TSS	25%	17%	8%
FC	83%	83%	83%
BOD_5	75%	58%	50%
Percentage exceeding one or more limitations	83%	83%	83%

*see table 1

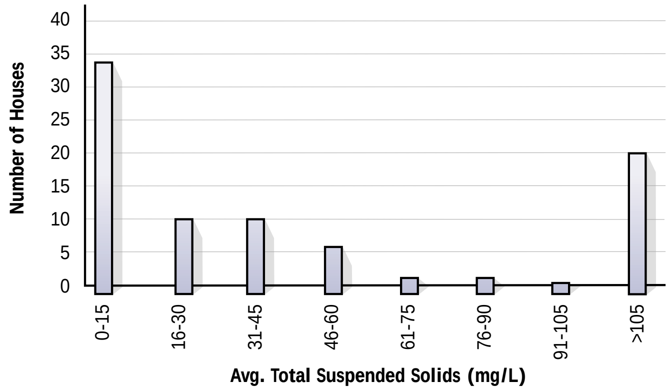

Figure 1

Average Total Suspended Solids (TSS)

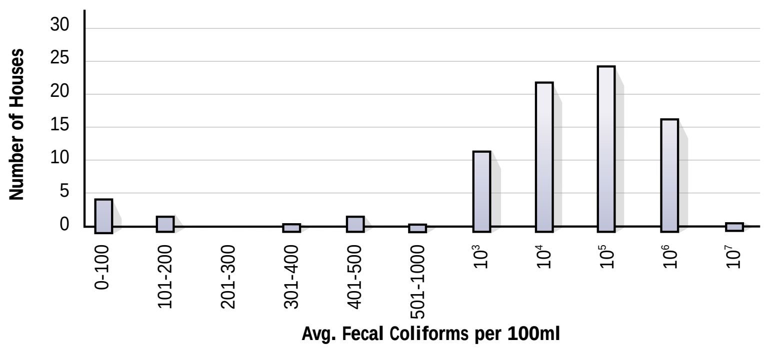

Figure 2

Average Fecal Coliforms (FC)

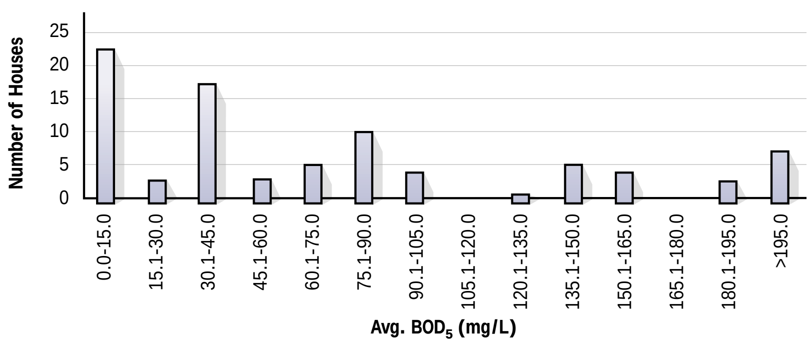

Figure 3

Average BOD_5

chlorine residual that met the state's 0.5 ppm standard. High BOD_5 in some units also could contribute to the low residual chlorine observed.

Turbidity was tested in the field on 84 of the 85 units sampled for laboratory analysis (table 4). Thirty-three percent had turbidity less than 25.0 NTU. Fifty-two percent of the units had a turbidity value less than 50.0 NTU. Fourteen percent of the units tested had a value greater than 200.0 NTU.

Attempts were made to determine whether this relatively simple measurement was predictive of other more difficult measures such as TSS, FC, and BOD_5 (figures 4, 5, 6). The coefficients of determination (r^2) demonstrate that only the natural logarithm (ln) of TSS showed a reasonable linear relationship to turbidity, and the sensitivity of that relationship is not sufficient to use for monitoring ATU effectiveness. Regression analysis also revealed no relationship between FC and BOD_5 (figure 7). Similarly, age of the ATUs was not predictive of any measured parameter (figures 8, 9, 10, 11).

Field Analyses

The 85 samples analyzed above were part of a larger survey in which 419 ATUs were field inspected in six counties. Inspectors measured residual chlorine and effluent turbidity and attempted to complete a questionnaire for each unit. Completeness of the information obtained varied according to the availability of the homeowner, accuracy of their records and/or recollections, accessibility of the ATU unit, and thoroughness of the inspector. Although the completeness of the information obtained was variable, some useful generalizations are suggested by the survey.

Chlorine residual was tested in the field on 149 units (table 5). Sixty-eight percent of the units had no chlorine residual. The remaining units (32 percent) had chlorine residuals; however,

Table 3

Chlorine Residual of Laboratory Samples

Description	# of Units	Percentage
Chlorine absent	62	74%
Chlorine present	22	26%
	n = 84	100%
Chlorine data not available	1	

Table 4

Turbidity of Laboratory Samples

Turbidity	# of Units	% of Values Reported
0.0–25.0	28	33%
25.1–50.0	16	19%
50.1–75.0	13	16%
75.1–100.0	6	7%
100.1–200.0	9	11%
>200.0	12	14%
	n = 84	100%
Turbidity data not available	1	

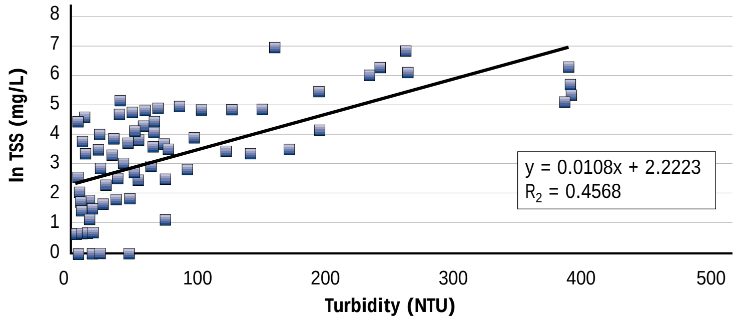

Figure 4

Turbidity vs. Natural Logarithm (ln) TSS

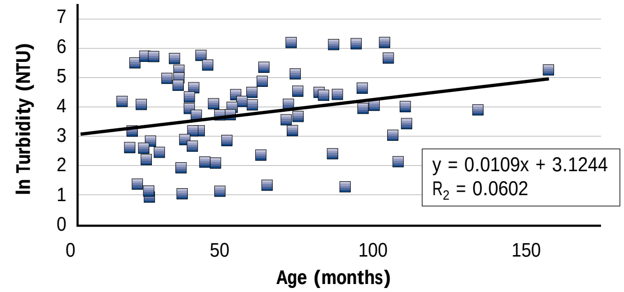

Figure 8

Age vs. Natural Logarithm (ln) Turbidity

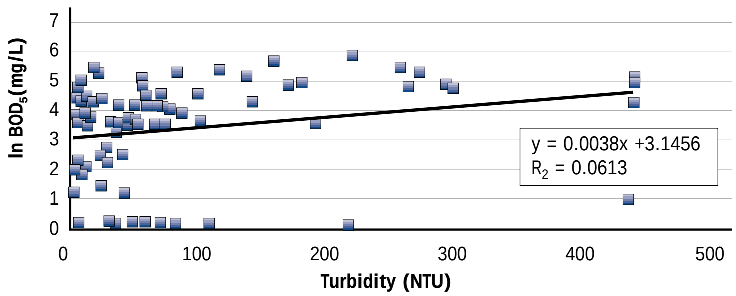

Figure 5

Turbidity vs. Natural Logarithm (ln) BOD_5

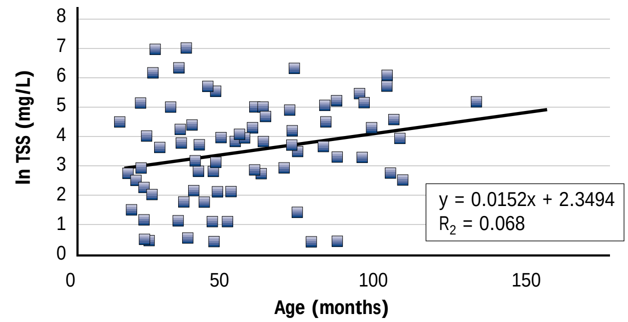

Figure 9

Age vs. Natural Logarithm (ln) Total Suspended Solids (TSS)

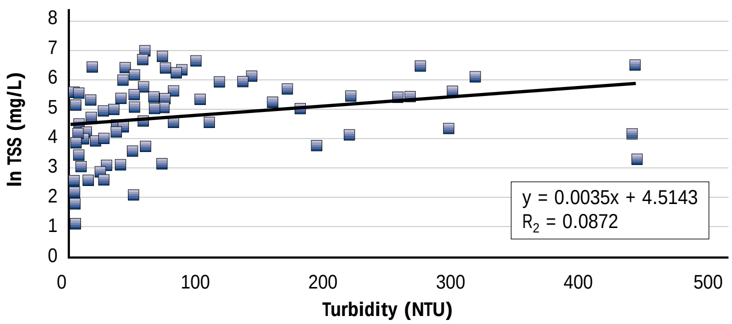

Figure 6

Turbidity vs. Log_{10} Fecal Coliforms (FC) per 100 mL

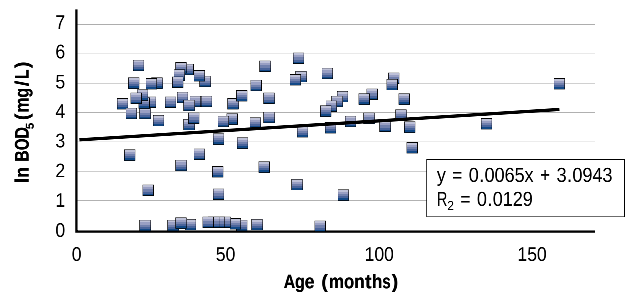

Figure 10

Age vs. Natural Logarithm (ln) BOD_5

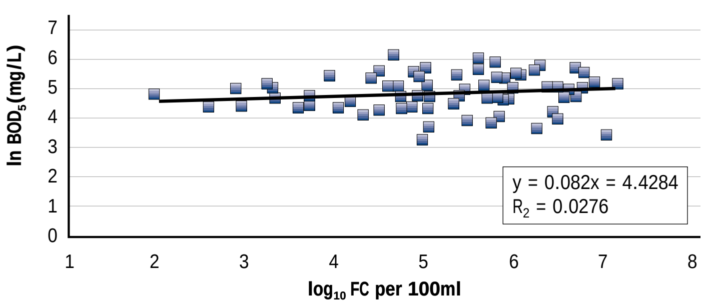

Figure 7

Log_{10} Fecal Coliforms (FC) vs. Natural Logarithm (ln) BOD_5

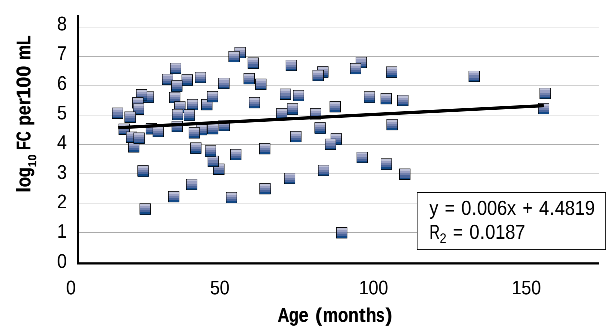

Figure 11

Age vs. Log_{10} Fecal Coliforms (FC)

Table 5

Chlorine Residual of All Units

Description	# of Units	Percentage
Chlorine absent	102	68%
Chlorine present	47	32%
Total ATUs	149	100%
Chlorine data not available	270	

Table 6

Turbidity of All Units

Turbidity	# of Units	% of Values Reported
0.0–25.0	54	37%
25.1–50.0	36	24%
50.1–75.0	16	11%
75.1–100.0	10	7%
100.1–200.0	18	12%
>200.0	14	9%
Total ATUs	184	100%
Turbidity data not available	271	

Table 7a

Total Maintenance Deficiencies*

Deficiencies	Field Data # of Units	Field Data Percentage	Lab Data # of Units	Lab Data Percentage
Units with a deficiency	272	65%	60	71%
Units with no deficiency	147	35%	25	29%
Total units	419	100%	85	100%

*Total Deficiencies = ATU maintenance deficiencies + chlorination deficiencies

Table 7b

Percentage of Laboratory Samples with or without Total Maintenance Deficiencies Exceeding Proposed WV DEP/OWR Grab Sample Limitations*

	% Exceeding Grab Sample Limits			
	TSS	FC	BOD_5	One or More Limit
Units with a deficiency	33	93	47	97
Units with no deficiency	12	80	24	80

*see table 1

only seven units had a value that met the state's 0.5 ppm standard.

Turbidity was tested in the field on 148 units (table 6). Thirty-seven percent had a turbidity value under 25 NTU. Over 61 percent of the units had a turbidity value under 50 NTU.

Relationships Between Maintenance/Chlorination Deficiencies and Grab Sample Standards

All 419 ATUs were inspected for a variety of total deficiencies, including ATU maintenance deficiencies and chlorination deficiencies. Inspectors examined for the following maintenance deficiencies:

- grounds (surface drainage, weeds, debris, access);
- unit controls (presence of a timer, warning device, overload protection, suitable wiring, access);
- waste stream pretreatment (type, size, condition);
- aeration compartment (aerator, blower/air line, roll; splash bowl, septic solids, odor, wiring/power);
- settling compartment (skimmer, tube settlers, outlet tee, floating solids, outlet weir, excessive scum);
- additional treatment (type, sand filter, polishing pond, modified wetlands); and
- effluent (clarity, odor, color).

Inspectors also examined ATUs for the following chlorination deficiencies:

- lack of stocked chlorine tablets,
- solids accumulation, and
- tablet drop failure (penciling, etc.).

The inspection form used on site to record these data is available from the National Onsite Demonstration Program [1].

Of the 419 units, field inspectors reported 272 units (65 percent) as having one or more total deficiencies, and 147 units (35 percent) as having no apparent deficiencies (table 7a). Of the 419 units inspected, 85 were sampled for laboratory analyses. A similar percentage of the 85 sampled units (71 percent) were identified as having one or more total deficiencies.

Using laboratory data, the percentage of units exceeding grab sample limits for TSS, FC, and BOD_5 was examined as a function of the presence/absence of total deficiencies (table 7b). ATUs with deficiencies always exhibited a higher percentage of units exceeding grab sample limitations (97 percent) when compared to units with no total deficiencies. However, a high number (80 percent) of units with no apparent deficiencies also exceeded acceptable effluent limits. FC counts were the most frequently in excess of the standard, followed by BOD_5 and TSS, respectively.

Table 8a

ATU Maintenance Deficiencies Identified by Inspectors

Maintenance Deficiencies	Field Data # of Units	Field Data Percentage	Lab Data # of Units	Lab Data Percentage
Maintenance deficiency	135	32%	34	40%
No maintenance deficiency	284	68%	51	60%
Total units	419	100%	85	100%

Table 8b

Percentage of Laboratory Samples with or without ATU Maintenance Deficiencies Exceeding Proposed WV DEP/OWR Grab Sample Limitations*

Maintenance Deficiencies	% Exceeding Grab Sample Limits TSS	BOD_5	TSS and /or BOD_5
Maintenance deficiency	41	59	71
No maintenance deficiency	18	27	31

*see table 1

Maintenance Deficiencies

ATU maintenance deficiencies were separated from chlorinator deficiencies because the same brand of ATU frequently employs different chlorinator designs. The following ATU maintenance deficiencies were included on the inspection form:

- access to the unit,
- surface drainage around and into the unit,
- weeds and debris around the unit,
- aerator malfunctions and blower/air line malfunctions,
- roll in the aeration chamber,
- septic solids/odor in the aeration chamber,
- wiring/power of the unit,
- access to the control panel,
- wiring/power to the control panel,
- floating solids in the settling compartment,
- excessive scum in the settling compartment, and
- clarity, color, and odor of the effluent.

Field inspectors reported that 135 units (32 percent) had one or more ATU maintenance deficiencies (table 8a), and 284 units (68 percent) had no identifiable ATU maintenance deficiency. The most common ATU deficiencies identified in the field were septic solids in the aeration chamber, aerator malfunctions, floating solids in the settling chamber, and odor of the effluent.

When maintenance deficiencies were present, a much larger percentage of units exceeded the proposed limitations for TSS (41 percent compared with 18 percent) and BOD_5 (59 percent compared with 27 percent) (table 8b). This suggests that regular maintenance would contribute to a significant performance improvement for the ATU. In addition, units with no maintenance deficiency exceeded TSS and/or BOD 31 percent of the time. This suggests that factors other than those indicated by the inspections may be contributing to failure. Further study is recommended to identify additional factors responsible for poor performance.

Chlorination Deficiencies

Field inspectors reported that 215 units (51 percent) had one or more ATU chlorination deficiencies and 204 units (49 percent) had no identifiable ATU chlorination deficiencies (table

Table 9a

Description of Chlorination Deficiencies

Chlorination Deficiencies	Field Data # of Units	Field Data Percentage	Lab Data # of Units	Lab Data Percentage
Chlorination deficiency	215	51%	48	56%
No chlorination deficiency	204	49%	37	44%
Total units	419	100%	85	100%

Table 9b

Percentage of Laboratory Samples with or without Chlorination Deficiencies Exceeding Proposed WV DEP/OWR Grab Sample Limitations*

	% Exceeding Grab Sample Limits TSS	FC	BOD_5	One or More Limits
Chlorination deficiency	29%	96%	46%	98%
No chlorination deficiency	24%	81%	32%	84%

*see table 1

Table 10

Chlorination Deficiency Types

Deficiency Description	Field Data # of Deficiencies	Field Data Percentage	Lab Data # of Deficiencies	Lab Data Percentage
Solids accumulation	46	19%	14	23%
Not stocked	95	39%	25	41%
Tablet drop failure	102	42%	22	36%
Total number of deficiencies*	243	100%	61	100%

*Some of the 215 total units with chlorination deficiencies showed more than one deficiency type.

9a). Access to the chlorinator could not always be obtained for various reasons. These units were not considered to have a chlorination deficiency because field inspectors did not clearly indicate how many chlorinators appeared to be working correctly. Thus, the actual percentage of chlorination deficiencies may be an underestimate (tables 9a, 9b, and 10).

FC limits were exceeded in 81 percent of sampled West Virginia ATU systems even when no chlorination deficiency was reported (table 9b). These data strongly suggest that current disinfection methods employed with West Virginia ATUs are inadequate and should be critically examined.

Three main chlorination deficiencies were included on the inspection. These were 1) solids accumulation in the chlorinator, 2) lack of stocking of chlorine tablets, and 3) tablet drop failure (chlorine tablets were not in contact with the effluent). Of the deficiencies that were reported, 42 percent were a result of tablet drop failure (table 10). Thirty-nine percent of the chlorination deficiencies were due to a lack of stocking of chlorine tablets. These two chlorination deficiencies accounted for more than 80 percent of the total chlorination deficiencies. The remaining 19 percent of chlorination deficiencies were due to solids accumulation in the chlorinator.

Other problems were encountered with chlorination, including soggy chlorine tablets, wrong type and size of chlorine tablets, broken and missing caps and chlorine feeder tubes, chlorine feeder tubes knocked over or misaligned, chlorinators off level, water bypassing the chlorinators, and no chlorinators at all. However, these problems were infrequent compared to the three main deficiencies.

Homeowner Satisfaction Interview

More than 200 homeowners responded to interview questions concerning the performance of their ATU system. Malfunctions reported included motor malfunctions, clogged filters, excessive hair buildup on aerator shafts, solids accumulation, excessive foam spilling from the unit, and odor problems. Some homeowners also expressed dissatisfaction in getting their systems serviced. Few West Virginia homeowners reported that they had their units pumped regularly. Despite these problems, the majority of homeowners (85 percent) reported being either "satisfied" or "very satisfied" with their ATU system (table 11).

Results of the present study suggest that many ATU systems produce effluents of unacceptable quality. Since the satisfaction of homeowners is high and the actual performance of the ATUs is comparatively low, public education of homeowners will be needed to make any changes in policies regulating ATUs.

Table 11

Owner Satisfaction

Response	# of Homeowners	% of Owners Responding
1 (unsatisfied)	5	2%
2	3	2%
3	23	11%
4	48	23%
5 (very satisfied)	127	62%
Total homeowners responding	206	100%

DISCUSSION

A recent Texas report (Blount, 1997) reported significantly different results from those obtained in the present study. In the Texas report, only a small range of units (1.5 to 7.8 percent) failed to comply with the Texas state regulations for BOD_5 and TSS of 65 mg/L. In this West Virginia study, 47 percent of the units exceeded limitations for BOD_5 or for TSS of 75 mg/L. West Virginia ATUs may have less pretreatment capacity than Texas ATUs, causing inadequate flow equalization and settling. Pretreatment tanks of 500 to 800 gallons are typically required in Texas but are not required in West Virginia.

A second significant difference is the amount of maintenance required by the two states. Texas requires quarterly maintenance including settleability and total solids field tests, as well as annual independent lab testing of all units. Texas ATUs are monitored, inspected, and maintained more frequently than those in West Virginia. By contrast, West Virginia requires only an initial two-year maintenance program in which the units receive maintenance twice a year for two years. Settleability and total solids testing is not routinely done in West Virginia on ATUs, even during the initial two-year maintenance period. The Texas report suggests that additional pretreatment and/or maintenance of West Virginia ATU systems is needed.

Cost may be a factor in the lack of maintenance of West Virginia ATUs. The cost of ATU operation and semiannual maintenance is estimated to be $27 per month in West Virginia. This includes the estimated cost of electricity to operate the unit at $10 per month and $17 per month for inspection visits and necessary pumping. If monitoring of units were to be required quarterly in West Virginia, the operational cost would likely increase to approximately $37 per month.

Nearly 90 percent of the West Virginia ATUs examined produced effluent of unacceptable sanitary quality as measured by FC counts. It appears that most units do not provide for adequate disinfection. Tablet chlorinators often were not stocked, or the tablet would get stuck in the tube and out of the effluent stream (tablet drop failure). Overall, very few tablet chlorinators worked properly and provided the required amount of free chlorine residual in the discharged effluent.

CONCLUSIONS

- Ninety-two percent of West Virginia ATU systems appear to be discharging effluent of unacceptable quality.
- Disinfection of effluent appears to be inadequate and must be improved to avoid potential public health threats.
- Maintenance problems with West Virginia ATU systems are common and safeguards to ensure effective continuous operation of the systems should be implemented.
- West Virginia ATU systems with no maintenance deficiency exceeded TSS and/or BOD_5 limits 31 percent of the time. This suggests that factors other than those indicated by the inspections may be contributing to failure. Further study is recommended to identify additional factors responsible for poor performance.
- The data suggest that mandatory lifetime maintenance should

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Mike Aiton works as a program coordinator for the National Onsite Demonstration Program at West Virginia University (WVU). During his 15-year tenure at the university, Mike has worked for the National Small Flows Clearinghouse and helped to establish the National Environmental Training Center for Small Communities. He also is pursuing his J.D. at WVU's College of Law.

Gary K. Bissonnette is a professor of environmental microbiology in the Division of Plant and Soil Sciences at West Virginia University. Dr. Bissonnette received M.S. and Ph.D. degrees from Montana State University. His research efforts focus on the microbiology of drinking water and wastewater, especially as related to the detection of microorganisms of public health significance.

Kelly Fleming (M.S.), Krista Kinneer (M.S.), Keith Hench, (Ph.D.), Todd Bozicevich (M.S.), Brian Cooley (M.S.), and Ed Winant (Ph.D.) of West Virginia University assisted the project in the lab, in the field, and with writing this report.

be required for West Virginia ATU systems.

- There is a pronounced difference between the positive public perception of West Virginia ATU systems effectiveness and their actual performance.

Because the satisfaction of homeowners is high and the actual performance of the West Virginia ATU systems is comparatively low, public education of homeowners will be needed to make any changes in policies regulating West Virginia ATUs.

Turbidity of effluent was not an acceptable indicator of compliance.

FC limits were exceeded in 81 percent of sampled West Virginia ATU systems even when no chlorination deficiency was reported (table 9b). These data strongly suggest that current disinfection methods employed with West Virginia ATUs are inadequate and should be critically examined.

NOTE

1. Copies of the questionnaire and onsite inspection form used in the West Virginia ATU survey can be obtained from the National Onsite Demonstration Program, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Or call (304) 293-4191 or (800) 624-8301.

ACKNOWLEDGEMENTS

The assistance of Cabell, Kanawha, Lincoln, Jackson, Marion, and Monongalia county health departments and the West Virginia Bureau of Public Health with survey development, field inspection, and sampling is gratefully acknowledged. The authors thank members of the ATU Survey Advisory Group and other reviewers for critically reading this report prior to publication. A full list of survey participants is available from the authors. Homeowners who took time to complete the ATU survey and allowed access to their units made this study possible.

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Author Guidelines for Juried Article Submissions

1. Manuscripts should be double-spaced and printed on 8.5 by 11-inch paper.
2. Manuscripts should be accompanied by an abstract of 150 words or less.
3. Authors are requested to follow the general style guidelines given in the *Chicago Manual of Style*, 14th Edition, or the ASAE *Guide for Refereed Publications, Monographs, and Textbooks* when preparing text, tables, and figures. The ASAE guide is available online at *http://www.asae.org/ pubs/style/*, or simply contact Cathleen Falvey, the juried articles editor, at (800) 624-8301, ext. 5526, for help and information.
4. Manuscripts that are prepared on a PC or Macintosh should be submitted in Microsoft Word, Word for Windows, WordPerfect, or ASCII format. Files should include (in this order) abstract, text, notes, references, and tables. Figures prepared on a computer should be submitted as separate files (*.tiff or *.eps) with accompanying "camera-ready" copy. A head-and-shoulders photo of each author is requested. Photographs should be sharp, glossy, black-and-white prints when possible, and they should be labeled on the back (please do not write directly on the back of the photos).
5. Manuscript evaluations will be sent to the principal author.
6. Manuscripts (and diskettes) not accepted for publication will be returned, if requested, to the principal author.
7. Manuscripts should not be submitted to another publication before or while under review by the *Small Flows Quarterly*.
8. All manuscripts go through a "blind" peer review. Therefore, a title page including the authors' names should be on a separate page from the remainder of the manuscript. The authors' names should not appear in the manuscript text at all except in a reference citation when appropriate. Please submit four hard copies of the manuscript, as well as an electronic copy on diskette or via e-mail.
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    West Virginia University
    P.O. Box 6064, Morgantown, WV 26506-6064

    cfalvey@wvu.edu
    Phone: (800) 624-8301, ext. 5526, or
    (304) 293-4191

Gravelless System and Chamber System

ENGINEERING SCIENTIST
Andrew Lake

What is the difference between a gravelless system and a chamber system?

A gravelless system is essentially what its name suggests—an onsite system that does not use a gravel media in its leachfield trenches or beds. A conventional onsite wastewater treatment system uses gravel to support the sidewalls in a drainfield trench to provide storage of peak wastewater flows and a media for the wastewater to flow through before reaching the infiltrative surface. A gravelless system uses nongravel materials (rubber, sand, fiber membrane, plastic, glass, or wrapped or slitted corrugated plastic pipe) as media in the drainfield's soil absorption trenches. The wrapped or slitted corrugated pipe is usually an 8- or 10-inch (inside diameter) plastic pipe.

These nongravel materials are installed surrounding the leachfield distribution pipes in the soil absorption trench. The depth of these trenches is dependent upon state and local regulations. Effluent loading rates and distribution methods in the gravelless system follow the same principles used in gravel systems.

A chamber system is like a gravelless system in that it does not use any media or aggregate in the trench bottom or leaching bed. The "chamber" is formed by a structure that is open at the bottom and may have a variety of sidewall configurations. These systems can be made of several different materials ranging from plastic and fiberglass to block or brick structures.

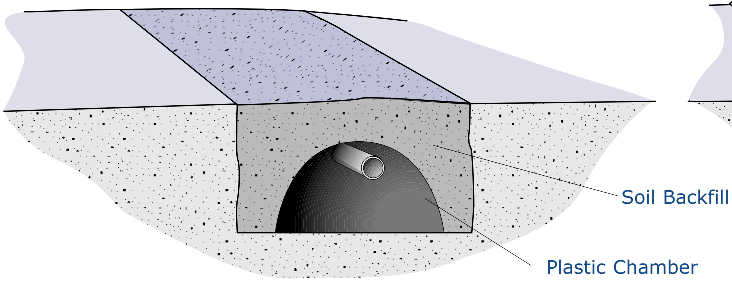
The use of gravelless or chambered system technologies eliminates the potential drawback of gravel as a negative system component. For example, the introduction of "fines" or dust into the leaching system with the use of gravel may create clogging within the leaching area. Eliminating gravel also removes the threat of soil compaction in the trench or bed. These technologies offer ease of construction and inspection and provide a higher storage capacity when wastewater generation exceeds infiltration.

When is a gravelless or chamber system appropriate?

Either of these systems can be used whenever a trench or a bed can be used. Like a conventional system, these technologies can be used on almost any slope and under most conditions. The only difference is that these systems use a support structure to maintain an underground void that allows for storage of the wastewater and for subsurface aeration within the drainfield trenches. As with conventional systems, the soil type and characteristics, as well as depth to water table and other factors, such as vertical and horizontal separation distances, control the use and acceptance of these alternative systems.

Studies have shown that these technologies perform somewhat better than conventional

Generalized Diagrams of Gravelless and Chambered Systems.



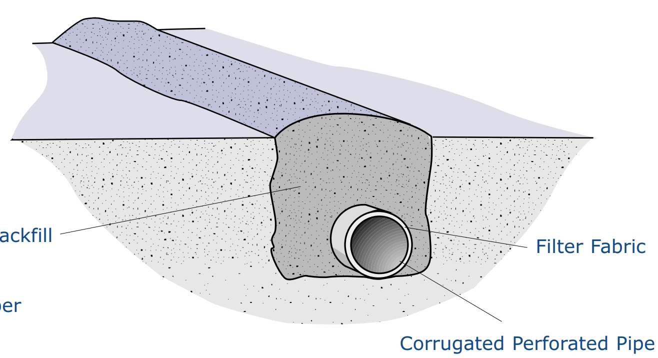


Table 1

State	Gravelless System Allowed	Chamber System Allowed	Reduction Allowed
Alabama		Yes	Yes
Alaska	Yes	Yes	None
Arizona	Yes	Yes	Yes
Arkansas		Yes	Some reduction is allowed
Colorado	Yes	Yes	Yes
Connecticut	No	Yes	Yes
Delaware	Yes	Yes	Yes
Florida		Yes	Yes
Georgia	Yes	Yes	Yes for chamber systems; none for gravelless systems
Hawaii	No	Yes	17- 20% for specific manufacturers of chamber systems
Idaho	Yes	Yes	Yes
Illinois	Yes	Yes	County-by-county approval for chamber systems
Indiana	Yes	Yes	Yes
Iowa	Yes	Yes	Yes for chamber systems; 8-inch gravelless pipe requires additional 20% length, and 10-inch gravelless pipe receives 24-inch wide credit
Kansas	Yes	No	Yes for chamber systems on a county-by-county approval process
Kentucky	Yes	Yes	Yes for chamber systems; no reduction for 8-inch diameter gravelless, and 30% reduction on 10-inch as experimental only
Louisiana	Yes	Yes	Some reduction is allowed
Maine	Yes	Yes	Yes
Maryland	Yes	Yes	None
Massachusetts	Yes	Yes	Yes
Minnesota	Yes	Yes	Yes for chamber systems
Mississippi	Yes	Yes	Yes for chamber systems
Missouri	Yes	Yes	Yes
Nebraska		Yes	Yes
Nevada		Yes	Yes
New Hampshire	Yes-Approved on product-specific basis	Yes	Yes for chamber systems; gravelless-sizing is product-specific
New Jersey	Yes	Yes	Sizing is product-specific
New York	Yes	Yes	
North Carolina	Yes	Yes	Yes for chamber systems
North Dakota	Yes	Yes	None
Ohio	Yes	Yes	None
Okalhoma	Yes	Yes	Some reduction is allowed
Oregon		Yes	Some reduction is allowed
Pennsylvania	Being used only under experimentation	Yes	Yes for chamber systems
Rhode Island	No	Yes	Yes for chamber systems in trenches and repairs only
South Carolina	Yes	Yes	Yes for chamber systems under the *Provisional and Demonstration Protocol*
South Dakota		Yes	Yes for chamber systems
Tennessee	No	Yes	Yes for standard chamber systems
Texas	Yes	Yes	Yes for chamber systems and gravelless systems
Utah		Yes	None
Vermont	Yes	Yes	None
Virginia	Yes	Yes	None
Washington	Yes	Yes	Reductions based on soil condition
West Virginia	Yes	Yes	Yes for chamber systems; gravelless receives no reduction
Wisconsin		Yes	Some reduction is allowed
Wyoming	Yes	No	Some reduction is allowed

gravel systems. However, there is some concern that, over time, the gravelless technologies will percolate the same as a conventional system due to the slime layer that builds up on the infiltrative surface. It is important to realize that gravelless technologies operate on the same principles as conventional systems.

The table on the left lists states that have provided information on the approval of use for gravelless or chambered technologies.

Because regulations change frequently, it is necessary to contact your regulatory authority to ensure that these systems are approved.

NSFC Resources

Gravelless Drainfields Technology Package is a compilation of articles describes the advantages of gravelless trenches and chamber systems over conventional gravel-filled trenches. The package contains several papers, abstracts of articles from the NSFC Bibliographic Database, case studies, and product information. The information is geared toward engineers, researchers, state regulatory agencies, state and public health officials, contractors/developers, and planners. The price for this 68-page book is $9.80. Additional shipping charges apply. Request Item #WWBKGN74.

Alternative Onsite Systems Technology Package was developed by the NSFC. This package is designed to inform homeowners of the many alternative onsite wastewater technologies that can be used in areas not suitable for the conventional septic tank and drainfield. Each technology listed in this package is given a brief overview. The package is useful for the general public, community planners, and local, state, and public health officials. The price for this 66-page book is $5. Additional shipping charges apply. Request Item #WWPKGN87. SF

Editor's Note: This column is based on calls received over the National Small Flows Clearinghouse (NSFC) technical assistance hotline. If you have further questions concerning gravelless or chamber systems, call (800) 624-8301 or (304) 293-4191 and ask to speak with a technical assistance specialist.

Burnett, Washington: From Straight Pipes to Alternative Onsite Systems

CONTINUED FROM PAGE 15

Burnett as a Training Center

Because Burnett was close to the NOWTC in Puyallup, "the project could be used as a site for training center attendees," said Steve Marek, public health manager for the Source Protection Program at the Tacoma-Pierce County Health Department. "Attendees can observe the operation of a wide variety of alternative systems under field conditions."

Said Stonebridge, "Nationally, Burnett will demonstrate a risk management approach to siting, design, and maintenance of onsite wastewater treatment systems."

NODP Phase II Systems at Burnett, Washington

"Several interesting designs were done in this project. A number of different technologies were demonstrated for primary, secondary, and polishing of domestic wastewater," said Solomon.

System 1: septic tank with recirculating gravel filter.

System 2: two-compartment septic tank with FAST (fixed activated sludge treatment) unit and subsurface drip disposal with pressure compensating emitters.

System 3: aerobic treatment unit (ATU) and raised-bed chamber system.

System 4: septic tank; Waterloo Biofilter; and shallow gravel bed disposal.

System 5: ATU to subsurface drip disposal with pressure compensating emitters.

System 6: septic tank, peat biofilter, and shallow gravel bed.

System 7: septic tank with mound (6-inch pea gravel, 15-inch ASTM C-33 sand, 6-inch drain rock) soil disposal component.

System 8: septic tank, Reactex filter, and sand filter unit.

System 9: 1,000-gallon septic tank subsurface drip with pressure compensating emitters.

System 10: 1,000-gallon septic tank, chamber in shallow trenches, and gravity flow with equal distribution.

System 11: septic tank/pump, at grade pressure lateral with Hydrotech valve, trench ASTM C-33 sand.

System 12: septic tank and chambers and gravel trenches.

System 13: septic tank; constructed wetlands; and chambers (gravity feed).

System 14: septic tank and surge/equalization tank; bottomless stratified sand filter.

System 15: septic tank, surge/equalization tank, and Glendon BioFilter Technology BioFilter.

"The demonstration project in Burnett, Washington, was not just a pipe project but a total community empowerment project as well," said Solomon. "The credit also goes to the various stakeholders who did more than what was required." These stakeholders are the Washington State Department of Health, the Pierce County Department of Community Service, the Washington Onsite Sewage Association, and the Tacoma-Pierce County Health Department.

"Phase II of NODP will have accomplished its mission soon," said Solomon, "which was to initiate the design, installation, and preliminary monitoring of alternative onsite systems. It's time for more detailed studies to be conducted by research institutions and other organizations to pick up where we ended."

For information about the Burnett project, contact Stonebridge at (360) 331-6101. For information about NODP II, call Solomon at (800) 624-8301 or (304) 293-4191. SF

Request for Presenters

Alternative Water and Wastewater Technologies for Small Communities Conference

Nebraska DEQ

The Nebraska Department of Environmental Quality's Nebraska Environmental Partnerships (NEP) program, along with numerous co-sponsors, is presenting the Alternative Water and Wastewater Technologies for Small Communities Conference. The conference will be held in conjunction with the 45th annual Great Plains Waste Management Conference and will highlight lower cost, alternative technologies to address water and wastewater issues in small communities. The NEP invites you to participate in the conference, which will be held Wednesday March 28, 2001 at the Holiday Inn, Omaha, Nebraska.

The conference will target community leaders, community utility workers, engineers, contractors, technical assistance providers, state regulators, funding organizations, and researchers on a national/regional level.

Presenters are asked to provide information about situations in which they applied alternative technologies to drinking water or wastewater problems in communities under 5,000 in population. They will present pragmatic information about what problem(s) were identified, what options were considered, why a particular option was selected, and what the results are to date. The NEP would like those involved with the project, such as community members, utility managers, engineers, regulators, or vendors to participate in the presentation.

If you are interested in making a presentation at the conference, please contact M. J. Rose, NEP Coordinator, at (402) 471-3193. The deadline for submitting a presentation application is November 1, 2000.

CONTINUED FROM PAGE 4

map would have us think there are none in the eastern half of the U.S. (Wrong.) You may have a chance, in future articles, to print better maps, perhaps of smaller areas, and larger scale, and more accurate. I hope so. Maps are useful, but they must be good, readable maps.

On page 16, the author notes that "water systems are . . . often located in arid regions where water sources are difficult to obtain." This is followed by a page on Arctic conditions where the cold temperatures are the chief problem to overcome. Yes, Native People live in deserts and tundra (and other places). But it appears there is a bigger problem, and it relates to "thinking inside a box." It appears that the U.S. Environmental Protection Agency (the "pocket" where the money comes from) is "wedded" to the flush toilet for all conditions, whether desert dry or permafrost cold. One of the biggest problems I see in the whole issue of human waste disposal is the blindness that assumes that the flush toilet is the only way to go, and nothing else needs to be said about it.

Consider the conditions of the arid western states, where the largest numbers of Native Americans reside and the largest reservations are located: both surface water and groundwater usually are in short supply, and drinking water is the critical need for human life. The flush toilet actually wastes water precisely in those places where water should not be wasted. Is this environmentally sound? Is this economically sound? Where is the consideration of dry toilets, or composting toilets, or other "alternative" disposal systems?

Some people will come back with a terse, but shallow answer, "cost," and will examine the issue no further. But everything that is built, even a low-maintenance system, has several costs: a) immediate capital construction costs, b) ongoing operation and maintenance costs, and c) environmental costs (which can include economic and social costs). For the costs of sewer lines and sewage treatment plants (with all three kinds of costs), alternative technology could be implemented that would conserve valuable drinking water supplies, avoid environmental damages (such as contamination), and allow Native Americans and Alaskan Natives the freedom they always have enjoyed, to move around from place to place.

Your *Small Flows Quarterly* would be doing generations of North American people a tremendous favor by pointing out to EPA/ESTD (Environmental Services and Training Division) people that they need to "think outside the box," and realize that the flush toilet is not the only answer and is not necessarily the best answer to human waste disposal. They should consider, in each case, the "green" or environmentally and economically sound alternatives to the water-wasting flush toilet. They should engage in what is termed "life-cycle costing" of any system design. There is alternative technology, and it is especially valuable in desert and tundra environments. Alas, there is no mention of this in the article. If ESTD people discuss alternatives with Native American people, it needs to be mentioned in future articles.

Thanks for letting me " sound off" in your direction. (P.S. I am employed as a planner in a state water resources program. I have been a planner for 31 years, in New York, Massachusetts, and Missouri. I also have lived in New Mexico and Oklahoma. My wife is Cherokee, from Oklahoma.)

Sincerely yours,
Richard Bounding Elk,
aka Richard M. Gaffney
Abenaki Indian

Dear Editor,

I found the Spring issue of the *Small Flows Quarterly* interesting and would like to comment on several articles.

The article on flow rate and waste strength is very good, but misleading since it uses ancient tables from a publication almost 30 years old. Having once worked in a regulatory agency for 15 years reviewing permit applications for various wastewater treatment systems, I think I can assure you that anyone submitting an application for a treatment system treating wastewater from a restaurant having a biochemical oxygen demand (BOD) of only 450 would soon have his submittal returned to him. Experienced engineers who have actually sampled influent from restaurants rarely design for anything less than a BOD of 1,000, and usually for a BOD of 1,200.

Hospitals and funeral homes also rarely have a BOD of 200 because of blood in the wastewater. If you ever designed a system for a small butcher shop, you soon learned the "rule of thumb" that one gallon of blood equals one thousand gallons of sewage based on BOD. Hospitals also usually have silver in their wastewater, which may be toxic to anaerobic bacteria in a septic system.

Another hint—laundromats—always have dual quarter-inch removable screens somewhere in the system or the system will plug up with lint. If you don't have the screens or if they are not cleaned daily, you will be sorry. If you block up your sand filter with lint, you can try dosing with several gallons of industrial strength sodium hydroxide from a plumber supply house.

The article on infrared technology brought back memories. Having been a machine gunner on one of the three FLIR (forward-looking infrared) gunships used in Vietnam, I must warn you that heat readings in shallow water can be very misleading. Shallow water warms faster than deeper water, and therefore water along the edge of a shallow lake would normally be expected to look different on the infrared screen even without sewage being discharged. We used to have a very difficult time finding freshly buried landmines, and we had a much greater difference in temperature than that expected between sewage seeps and lake water. Interpreting what is shown on an infrared screen or pictures takes experience; slightly exposed sandbars, for example, retain the heat of a sunny day for a long, long time.

Sincerely,
Al Sever, P.E.
Montoursville, Pennsylvania

Free Newsletter Discusses Alternative Toilets

Homeowners, local officials, and others who want to learn about alternative toilets will appreciate the newsletter *Pipeline*.

Published by the National Small Flows Clearinghouse (NSFC), *Pipeline* is written for a general audience, and each issue explains a wastewater technology or theme of interest to local officials and community residents. The articles are presented in an easy-to-read non-technical style and include a list of contacts and resources in each issue.

Alternative toilets are the focus of the Summer 2000 *Pipeline* (Item #SFPLNL22), which describes various alternative toilets that can be used in homes and public rest-room facilities. The newsletter discusses operation and maintenance, plus advantages and disadvantages of each. This *Pipeline* includes two case studies that show how alternative toilet systems helped to resolve wastewater disposal problems.

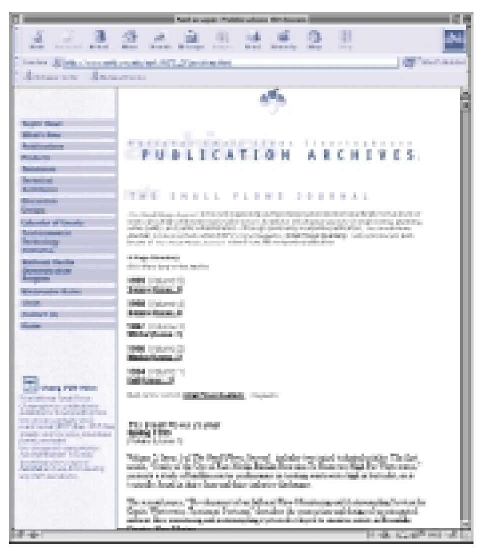
The *Pipeline* newsletter may be downloaded from NSFC's Web site as well. Located at www.nsfc.wvu.edu, the NSFC Web site also contains information about new wastewater-related products, NSFC services, and a calendar of upcoming conferences and events.

Readers are encouraged to reprint *Pipeline* articles in local newspapers or include them in flyers, newsletters, or educational presentations. *Pipeline* can also be ordered in bulk and distributed at public meetings or other forums.

To order a particular *Pipeline* issue or for a free subscription, call the NSFC at (800) 624-8301 or (304) 293-4191, or write to NSFC, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. The international subscription fee is $6.00. All back issues of *Pipeline* cost 20 cents each, and shipping charges apply.

Past Issues of *The Small Flows Journal* Now Available on NSFC's Web Site

The National Small Flows Clearinghouse (NSFC) recently added a new section to its Web site for archives of past issues of *The Small Flows Journal*. These issues are no longer available in print and can only be downloaded from this site. The URL for *The Small Flows Journal* Archives page is www.estd.wvu.edu/nsfc/NSFC_SFJarchives.html.



When it was in publication, *The Small Flows Journal* was the only peer-reviewed technical journal devoted specifically to the study of onsite and small community wastewater issues. Its articles encompassed aspects of engineering, planning, water quality, and public administration.

Now these peer-reviewed technical articles are included as a section within NSFC's new magazine, *Small Flows Quarterly*. NSFC's Archives Web page contains back issues of *The Small Flows Journal* before it was combined with the *Small Flows Quarterly* magazine. Future issues of the journal will be archived with this new magazine.

The latest issues of *Small Flows Quarterly* and NSFC's newsletter, *Pipeline*, may be downloaded from NSFC's Web site as well. In addition, the NSFC Web site includes information about new wastewater-related products, NSFC services, and related projects, such as the National Onsite Demonstration Program.

Located at www.nsfc.wvu.edu, the site also contains a public education section called "Wastewater Notes" and a listing of upcoming events. Those interested in finding out which conferences NSFC representatives will attend can access that information on the "Calendar of Events" page.

Also included are links to the NSFC's "sister" organizations, the National Drinking Water Clearinghouse and the National Environmental Training Center for Small Communities, which also have their own publications *On Tap*, *Water Sense*, and *E-train* online.

New NSFC Products Are Available

Polluted

Developed by the EPA Office of Water, this brochure folds out to graphically illustrate sources of runoff, such as forestry, agriculture, urban stormwater, household and automotive care, and construction. The brochure lists activities in which the community can participate to help reduce the impact of runoff and pollution entering nearby waterways. Regional EPA Nonpoint Source Coordinators are listed as sources of more information. This two-page foldout could be useful to local and state officials and the general public.

This brochure is free. Ask for Item #GNBRPE51.

Response to Congress on the AEES "Living Machine" Wastewater Treatment Technology

Developed by the U.S. Environmental Protection Agency (EPA) Office of Water, this booklet describes the Advanced Ecologically Engineered System (AEES) "Living Machine" wastewater treatment technology, which is intended to provide water quality improvements for a variety of water sources. The AEES contains various microorganisms, protozoa, higher animals, and plants that are intended to provide "natural" water treatment, as opposed to conventional wastewater treatment processes. "Living Machine" developers claim to clean wastewater to advanced treatment standards using "natural solar powered greenhouse-based technology without the use of chemicals." The booklet discusses four AEES demonstration projects (funded in part with special appropriations by the U.S. Congress) that were designed to show the ways in which this technology can be employed in various wastewater treatment applications. The demonstration projects were located in Frederick County, Maryland; South Burlington, Vermont; Harwich, Massachusetts; and San Francisco, California. Performance data and conclusions are provided. This 42-page booklet may be useful to engineers, researchers, and state regulatory agencies.

The cost for this booklet is $6.05. Request Item #WWBLGN143.

Response to Congress on Privatization of Wastewater Facilities

Produced by the EPA Office of Water, this response was developed to address a U.S. House of Representatives Appropriations Committee's request to examine the use of public/private partnerships as a source of funds to meet current and future wastewater infrastructure needs. The committee was concerned about the costs that local, state, and federal governments must finance to meet projected wastewater needs and the potential of the private sector to play a significant role in accomplishing this task. This booklet provides an overview of the wastewater public/private partnership process. It presents the most common partnership arrangements; the financial, non-financial, and other issues associated with privatization; the impediments to privatization; and several case studies of public/private partnership arrangements. This 39-page booklet may be helpful to local and state officials, managers, planners, and the general public.

The cost for this booklet is $5.65. Ask for Item #WWBLGN144.

Choices for Communities: Wastewater Management Options for Rural Areas

Written by Mike Hoover, Ph.D., from the North Carolina State University, College of Agriculture and Life Sciences, Waste Management Programs, this booklet discusses wastewater management options for rural communities. It begins with a history of onsite systems and discusses alternatives to centralized sewering, stressing that management, maintenance, and inspection are key. The dilemma for many rural communities is that they lack a wastewater infrastructure, but a centralized system is too difficult and costly to implement. Today, there are more wastewater treatment options for rural communities, including surface or subsurface land-based technologies or surface-water discharge systems. The booklet outlines steps to a community-needs assessment, including planning and economic aspects. Also discussed is the Clean Water Act of 1972 and what effects it had on small communities. The booklet examines alternatives to the conventional septic system, alternative wastewater collection technologies, and land-based treatment and disposal technologies. Advantages and disadvantages are included. The cost-effectiveness of land-based technologies is discussed using case studies of several North Carolina towns. In addition, centralized and decentralized approaches are compared, based on a detailed analysis of costs by the EPA using a hypothetical rural community. This 16-page booklet can serve as a resource for local, state, and public health officials; engineers; finance officers; contractors/developers; managers; planners; researchers; and state regulatory agencies.

The cost for this booklet is 50 cents. Ask for Item #WWBLMG09.

On-Site Wastewater Treatment Systems: Low-Pressure Dosing

Written by Bruce Lesikar with the Texas A&M University Agricultural Extension Service, this fact sheet details the characteristics, advantages, disadvantages, maintenance, and costs of a low-pressure dosing system for residential domestic use. An illustration of low-pressure dosing system components is included, as well as a graphic depiction of how the system distributes wastewater into the soil several times a day. This two-page fact sheet may be useful to local, state, and public health officials; contractors/developers; and the general public.

The cost of this fact sheet is $1.00. Request Item #WWFSGN133.

On-Site Wastewater Treatment Systems: Subsurface Drip Distribution

Written by Bruce Lesikar with the Texas A&M University Agricultural Extension Service, this fact sheet details the characteristics, advantages, disadvantages, maintenance, and costs of a drip (irrigation) distribution system for residential domestic use. An illustration of subsurface drip system components is included, as well as a graphic depiction of how the system distributes wastewater uniformly in the lawn. This two-page fact sheet could be useful to local, state, and public health officials; contractors/developers; and the general public.

The cost of this fact sheet is $1.00. Ask for Item #WWFSGN132.

Onsite Wastewater Treatment Systems: Spray Distribution

Written by Bruce Lesikar of the Texas Agricultural Extension Service at Texas A&M University, this fact sheet gives an overview of spray distribution systems for residential domestic use. It explains how the technology works and what maintenance is required. Characteristics, advantages, disadvantages, and costs are included. This two-page fact sheet may be useful to local, state, and public health officials; contractors/developers; and the general public.

The cost for this fact sheet is $1.00. Ask for Item #WWFSGN134.

The Problem with Shallow Disposal Systems

In this 15-minute video about "Class V" injection wells, citizens and local officials in three communities reveal how chemical waste discharged to groundwater through shallow disposal systems contaminated their water resources and how it affected their communities. Produced by the EPA Office of Ground Water and Drinking Water, this video demonstrates that: 1) shallow disposal systems are a common, but often overlooked, source of dangerous industrial chemicals; 2) federal and state regulations are not enough to control this kind of pollution in a community; and 3) there are simple, preventive steps a community can take to reduce this serious threat to its water supply without closing businesses or going into debt. This video shows what three communities in Great Falls, Virginia; Espanola, New Mexico; and Missoula, Montana, did to remedy the contamination of their water supplies and prevent future pollution. It is available in both English and Spanish and is a good community education tool. To receive the Spanish version, contact Harriet Hubbard with the EPA at (202) 260-9554. This video may be of interest to local, state, and public health officials; state regulatory agencies; contractors/developers; engineers; planners; managers; and finance officers.

This video is free. Ask for Item #WWVTPE50.

Watershed Protection: A Statewide Approach

Produced by the EPA Office of Water, this book is one of two watershed protection guides designed for state water quality managers and others involved in watershed-based activities as they adopt, implement, and evaluate watershed protection programs. It discusses the

premise of the watershed protection approach: that many water quality and ecosystem problems are best solved at the watershed level rather than at the individual waterbody or discharger level. This 81-page book could be useful to planners, local and state officials, and the general public.

This book is free. Ask for Item #GNBKGN14.

State of the Chesapeake Bay: A Report to the Citizens of the Bay Region

Developed by the Chesapeake Bay Program, this book is a report on the progress made to protect and restore the Chesapeake Bay. This 64,000 square-mile watershed is home to more than 3,000 species of plants and animals and at least 15.1 million people. The Chesapeake Bay Program partners have set clear goals for recovery through nutrient and toxic pollution reduction, as well as habitat protection and restoration, which have led to the return of bay grasses and cleaner water. This report highlights water quality conditions and the status of aquatic life. It explains the progress made to reduce the top four stressors on the bay system: excess nutrients, toxic pollution, air pollution, and landscape changes. Also discussed are the most recent policy decisions and goals that are driving the overall clean-up effort, along with new findings, innovative technologies, and some of the challenges beyond the year 2000. This 59-page book can be helpful to local, state, and public health officials and the general public.

This book is free. Ask for Item #WWBKPE54.

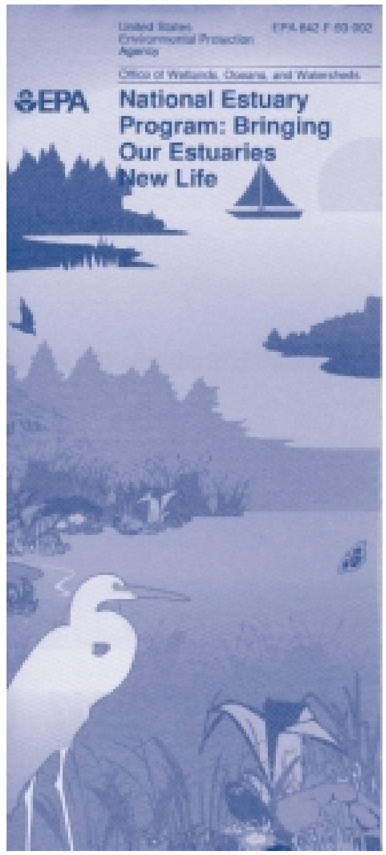
Environmental Indicators of Water Quality in the United States

Prepared by the EPA Office of Water, this report shows trends in water quality over time. It describes our nation's water resources, human activities, and natural events, as well as their impact on water quality. The 18 indicators that will be used to measure progress toward water goals and objectives are also explained. These indicators are illustrated with graphs, charts, or maps and are categorized under one of five objectives: 1) conserve and enhance public health; 2) conserve and enhance aquatic ecosystems; 3) support uses designated by the states and tribes in their water quality standards; 4) conserve and improve ambient conditions; and 5) reduce or prevent pollutant loading and other stressors. This 28-page booklet could be useful to local, state, and public health officials; engineers; operators; state regulatory agencies; researchers; and the general public.

This booklet is free. Ask for Item #GNBLGN13.

National Estuary Program: Bringing Our Estuaries New Life

Developed by the EPA Office of Wetlands, Oceans, and Watersheds, this foldout poster highlights 21 local NEPs (National Estuary Programs).



In 1987, the NEP was established to protect and restore the health of estuaries while supporting economic and recreational activities. Local NEPs developed partnerships between government agencies that oversee estuarine resources and the people who depend on the estuaries for their livelihood and quality of life. These groups plan and implement programs according to the needs of their areas. Each NEP demonstrates practical and innovative ways to revitalize and protect estuaries. This poster includes contacts for each local NEP. This two-page foldout could serve as a resource for local and state officials and the general public.

This poster is free. Ask for Item #GNPSPE52.

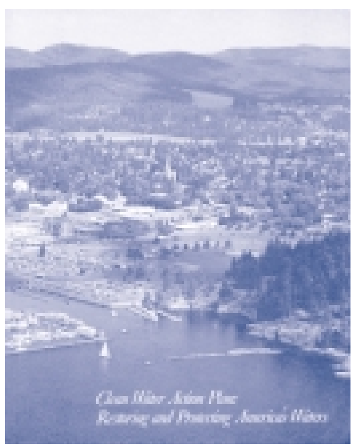
Water Pollution Control: Twenty-Five Years of Progress and Challenges for the New Millennium

Developed by the EPA Office of Water, this booklet discusses the Clean Water Action Plan and other ways to provide protection from public health threats posed by water pollution, including decentralized wastewater treatment (onsite) systems. In 1972, Congress passed the Clean Water Act (CWA) in response to public outrage over the deplorable condition of the nation's waters. This report summarizes the progress and challenges of the CWA's first 25 years, and what work remains to be done. The basic CWA approach has been greater control of "point sources" of water pollution—primarily factories and city sewers, along with control of activities that destroy wetlands. The report details ways in which federal law and policy have been continually strengthened to clean up America's waters, including the National Pollutant Discharge Elimination System (NPDES) Program. Funding remains an important component of the CWA and its 1987 amendments in the form of the State Revolving Fund (SRF). Despite impressive progress, states report that close to 40 percent of the waters they surveyed are too polluted for basic uses, such as fishing or swimming. New CWA focuses are more effective control of polluted runoff and promoting water quality protection on a watershed basis. This five-page booklet may be useful to local, state, and public health officials; managers; finance officers; state regulatory agencies; planners; operators; engineers; and the general public.

This booklet is free. Ask for Item #GNBLGN15.

Clean Water Action Plan: Restoring and Protecting America's Waters

Prepared by the U.S. Department of Agriculture (USDA) and the EPA, this book details the Clean Water Action Plan, which the USDA and the EPA initiated to meet the promise of clean, safe water to all Americans. The book explains how the action plan builds on the foundation of existing clean water programs, and it proposes new actions to strengthen efforts to restore and protect water resources. Under this plan, the federal government will support locally led partnerships, increase financial and technical assistance to states, and help states and tribes restore and sustain the health of aquatic systems. Factors such as regulation, economic incentives, technical assistance, education, and accurate information were identified as the necessary tools for restorating and protecting water resources. The book discusses how the goals of the Clean Water Action Plan can be achieved through a good watershed approach, strong federal and state standards, natural resources stewardship, and educating citizens and officials. This 101-page book can serve as a resource for local and state officials and the general public.



This book is free. Ask for Item #WWBKGN142.

On-Site Wastewater Treatment Systems: Conventional Septic Tank/Drain Field

Written by Bruce Lesikar with the Texas A&M University Agricultural Extension Service, this fact sheet details the costs, characteristics, advantages, disadvantages, and maintenance for a conventional septic tank soil absorption system for domestic residential use. This two-page fact sheet, which includes illustrations of a septic tank/soil absorption field and a two-compartment septic tank, may be useful to local, state, and public health officials; contractors/developers; and the general public.

The cost of this fact sheet is $1.00. Ask for Item #WWFSGN131.

Linear Regression for Nonpoint Source Pollution Analyses

Developed by the EPA Office of Water, this fact sheet is intended to demonstrate an approach to describing the relationship between variables using regression for nonpoint source pollution analyses. This fact sheet is targeted toward people in state water quality monitoring agencies who are responsible for nonpoint source assessments and implementating watershed management. In nonpoint source analyses, linear regression is often used to determine the extent to which the value of a water quality variable is influenced by land use or hydrologic factors, such as crop type, soil type, percentage of land treatment, rainfall, or stream flow, or by another water quality variable. Practical applications of these regression results include the ability to predict water quality impacts due to changes in the independent variables. This eight-page fact sheet could serve as a resource for engineers, state regulatory agencies, state officials, and public health officials.

This fact sheet is free. Ask for Item #WWBLRE30.

How Wastewater Treatment Works . . . The Basics

Developed by the EPA Office of Water, this trifold brochure describes the two basic stages in the treatment of wastewater: primary and secondary. The primary treatment section details bar screens, a grit chamber, a sedimentation tank, and raw primary biosolids (sludge). The secondary treatment section describes the trickling filter, activated sludge process, aeration tank, and disinfection. It also discusses other treatment options, including biological treatment capable of removing nitrogen and phosphorus; and physical-chemical separation techniques, such as carbon adsorption or reverse osmosis. This two-page brochure may be helpful to the general public.

This brochure is free. Ask for Item #WWBRPE53.

Funding Estuary Projects Using the Clean Water State Revolving Fund

Developed by the EPA Office of Water, this fact sheet outlines general information about funding estuary projects using the Clean Water State Revolving Fund (CWSRF), including who may qualify, its history, its financial capacity, the advantages of loans versus grants, sources of loan repayment, and challenges. To counteract the serious threats to estuaries across the country, EPA would like to see the CWSRF become a major source of funding for estuary protection. The 51 CWSRF programs currently issue approximately $3 billion annually in loans. SRF loans are issued at below-market rates (zero percent to less than market), offering borrowers significant savings over the life of the loan. The fact sheet discusses the National Estuary Program in relation to the SRF, and includes success stories of innovative CWSRF projects. This four-page fact sheet may be of interest to almost any wastewater professional, but particularly useful to local and state officials, state regulatory agencies, planners, managers, finance officers, public health officials, and the general public.

This fact sheet is free. Ask for Item #FMFSFN32.

Community-Based Environmental Protection: A Resource Book for Protecting Ecosystems and Communities

Developed by the EPA Office of Sustainable Ecosystems and Communities (OSEC), this book discusses how local communities play a prominent role in environmental protection and describes how recreational, economic, and other activities affect the quality of ecosystems. Protecting our nation's ecosystems requires communities and individuals to conserve or restore habitats and help solve other environmental problems not specifically addressed by traditional regulatory approaches. This book draws on the experiences of many different communities to provide examples of community-based environmental programs. It also shows how other communities have assessed the interrelationships between their goals, such as residential development and ecosystem quality. Local and state officials, as well as the general public may find this 137-page book useful.

This book is free. Request Item #GNBKGN12.

Protecting Wetlands with the Clean Water State Revolving Fund

Developed by the EPA Office of Water, this fact sheet briefly outlines how the Clean Water State Revolving Fund (SRF) works, the various types of funding available (i.e., loans, grants), categories of eligibility, source of repayment, and where to obtain additional information. Based on the serious threats to wetlands resources across the country, EPA would like to see the SRF become a major source of funding for wetlands protection. The 51 Clean Water SRF programs currently issue approximately $3 billion in loans annually. SRF loans are issued at below market rates (zero percent to less than market), offering borrowers significant savings over the life of the loan. This two-page fact sheet may be of interest to local and state officials, planners, managers, finance officers, and the general public.

This fact sheet is free. Ask for Item #FMFSFN31.

Rural Community Assistance Program (RCAP) Help for Small Community Wastewater Projects

Developed by the EPA Office of Water, this fact sheet describes RCAP, a national network of nonprofit organizations, and how they provide onsite technical assistance to communities to help them attain or maintain adequate wastewater treatment services. The fact sheet discusses how, through a partnership agreement with the EPA, RCAP provides the appropriate financing, management, operation and maintenance, etc., through the Small Community Wastewater Project. The project addresses community-specific wastewater compliance problems, particularly compliance with the Clean Water Act requirements. This fact sheet discusses funding for small community wastewater projects and provides a contact for those who want more information. This two-page fact sheet could be of interest to local, state, and public health officials; state regulatory agencies; planners; managers; finance officers; contractors/developers; engineers; and the general public.

This fact sheet is free. Ask for Item #WWFSFN32.

Clean Water State Revolving Fund Program

Developed by the EPA Office of Water, this fact sheet describes the Clean Water State Revolving Fund (CWSRF) program that finances a range of environmental projects. Under the program, the EPA provides grants or "seed money" to capitalize state loan funds. The two-page fact sheet discusses how the states make loans to communities, individuals, and others for high-priority water-quality activities. As money is paid back into the revolving fund, the CWSRF makes new loans to other recipients who need help in maintaining water quality. This fact sheet discusses benefits, project eligibility, and summarizes the Clean Water Act. Local, state, and public health officials; state regulatory agencies; operators; contractors/developers; engineers; planners; managers; and finance officers will find this information particularly useful as they seek funding to correct or prevent water quality problems.

This fact sheet is free. Ask for Item #WWFSFN06.

CONTINUED ON PAGE 63

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Funding Water Conservation and Reuse with the Clean Water State Revolving Fund

Developed by the U.S. EPA Office of Water, this fact sheet discusses the Clean Water Act (CWA) of 1987, which authorized the Clean Water State Revolving Fund (CWSRF) to finance point source, nonpoint source, and estuary projects. The programs work like banks: federal and state contributions are used to capitalize or set up the programs. These assets, in turn, are used to make low- or no-interest loans. Repaid funds are recycled to fund other water quality projects. This fact sheet describes how the CWSRF works, how to get a project funded, and the sources of loan repayments. Examples of successful projects are summarized. This two-page fact sheet could be useful to engineers, local and public health officials, operators, planners, finance officers, and the general public.

The cost is 30 cents. Ask for Item #FMFSFN35.

USDA Loan and Grant Funding for Small Community Wastewater Projects

This booklet by the U.S. EPA Office of Water provides general information about the U.S. Department of Agriculture Rural Utilities Service's (RUS) Water and Waste Disposal Loans and Grants Program, including how RUS funding compares to joint funding sources and to EPA total need. Information is presented textually as well as graphically and in table form. The Water and Waste Disposal Loans and Grants Program provides loans and grants for water, sewer, stormwater, and solid waste disposal facilities. The program makes assistance available only to rural areas with 10,000 or fewer people. This eight-page booklet may be helpful to local, state, and public health officials; finance officers; managers; planners; and the general public.

The cost is $1.15. Ask for Item #FMBLFN34. SF

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NATIONAL SMALL FLOWS CLEARINGHOUSE

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(e.g., no site or soil restrictions such as drinking water wells in close proximity, or a high groundwater table). Model Program 1 is intended to raise the local regulatory agency's awareness of the location of systems, raise homeowners' awareness of basic system needs, and ensure homeowner compliance with basic maintenance requirements. This program also serves as a starting point for communities to have basic data that will help them determine if higher management levels are necessary.

- ***Model Program 2*—Management Through Maintenance Contracts**: EPA recommends this program where sites with limiting conditions, such as small lot sizes, or restrictive soil conditions (e.g., slowly permeable soils, shallow soils with limited treatment capacity, or high groundwater table) are encountered in a small portion of a community. These limiting conditions require improved effluent dispersal to the soil or additional treatment units, such as media filters or aerobic treatment units, and are typically operated through contracts with equipment vendors. Model Program 2, therefore, sets higher expectations for a regulatory program and for educating homeowners.
- ***Model Program 3*—Management Through Operating Permits**: This program is recommended by EPA in situations where the receiving environment indicates a need for advanced levels of treatment, such as an unconfined aquifer used as a drinking water supply or a fish spawning area. Model Program 3, consistent with the increasing risk, recommends setting measurable performance standards and ensuring compliance by issuing renewable operating permits that indicate specific performance criteria to be achieved. The regulatory agency monitors these systems for compliance with the performance criteria.
- ***Model Program 4*—Utility Operation and Maintenance**: This program is appropriately applied where engineered designs, such as aerobic treatment units, are required to overcome site, soil, or environmental conditions not conducive to conventional or alternative onsite technology. Frequent monitoring and maintenance is needed in these situations. Model Program 4 recommends that a public/private utility that is responsible for system performance provide operation and maintenance to ensure that maintenance needs are met.
- ***Model Program 5*—Utility Ownership and Management**: This program represents the management needs of a more complex program where a very high level of control is required due to environmental or public health concerns. Model Program 5 includes the public/private utility as the designated management entity that both owns and operates the onsite systems in a manner analogous to a publicly owned wastewater utility. This program is similar to the utility concept in Model Program 4. Under this level of management the utility maintains total control of all aspects of management—not just operation and maintenance.

> These model programs are not intended to supercede existing federal, state, tribal, and local laws and regulations, but rather to complement them.

We encourage everyone with an interest in onsite/decentralized wastewater systems to examine the proposed guidelines and offer their comments. Once a notice has been published in the *Federal Register*, the draft guidelines will be posted on EPA's Web site. Printed copies will also be available for mailing. Comments can then be submitted electronically via the Web or by letter or fax. To be notified of the availability of the guidelines or to receive updated information about other decentralized wastewater activities, call EPA's contractor, Lisa Knerr of TetraTech, at (703) 385-6000 ext. 169. For more information on the draft guidelines or other initiatives related to onsite/decentralized wastewater systems, visit EPA's Web site at www.epa.gov/owm/decent. SF

Joyce Hudson is a senior environmental engineer with the EPA's Office of Wastewater Management in Washington, D.C., and is involved in many aspects of its municipal wastewater technology program. She has been employed with EPA for the last 20 years and currently manages the agency's effort to promote onsite/decentralized wastewater systems.

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for assessing performance. Waiting until we can 1) install new side-by-side systems, 2) allow biomats to form, and 3) allow systems to mature before we answer each and every new question about system performance is not realistic.

But another approach, field performance surveys, can provide complementary research data from the side-by-side protocol. Statistically sound field performance surveys that evaluate random, stratified groups of hundreds of real systems under a broader range of environmental conditions can help the researcher extrapolate the results from the narrow set of conditions in an intensive side-by-side study. Field performance surveys can address a broader range of conditions (soils, climates, wastewater strengths and flows, as well as system design, installation, and operation variations) that represent reality in the field.

THE SCIENTIFIC METHOD AND REGULATORY DECISION MAKING

We have discussed the scientific method and how we need to build a much stronger scientific foundation as the basis for improving the quality and credibility of our decisions in the onsite field. But "pure" scientific method and studies are not enough in the world of practical regulatory decision making. Let's turn to three other considerations that must complement the pure scientific method. Or to put it differently, let's consider the broader context in which onsite science must work.

Our environmental values, not just science, determine performance standards. As we move toward a more performance- and treatment-based approach to regulation of onsite wastewater, we need to consider the same objectives as are needed in all other aspects of environmental protection: "how clean is clean" groundwater and surface water? Federal law and regulation, of course, have provided one set of answers, such as "fishable/swimmable" surface waters. States and localities will have to decide whether the federally defined objectives—or values—are sufficient. After those value decisions have been made, good science is necessary to determine whether products, technologies, management practices, or other pollution mitigation mechanisms are practical and sufficient to achieve the standards.

The American public does not make decisions on the basis of science alone. Almost all of us agree that a) we need treatment and performance standards, b) we need to get better at using scientific data in making decisions, and c) we need better enforceable procedures for management and maintenance of onsite systems.

Implementing what we agree on will require increased public expenditures, and therein lies the pickle. How, exactly, do I convince my Aunt Millie that she needs to spend money on a better system in order to protect the environment and more money on maintenance to ensure her system does not fail?

We think the beginning of the answer is that our environmental niche, onsite wastewater treatment, needs to see itself as being similar to all other environmental issues. Pollution is pollution. We need allies to address problems systematically. We need nongovernmental environmental groups—with their amazing historical ability to create public interest and support for addressing environmental problems—to share our values and commitment to improved onsite wastewater management.

There is never enough "pure" science to make perfect decisions. Since soon after the first Earth Day, every environmental regulator has wished to have third-party, peer-reviewed, replicable, and published studies of every aspect of the pollution problem under consideration. Environmental protection, however, will not be quickly advanced—in the onsite field or any other—if the regulator waits on perfect scientific certainty. Therefore, we cannot let the perfect be the enemy of the good.

In most parts of environmental protection, a kind of informally accepted set of rules has evolved in response to this dilemma. The rules are collectively called, "acceptance of the scientific weight of evidence."

Regulators should not and cannot afford to throw out data. Rather, they should put data into a hierarchy like the castle we used as an example. They can give, for instance, one weight to data supplied by a self-interested manufacturer; another weight to informal surveys by other regulators; still other emphasis to studies performed by non-academic third parties; weight to tests performed in somewhat different countries or climates; weight to laboratory studies versus field studies versus epidemiological studies; and so forth.

We in the onsite field must set higher standards for the scientific documentation we expect for product approval and other decisions. But, let's also use all of the data at our disposal (imperfect as it may be) for making decisions, and accept that we will have to make judgments about the relative value or weight of these data.

As we discussed earlier, the scientific process resembles building a castle out of blocks. Each block is a study of some performance claim in which we are interested. What matters is whether there are enough blocks, of sufficient strength, to verify that a castle can stand.

And about the strength of the castle, you will have to make a judgment. As with practicing medicine, there will never be perfect certainly, but that should not keep you from making decisions or taking risks on new technologies. Just as in medicine, old remedies are often not the best remedies.

Yet despite the complications, science surely has to be the decision-making tool on which we need to rely in the future—as already does the rest of environmental management. Any other castles are made out of sand. SF

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Small Governments and the Regulatory Process

CONTRIBUTING WRITER
Steve Wilson

Editor's Note: This is the second half of a two-part column dealing with small governments and environmental protection.

There are communities in the U.S. that are so small, so geographically isolated, so impoverished that they have neither the financial, technical, or managerial resources to meet even the basics established by national and state environmental laws.

That this is a national problem becomes obvious only when you step back and consider the numbers of people affected. According to the Census Bureau, as many as 61 million people live in rural areas where we might expect to find most of the country's small towns.

Developing Regulations

Helping small communities comply with existing environmental laws and regulations is important, but only half of the equation. The other half involves small communities in the actual design of new regulations. The U.S. Environmental Protection Agency's (EPA) program offices have long worked to involve small communities in the regulatory process.

Since 1996, EPA has stepped up these efforts by implementing the Small Business Regulatory Enforcement Flexibility Act (SBREFA) amendments to the Regulatory Flexibility Act. Simply put, these laws provide a process for involving small towns in the development of regulations.

Involving small communities in developing regulations turns out to be a very difficult thing—too early in the process, and there is little or nothing to talk about; too late in the process, and comments from small towns are likely to have little impact.

The other big problem is the demand on the time and energy of the individuals involved. If a part-time, small town mayor who must also make a living has difficulty keeping up with existing complex and technical environmental rules, imagine how difficult it is for that person to keep up with technical briefings, discussion papers, draft rules, and the like.

In order to find a solution to these and other problems, EPA has been experimenting with different ways to involve small towns. The Small Community Outreach Project for the Environment is one such project that involves small towns and local universities.

Policy Consultation

In 1996, EPA created the Small Community Advisory Subcommittee (SCAS) of the Local Government Advisory Committee. The specific objectives of the SCAS are to

- change the way EPA and state environmental agencies develop environmental regulations impacting small communities,
- effectively inform policy makers about the disproportionate costs of providing environmental protection for small communities, and
- encourage EPA, states, and third party providers to offer a range of technical assistance and professional services to small communities.

Although SBREFA can be an effective process for involving small communities in rulemaking, that involvement does not happen early enough to be effective. SCAS has found that the Office of Management and Budget (OMB), the Small Business Administration (SBA), and EPA pay more attention to national associations representing local government and small business than to people living and working in smaller communities. SCAS determined that EPA, OMB, and SBA put too much emphasis on gathering the opinion of Washington-based institutions that represent some small communities.

The SCAS recommended that EPA increase direct involvement of small communities in the regulatory process and reaffirm its commitment to small community consultation for any rule that has an impact on any small community.

Another recommendation was that, building on the work of EPA's Office of Groundwater and Drinking Water, each EPA program office regularly promulgating regulations should establish a core group of small community representatives. The core group would be a group of advisors sufficiently knowledgeable to provide meaningful individual input on several rules. The program offices would be responsible for core group orientation about the specific issues associated with the rule. A consultation plan for each rule should state how these small community experts would be consulted and, if necessary, supplemented with other knowledgeable advisors during the rule making process. SF

Steve Wilson works for the EPA in the Congressional and Government Relations Office of the Office of Water as EPA's Small Community Coordinator.

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