SMALL FLOWS QUARTERLY

SF

Helping America's Small Communities Meet Their Wastewater Needs

JURIED ARTICLE

Field Assessment of Onsite Rock-Plant Filters in Kansas

Tracking Sewage with Infrared Technology

Spring 2000 Volume 1, Number 2

NATIONAL SMALL FLOWS CLEARINGHOUSE

Helping America's Small Communities Meet Their Wastewater Needs

Tim Suhrer, *Small Flows Quarterly* Editor

From the Editor

Welcome to the second issue of the *Small Flows Quarterly*. Our first issue was a broadside aimed at laying out our conviction that management is the key to success for the onsite wastewater treatment industry. I had planned to swing about with this issue and present more in the way of technology; however, there are still some basic issues concerning onsite system management that we need to deal with in a general way.

For instance, what are the nuts and bolts you need to consider before setting out to put together a management district (p. 30)? If you are a small community with limited financial resources, is it possible to install a wastewater treatment facility yourself (p.25)? We also need to examine the barriers to widespread acceptance of alternative onsite treatment systems (p. 28) that exist not only as regulatory and economic facts, but also as perceptions in the public mind.

On to technology, then, and the murky waters of high-strength wastewater treatment (p. 14); it is an ill-defined area, and we have made an attempt to pull together information on the challenges faced in the onsite treatment of commercial wastewater and suggested methods for designing systems.

In addition to our peer-reviewed paper on rock-plant filters (p. 36), we are presenting a paper on virus removal in standard septic tanks (p.26) that I have edited as a technical article. This is a practice I intend to continue in order to give important and interesting papers the wider audience they deserve and to further inform our readers.

Those are just the highlights–read on, and as always, I welcome your comments, suggestions, and story ideas.

Wanted:

Onsite System Educational Materials

Read any good septic system brochures lately? If so, the National Onsite Demonstration Project (NODP) needs your help.

The NODP is conducting a massive nationwide search for copies of, or information about, public education materials concerning onsite wastewater systems. According to John Mori, NODP executive director, the organization would like either to receive actual copies of the materials or tips about how to locate them.

"We are interested in seeing everything communities are using—from brochures and newspaper articles and inserts, to homeowner packets, manuals, and Web sites," Mori says. "We are looking for anything that towns, counties, states, companies, or organizations publish to educate residents about onsite systems, their operation and maintenance, or their potential impact on public health and the environment."

Your Community Will Benefit

The NODP may seek permission to use portions of the materials it receives to create new improved materials or to copy or adapt existing materials in their entirety. Of course, credit will be given to the people and communities who developed the original materials. The new materials, in turn, will be sent out to everyone who contributes. In addition, the new materials will be available through the NODP to communities and organizations interested in beginning their own onsite system public education programs.

If you would like to help the NODP, please send materials or information to Donna Pifer, Onsite System Materials Search, NODP, WVU, PO Box 6064, Morgantown, WV, 26506-6064. Contact Ms. Pifer via e-mail at *dpifer2@wvu.edu*, or by phone at (800) 624-8301 or (304) 293-4191, ext. 5502.

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Peter Casey, P. Eng. | Program Coordinator

Timothy Suhrer | Managing Editor

Cathleen Falvey | Associate Editor

Eric Merrill | Senior Graphic Designer
Kairi Frame | Graphic Designer

Colleen Mackne | Promotions Writer/Editor

Margaret C. McKenzie | Staff Writer
Marilyn Noah | Staff Writer
Natalie Eddy | Staff Writer

Jennifer Hause | Engineering Scientist
Tricia Angoli | Engineering Scientist
Andrew Lake | Engineering Scientist

Article Submissions
Small Flows Quarterly welcomes letters to the editor, articles, news items, photographs, or other materials for publication. Please address correspondence to:

Editor, *Small Flows Quarterly*
National Small Flows Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064
(800) 624-8301 or (304) 293-4191
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The National Small Flows Clearinghouse, established by the U.S. Environmental Protection Agency under the federal Clean Water Act (CWA) in 1977 and located at West Virginia University, gathers and distributes information about small community wastewater systems. *Small Flows Quarterly* is funded through a grant from the U.S. Environmental Protection Agency.

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SF

JURIED ARTICLE

Field Assessment of Onsite Rock-Plant Filters in Kansas

Kyle R. Mankin
G. Morgan Powell

36 In this study, three residential sites in southeastern Kansas using rock-plant filters were monitored for two years. Health officials in Kansas are investigating cost-effective, low-maintenance alternative onsite wastewater treatment systems for areas of the state with tight subsoils that limit water infiltration in soil absorption systems.

IN THIS ISSUE...

Arkansas Sanitarian Uses

Infrared Technology

To Track Down Sewage

Natalie Eddy

22 John Church, with the Arkansas Department of Health, uses a helicopter equipped with a Forward Looking Infrared (FLIR) imaging system, video equipment, and a global positioning system (GPS) to find, film, and map sewage runoff entering Lake Conway. Residents of the area contracted Church to track down the source of the runoff, suspected to be septic effluent from failed septic systems and straight piping. More than 75 subdivisions are located on or near the lakeshore.

NODP Update

NODP II Helps Rhode Island Improve Coastal Pond

Jill A. Ross

10 Seven failed onsite systems in Rhode Island's Green Hill Pond Watershed have been replaced with alternative and innovative wastewater treatment systems. These have helped to improve the water quality of a poorly flushed, severely degraded, 400-acre, coastal pond.

NATIONAL SMALL FLOWS CLEARINGHOUSE

FY 2000 Guidelines for the American Indian Environmental General Assistance Program

The U.S. Environmental Protection Agency's (EPA) American Indian Environmental Office has issued final guidelines on the award and management of general assistance agreements for Indian tribes. Established in 1993, General Assistance Program (GAP) funds assist tribal governments and intertribal consortia in planning, developing, or establishing environmental protection programs. This new document provides national policy guidelines and criteria aimed at promoting national consistency and appropriate use of GAP funds. A copy of the guidelines can be found at the EPA's Web site at *http://www.epa.gov/indian/gap2000.pdf.*

Draft Unified Policy for Watershed Management on Federal Lands Released

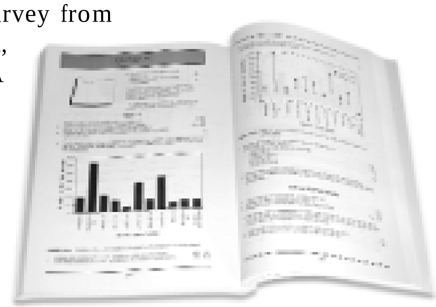
Agriculture Secretary Dan Glickman and Interior Secretary Bruce Babbitt announced a proposal to unify federal efforts to protect water quality on federal lands. A key action of the President's Clean Water Action Plan, the proposal is a starting point for obtaining input from local, state and tribal governments, citizen groups, and others with a stake in clean, healthy watersheds.

The proposal is a framework to protect public health, reduce polluted runoff, improve natural resources stewardship, and increase public involvement in watershed management on federal lands. Listening sessions will be held around the country to discuss the proposed policy. For a copy of the proposed policy, visit *http://www.cleanwater.gov/ufp* on the Internet.

Deadline To Submit Information about Onsite Systems Is July 31

Those who want their information to be included in the upcoming health department report need to turn in their survey forms to the National Small Flows Clearinghouse (NSFC) by July 31, 2000. Surveys were sent to health departments and other local permitting agencies throughout the U.S. to gather information about the status of onsite systems for the year 1998.

If the form has already been completed and returned, thank you for your assistance. If another survey form is needed, please contact Tricia Angoli, NSFC technical assistance specialist, at (800) 624-8301.



This is a follow-up effort to a first survey from which data was compiled into a report, "National Onsite Wastewater Treatment: A National Small Flows Clearinghouse Summary of Onsite Systems in the United States, 1993," which provides information about alternative and conventional onsite systems across the country. The NSFC will be creating a new report based on 1998 information that builds on the data collected from 1993.

Information sought includes the number of new onsite systems permitted, types of onsite technologies permitted, number of onsite systems reported to have failed, licensing/certification, system costs, and when systems are inspected. The quality of the information depends on the level of participation by local and state officials.

Because everyone's response to this project is vital, all agencies taking the time to complete and return the form will be eligible to purchase a variety of educational materials from the NSFC at special bulk rates.

To find out more about the health department report about onsite systems, call the NSFC at (800) 624-8301 or (304) 293-4191. SF

EPA To Publish Draft Voluntary National Standards for Onsite Management

A draft version of the U.S. Environmental Protection Agency's (EPA) "Voluntary National Standards for Management of Onsite/Decentralized Wastewater Systems" is undergoing a final round of internal review. The agency plans to publish the draft standards in the *Federal Register* by late spring.

"We received many thoughtful comments on the preliminary draft standards," said Robert Lee, chief of the EPA's Municipal Technology Branch. "In response to the comments received, we have simplified the standards and will also prepare a companion guidance document to assist communities and states in implementing the standards. An outline of this guidance document will be included with the draft management standards."

There will be a 60-day period for submitting comments after the standards are published in the *Federal Register*. For additional information concerning the draft standards, contact Lee at (202) 260-7356 (e-mail *lee.bob@epa.gov*), Joyce Hudson at (202) 260-1290 (e-mail *hudson.joyce@epa.gov*), or Steve Hogye at (202) 260-5841 (e-mail *hogye.stephen@epa.gov*). SF

Calendar of Events

MAY

85th Annual New Jersey Water Environment Association Conference & Exposition
New Jersey Water Environment Association
May 1–5
Atlantic City, New Jersey
(201) 670-5576

Buffers: Commonsense Conservation for Urbanizing Landscapes
The National Arbor Day Foundation with financial support from U.S. Department of Agriculture's (DA) Natural Resources Conservation Services, U.S. Environmental Protection Agency (EPA), U.S. Fish & Wildlife Service, and USDA Forest Service
May 9-11
Nebraska City, Nebraska
(888) 448-7337

Regional Water Planning Conference
National Ground Water Association
May 17–18
Austin, Texas
(800) 551-7379
Bob Masters *rmaste@ngwa.org*

JLC Live! 2000 Construction Training Shows
Journal of Light Construction
May 19–20
Providence, Rhode Island
Larry Rice (802) 434-4873
http://www.jlclive.com
lrice@bginet.com

2nd International Conference of Remediation of Chlorinated and Recalcitrant Compounds
Battelle, U.S. Microbics, Geomatrix, Parsons Engineering Science, Inc., NAVSAC, Environmental Technologies, Inc., and Regenesis
May 22–25
Monterey, California
(800) 783-6338

WEF/Purdue Industrial Wastes
Water Environment Federation
May 21–24
St. Louis, Missouri
(703) 684-2400

JUNE

22nd Annual Hawaii Water Environment Association Conference
Hawaii Water Environment Association
June 5–7
Honolulu, Hawaii
(808) 521-4711

*** Second Annual Onsite Wastewater Regulators Conference**
National Small Flows Clearinghouse
June 11–14
Denver, Colorado
Sandy Miller (800) 624-8301

National Wastewater Operator Trainers Conference
Utah Department of Environmental Quality, The Water Environment Association of Utah, and EPA
June 11–14
Salt Lake City, Utah
(800) 637-4390

Onsite Wastewater Systems Conference
National Environmental Health Association (NEHA)
June 15–18
Denver, Colorado
(303) 756-9090

*** 2000 NEHA Annual Educational Conference and Exhibition**
NEHA
June 15–19
Denver, Colorado
(303) 756-9090
(303) 691-9490
staff@neha.org

15th Annual Training & Technical Conference
Louisiana Rural Water Association
June 19–23
Alexandria, Louisiana
(337) 738-2896
lrwa@beci.net

JULY

ASAE Annual International Meeting: "Engineering Solutions for a New Century"
The American Society of Agricultural Engineers
July 9–12
Milwaukee, Wisconsin
(616) 429-0300

Protecting Florida's Environment
Florida Onsite Wastewater Association
July 20–22
Ocean Center Daytona Beach, Florida
(850) 402-9230

Multidisciplinary Water Resources Conference
American Society of Civil Engineers
July 30–August 2
Hyatt Regency Minneapolis, Minnesota
(800) 548-2723

AUGUST

AWRA Summer Specialty International Conference: Riparian Ecology and Management in Multi-Land Use Watersheds
American Water Resources Association
August 27–31
Portland, Oregon
Jim Wigington (541) 754-4341
http://www.awra.org/meetings/portland/portland.html

International Exhibition of Technologies for Public Cleaning and Solid Waste
Associacao Braslleira de Engenharia Sanitaria e Ambiental Capftulo Nacional da AIDIS
August 29–31
Sao Paulo, Brazil
(21) 537-4338

SEPTEMBER

Texas Water: 2000 and Beyond
Texas A&M University
September 30–October 2
College Station, Texas
Jim Norwine *kfjrn00@tamuk.edu*
Rick Giardino *Rickg@tamu.edu*
Sushma Krishnamurthy *Skrishna@tamiu.edu*

8TH Annual International Activated Carbon Conference
Professional Analytical and Consulting Services, Inc.
September 21–22
Pittsburgh, Pennsylvania
(800) 367-2587

JLC Live! 2000 Construction Training Shows
Journal of Light Construction
September 29–30
Las Vegas, Nevada
Larry Rice (802) 244-9987
http://www.jlclive.com
lrice@bginet.com

Short Courses and Continuing Professional Education

The 8th Annual Course! Practical Applications in Hydrogeology
Cook College Rutgers, The State University of New Jersey
May 4, 11 & 18
New Brunswick, New Jersey
(732) 932-9271

Onsite Wastewater Disposal Systems: Regulation, Design, Inspection, Operation and Maintenance
Cook College, Rutgers University
May 17 & 24
New Brunswick, New Jersey
(732) 932-9271

The Advanced Clean Air Compliance Course
"Now and in the Future"
Government Institutes Division, ABS Group Inc.
July 10–11
Washington, DC
(301) 921-2345

Compliance Monitoring for Title V/Part 70
"One-Stop Shopping" for the Compliance Professional
Government Institutes Division, ABS Group Inc.
July 12–13
Washington, DC
(301) 921-2345

The Environmental Compliance Boot Camp
Government Institutes Division, ABS Group, Inc.
July 17–21
Hilton Head, South Carolina
(301) 921-2345

The Environmental Training Institute for Small Communities
National Environmental Training Center for Small Communities
West Virginia University
July 31–August 5
Morgantown, West Virginia
Sandy Miller (800) 624-8301

If your organization is sponsoring an event that you would like to have promoted in this calendar, please send information to the *Small Flows Quarterly*, Attn. Annette Judy, National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Or contact Ms. Judy at (800) 624-8301 or (304) 293-4191, or via e-mail at *ajudy@wvu.edu*.

* Denotes that NSFC staff will be attending.

Century's Change Brings

Earth Day's 30th Anniversary

STAFF WRITER

Natalie Eddy

On April 22, hundreds of millions of people worldwide participated in the 30th anniversary celebration of Earth Day. The celebration involved thousands of events from rallies and parades to concerts and earth fairs according to Michelle Ackermann, communications director of Earth Day Network, the international organization coordinating Earth Day 2000 events worldwide.

Ackermann said this year's Earth Day differed from those in the past because it focused on one specific theme: clean energy now. Organizers hope to call attention to issues of energy and global warming.

"Energy and global warming are issues that affect all of us around the world,'' Ackermann said.

In the Beginning

Ushering in a new decade after the tumultuous 1960s, 1970 was a year of national unrest. During 1970, Richard Nixon was serving his second year in office and the Vietnam War raged on while anti-war sentiment grew with increasing protests and marches. Notable events of 1970 included the shootings at Kent State as well as the Apollo 13 astronauts' failed moon mission and narrow escape from disaster. It was during this turbulent time that former Wisconsin Senator Gaylord Nelson proposed holding a nationwide "environmental teach-in'' on college campuses across America, modeled after the now famous anti-war protests.

In a speech Nelson gave at the University of Illinois in 1990, he recounted the events that led to Earth Day's formation. "For years prior to Earth Day it had been troubling to me that the critical matter of the state of our environment was simply a non-issue in the politics of our country. The puzzling challenge was to think up some dramatic event that would focus national attention on the environment.

Finally, in 1963, an idea occurred to me that was, I thought, a virtual cinch to get the environment into the political limelight once and for all.''

Nelson's plan was to have then President John F. Kennedy promote a nationwide conservation tour, explaining the importance of the environment. In the fall of 1963, Nelson and Senators Hubert Humphrey, Gene McCarthy, and Joe Clark accompanied Kennedy on the tour through Pennsylvania, Wisconsin, and Minnesota.

Nelson said the tour didn't achieve what they had hoped, but it became "the germ of the idea that ultimately flowered into Earth Day.''

Six years later, in July 1969, Nelson decided to have a teach-in. After garnering support, the first national environmental teach-in was planned for the spring of 1970. This event became the first Earth Day. Denis Hayes was the national organizer for the first Earth Day and today is chair of the Earth Day Network.

"Earth Day achieved what I had hoped for. The objective was to get a nationwide demonstration of concern for the environment so large that it would shake the political arena. It was a gamble, but it worked. An estimated 20 million people participated in peaceful demonstrations across the country,'' said Nelson.

Earth Day 1970 led to the creation of the Environmental Protection Agency and the passage of the Clean Air Act, the Clean Water Act, and the Endangered Species Act.

Twenty years later, more than 200 million people worldwide from 141 countries participated in Earth Day 1990. Later that year, Nelson and Bruce Anderson, a solar energy architect, author, and New Hampshire Earth Day organizer, co-founded Earth Day USA with the hope of making Earth Day an even more visible annual event.

In 1995, Earth Day USA launched *http://www.earthday.org* on the Internet. In 1999, the organization closed it doors and passed its Web address on to Earth Day Network, headquartered in Seattle, Washington, which now spearheads the event.

Hayes commented, "That Earth Day has survived as an annual, international event is a heartening testament to the strength of a good idea. Earth Day is also evidence that substantial numbers of us can transcend our troublesome tribal reflexes and embrace the reality that we all live in a place known as 'downstream.' "

For more information about Earth Day 2000 and the organizations and countries participating, log onto Earth Day Network's Web site at *http://www.earthday.net.* SF

EARTH DAY TIMELINE

1963..
Former Wisconsin Senator Gaylord Nelson's conservation tour with President John F. Kennedy travels through Pennsylvania Wisconsin, and Minnesota.

1970..
First National Environmental Teach-In is held. Twenty million people participate across the country.

1970..
The U.S. Environmental Protection Agency is created.

1970..
The Clean Air Act is passed.

1972..
The Clean Water Act is passed.

1990..
Earth Day draws 200 million participants from 141 countries.

1990..
Earth Day USA is founded.

1999..
Earth Day USA merges into Earth Day Network.

2000..
30-year anniversary of Earth Day.

Wastewater on the web...

Local Government Financial Aid Websites

U.S. Environmental Protection Agency's (EPA) Environmental Finance Program Web Site

http://www.epa.gov/efinpage/

This Web site provides guidance and information on financing sources for state and local governments. It also includes a *Guidebook of Financial Tools* and links to an Environmental Finance Center Network.

Region 2 Maxwell Environmental Finance Center (EFC) at Syracuse University

http://www.exed.org/EFC/efc.html

The Maxwell EFC provides services and information to state and local governments and the private sector pertaining to environmental governance, utility rate-setting, capacity development, and technical assistance in cost-effective environmental management.

Region 3 Environmental Finance Center at the University of Maryland

http://www.mdsg.umd.edu/EFC/index.html

The center promotes alternative and innovative ways to manage the cost of environmental activities, provides training and development opportunities in environmental management, and works to increase awareness of benefits associated with sound environmental management policies.

Region 5 Great Lakes Environmental Finance Center at Cleveland State University

http://www.csuohio.edu/glefc/

The Great Lakes (EFC) provides services to organizations and state and local governments including financial and economic analysis and strategies, policy analysis and planning, training seminars and conferences, information distribution and exchange, and report and publication series.

Region 6 Environmental Finance Center at the University of New Mexico

http://nmeri.unm.edu/

The New Mexico EFC specializes in providing technical assistance and information about environmental financing opportunities. It helps decision makers overcome capital market barriers and develop techniques for funding environmental mandates.

Once at the site, select "Research Thrusts" from the menu on the left and then select "Environmental Engineering and Finance Center."

Region 9 Environmental Finance Center at California State University at Hayward

http://barney.sbe.csuhayward.edu/~efc9/

This EFC's mission is to inform public and private environmental entrepreneurs, investors, and financial managers about business and investment opportunities available within the environmental industry, and to assist these parties in taking advantage of these opportunities. Services include conferences and seminars, course development, advisory panels, and financial research.

Region 10 Environmental Finance Center at Boise State University

http://sspa.idbsu.edu/efc/

This EFC is committed to helping the regulated community build and improve the mechanical, managerial, and financial capabilities needed to comply with federal and state environmental laws.

Grant Scape

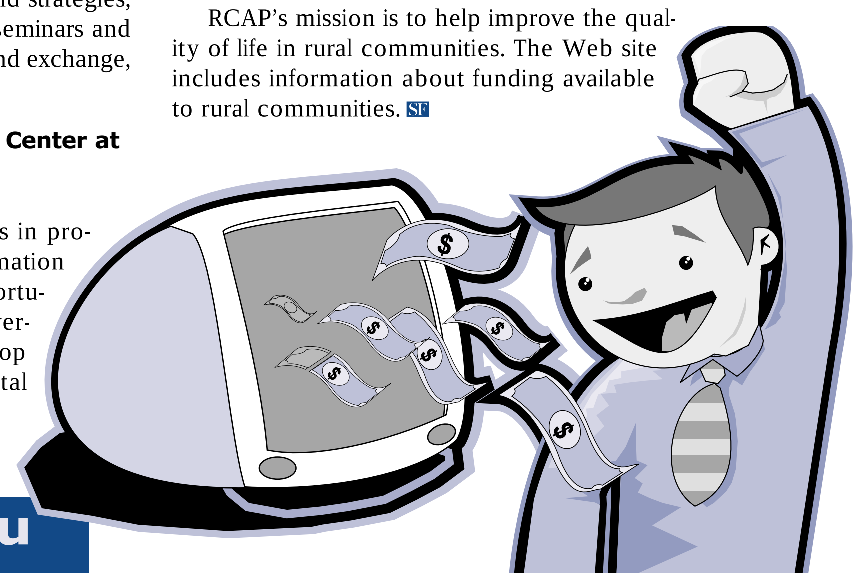
http://www.grantscape.com/omaha/grants/services/101.html

Grant Scape offers general funding and grant information. Sections of the Web site include Funder of the Day, What's New, Nonprofit Forum, and Grant Seeking 101.

Rural Community Assistance Program (RCAP)

http://www.rcap.org/

RCAP's mission is to help improve the quality of life in rural communities. The Web site includes information about funding available to rural communities. SF



Reservations about Management of Decentralized Wastewater Treatment Systems and "Alternative Systems"

CONTRIBUTING WRITER
Randy May

Writing this piece strikes me as an act akin to declaring my opposition to the American Flag and apple pie. Please read it with an eye toward the fact that I am voicing concerns common to many of us in the regulatory community. Being a regulatory engineer and general curmudgeon, I am able to raise the following serious reservations about some favorite themes in our field.

Is management of all systems achievable?

All rational players in our field recognize the desirability of the concept of managing decentralized systems even for the simplest septic tank/leachfield system. Management becomes absolutely critical for successfully dealing with any more advanced technologies with moving parts. I am skeptical, however, about exactly how we get there.

In 1977, I co-authored a legislative report on the creation of a "sewer avoidance program." The resultant legislation gave Connecticut's municipal water pollution control authorities, in conjunction with our health jurisdictions, all the legal tools they needed to create centralized management of decentralized sewage systems. With the exception of some "community sewerage systems" (cluster systems for pollution abatement and new development), no municipality or service district has been willing to use these tools. In other words, no municipal government has been willing to manage individual onsite systems.

Even when the state offered 100 percent grants for onsite repairs we had no takers. The idea of government having an easement to inspect and service backyard systems is as popular in New England as George III and his tea tax. I believe we need to bridge this gap of political wills before we will see effective management models.

What are alternative systems?

I am amused that we have no national definition for "alternative systems"—a sure method of preventing progress. There are many options, but for the purposes of this discussion, I am limiting my definition of alternative to those onsite systems that use secondary or tertiary mechanical treatment prior to an individual onsite leaching system. (I am not including community or cluster systems in the definition because engineering scale and management potential for these systems are quite different. We have many such systems in Connecticut and a near perfect success rate with them.)

The popular claim is that alternative onsite systems improve treatment, allow development of "unsuitable" land, reduce costs, avoid urban sprawl, and probably cure the common cold. The following are my questions about this thesis.

What scope are we talking about managing?

I can see the validity of using alternative systems at a mythical Lake Pristine, with 30 seasonal homes on till soils, shallow to bedrock, and already suffering early eutrophication. However, that is not a real-world problem for me or for most regulators.

In my jurisdiction, a real problem is more like 400 to 700 houses on postage-stamp sized lots in a lake or seashore area. Usually these sites have severely limited soils thanks to the glacier. I have been told that the Canadians call these "urban densities in rural areas" (UDIRAs). In most of these cases the systems either have surfacing failures or are hopelessly overloading groundwater resources.

We need consensus on realistic numbers for which to consider alternative technologies as solutions. The idea of managing many hundreds of such systems seems to run counter to common sense.

Stop bad-mouthing conventional onsite systems

Our literature is replete with studies that illustrate that properly sited, designed, and installed conventional systems at rational densities are the most elegant and effective sewage disposal systems out there. Read the literature with care and understand that, when done properly, conventional septic systems are passive, cost-effective, tertiary systems.

Recently, one author compared use of such systems with the long discredited practice of primary treatment/point source discharges to surface waters. That is a false analogy. A septic tank is a primary treatment tank where physical operations predominate. As a result, great process stability is the rule. The biomat in the leaching system and surrounding unsaturated soils structure provides highly stable secondary and tertiary treatment of effluent, virtually unmatched in sanitary engineering.

Let's thoroughly read the literature before leaping to conclusions. Be mindful of what I humbly call May's first law—"in sewage treatment, make it strong and simple."

Stop advocating the use of alternative systems to develop "unsuitable" land

Land that is "unsuitable" for a conventional system is usually in that category due to hydrogeologic and other physical limitations. This means that there are other construction and environmental reasons not to develop these sites. Touting alternative systems as a way to develop such land flies in the face of wise and sustainable development, wetlands protection, and coastal area management, among other federal initiatives and state water quality and resource protection laws.

Stick with what has been demonstrated to work

Remember some realities of engineering. First, there is the law of engineering scale. You cannot simply scale a process or device up or down on a one-to-one basis and expect it to work. This is certainly true in process engineering of sewage treatment. Secondly, remember how difficult it is to operate advanced wastewater treatment plants even with trained operators. Finally, one or two test systems operated by swarms of graduate students do not translate into field performance.

In my opinion, the following alternative technologies clearly meet the tests stated above: intermittent sand filters (with a tip of the hat to Oregon) and properly designed, constructed, and operated recirculating sand filters. I believe sequential batch reactors make sense at this scale, but that is not yet established in the literature. We badly need aggressive third-party investigation of success/failure of other alternatives following the model investigations of Hoover and Amoozegar in North Carolina.

Conclusions

Being overly conservative is the bane of our field, and I may be guilty of it. However, the "alternatives are great" train is moving out of the station without an engineer and with too few of us who bear the societal responsibility for our decisions on board. Let's get more answers before we open the throttle. SF

Randy May is a supervising sanitary engineer with Connecticut's Department of Environmental Protection, where he has worked for 27 years. He has written and presented numerous papers on wastewater topics; his prime interest is the application of hydrogeologic evaluation to land treatment systems. He is co-inventor of the Infiltrator leaching system.

Letter to the Editor

Dear Editor,

I thank you and the National Small Flows Clearinghouse for publishing my series of three articles about onsite systems in the 21st century in the 1999 Spring, Summer, and Fall issues of *Small Flows*. I received a number of calls from your readers telling me that they agree with the views presented in the articles and they all would like to see the industry move in those directions. I want to thank all the readers who called and I am sure that if all the players take the necessary actions, the future of onsite systems is quite good.

I also received one call from Colorado disagreeing with my statement on the use of constructed wetlands. Then, I also read the letter from Michael Ogden, P.E., in the Fall issue of *Small Flows*, expressing disagreements and serious concerns about the statement, "It is practically impossible to obtain uniform quality of effluent consistently with such a system." To both the caller from Colorado and Mr. Ogden, and to all other readers who may have similar concerns, I would like to say that I never intended to create any bias for any technology. Natural systems like constructed wetlands can and do offer a good alternative for treating wastewater, provided they are adequately designed and provisions are made to adjust the operation when needed to account for variability in influent quality.

Many times I have seen the use of constructed wetlands being promoted for single-family homes and for small clusters of homes (typically less than 500-gallons-per-day systems) just because it's simple, passive, and natural, without giving due regard to the actual performance of the technology for treating wastewater. I have been to sites where the effluent from a constructed wetland looked and smelled no different than septic tank effluent. Such use of wetlands bothers me. I don't believe in promoting any system just because the system requires no pump or other mechanical components, like a conventional septic drainfield.

I also believe that the designer or the engineer must take responsibility for the performance of a system and must be held accountable for achieving the performance goals of the system for at least the first 3 to 5 years of operation. To those designers and engineers who have figured out a way to make constructed wetlands work on a consistent basis, I say go for it, and also document and promote your concepts. There is no reason for any one, especially the regulators, to prohibit competent designers or engineers from doing the right system, particularly when the designers are ready to take the financial responsibilities for changing the system's design in case it doesn't operate as planned.

Sincerely yours,
Anish R. Jantrania, Ph.D., P.E.

NODP II Helps Rhode Island Improve Coastal Pond

CONTRIBUTING WRITER

Jill A. Ross

Seven failed onsite systems in Rhode Island's Green Hill Pond Watershed have been replaced with alternative and innovative wastewater treatment systems. The new systems are performing well and helping to improve the water quality of a severely degraded 400-acre poorly flushed coastal pond.

Part of Phase II of the National Onsite Demonstration Project (NODP), these innovative onsite systems are being closely monitored and are performing as researchers expected them to, said David Dow, program manager of the University of Rhode Island Onsite Wastewater Training Center (URI-OWTC) and project manager for the NODP sites.

"All of the new systems have been installed and are working well," said Dow. "For the most part, everything has gone according to plan—the systems are functioning as expected, and the homeowners are pleased with their new systems."

Green Hill Pond, located along Rhode Island's southern coastline in the communities of South Kingstown and Charlestown, has been closed to shellfishing since 1993 due to nonpoint source pollution. According to Dow, one of the main causes of this pollution is marginally functioning and failed septic systems, which have contributed to high fecal coliform counts and eutrophication from excess nitrogen.

"Years ago the small homes located in this coastal area were only used seasonally—maybe two or three months of the year," said Dow. "Today these homes are used much more extensively—for nine months or more."

The increasing human presence in this sensitive environment, combined with the fact that most of these homes are located on very small lots (5,000 square feet or less) served mostly by cesspools that often come into contact with the water table, has resulted in serious water quality problems for the Green Hill Pond Watershed.

NODP Assists in Pond Cleanup

In an effort to improve this deteriorating situation, the URI-OWTC applied for and received funds in 1998 through the NODP II, a U.S. Environmental Protection Agency (EPA)-funded project that seeks to demonstrate innovative and alternative onsite wastewater treatment technologies in environmentally sensitive areas. NODP II is administered by the National Small Flows Clearinghouse in Morgantown, West Virginia.

The URI-OWTC worked closely with the Rhode Island Department of Environmental Management (DEM), the Rhode Island Coastal Resource Management Council, and the communities of South Kingstown (population 30,000) and Charlestown (population 10,000) to solicit candi-

Photo courtesy of David Dow

A five- by 15-foot raised bottomless sand filter provides final treatment of effluent on this site with a seasonal high water table of six inches. Effluent passes through two feet of engineered sand before final dispersal in native soil three inches below natural grade. The system is monitored and adjusted by a remote telemetry system accessed by personal computer from the University of Rhode Island campus.

dates for the demonstration sites. Homeowners were required to contribute $5,000 toward the $12,000 to $15,000 cost of new system installation.

"We were looking for year-round residents for the project and received 55 responses from which we selected seven sites for installations," said Dow. "All of the selected systems were cesspools or failing septic systems."

Dow explained that using onsite systems on such small lots requires an advanced level of treatment in order to incrementally improve the future water quality of the pond. "In some cases, a properly functioning conventional septic system is really not good enough. We have to look at nitrogen and pathogen reduction issues in this watershed," he said.

All seven sites used some type of advanced treatment unit. Technologies include a drip irrigation system; three variations of geotextile filters, one having a bottomless sand filter for final effluent polishing; a single-pass sand filter; a peat biofilter with an ultraviolet (UV) disinfection unit; and a fixed activated sludge treatment system followed by a UV unit. Five systems feature shallow pressurized drainfields—narrow drainlines only 10 to 12 inches deep using native soil. (See the box on page 45 for further details about the individual systems.)

Photo courtesy of David Dow

An Orenco Advantex geotextile filter system replaced a failing cesspool on this 5,000-square-foot lot. The system recirculates back to the septic tank, and discharge from the filter goes to a pump basin where it is dosed to a shallow, pressurized drainfield. The homeowners are artists and enjoyed customizing the lids and treatment unit for the system.

All the systems were installed between April and June 1999. URI-OWTC staff are monitoring systems monthly, Dow said, and this will continue for another year.

"We are currently fine tuning the systems to maximize nitrogen removal," said Dow. "Biochemical oxygen demand and total suspended solids concentrations from all systems are less than 10 milligrams per liter. Two of the systems incorporating UV disinfection units in the treatment train show complete fecal coliform removal."

Dow admitted that homeowners need to pay extra attention to these systems. URI-OWTC staff members are running the systems now; homeowners only call if they experience problems. However, plans are to have a municipal management program for all systems in the watershed by June 2001.

Homeowners are satisfied with their new systems, and now some of their neighbors are even having similar innovative systems installed, said Dow.

These demonstration systems have been approved by the Rhode Island DEM for use as repairs for failing systems, said Dow. "This enables homeowners to install these types of systems without a variance, thereby streamlining the permit process. Because of this, we've had good follow-through in the communities with designers and installers beginning to utilize these systems in critical resource areas."

Dow said the demonstration project also familiarizes regulators with these systems. These regulators will review formal applications from vendors for general use of these technologies.

Education Critical to Watershed's Health

The NODP II systems have raised awareness of the role that onsite wastewater treatment systems play in protecting the watershed, said George Loomis, soil scientist and URI-OWTC director.

"Through these demonstration projects we try to get as many people as possible educated about these newer technologies," said Loomis. "Once they are interested, they usually become advocates for alternative technologies."

Engineers and designers as well as municipal officials often tour the technology sites. Cooperative Extension's Home*A*Syst and Municipal Watershed Training Programs use these sites to engage local officials and homeowners in a dialog about wastewater management options. Loomis and Dow teach workshops about onsite wastewater treatment options and take homeowners, town officials, and board members on tours of the NODP II sites.

"You can talk to homeowners and try to explain and describe these systems, but once they see one installed in a neighbor's yard, that takes lots of the mystique away," said Loomis. He noted that often the public is quite interested in learning about onsite wastewater systems.

Additionally, URI-OWTC worked with the Rhode Island Independent Contractors and Associates to use the installation of the systems as a training venue for more than a dozen of the association's nearly 450 members. Loomis said that other local installers and designers were also invited to view the installations. This marks the third demonstration project that the contractors' association has supported fully.

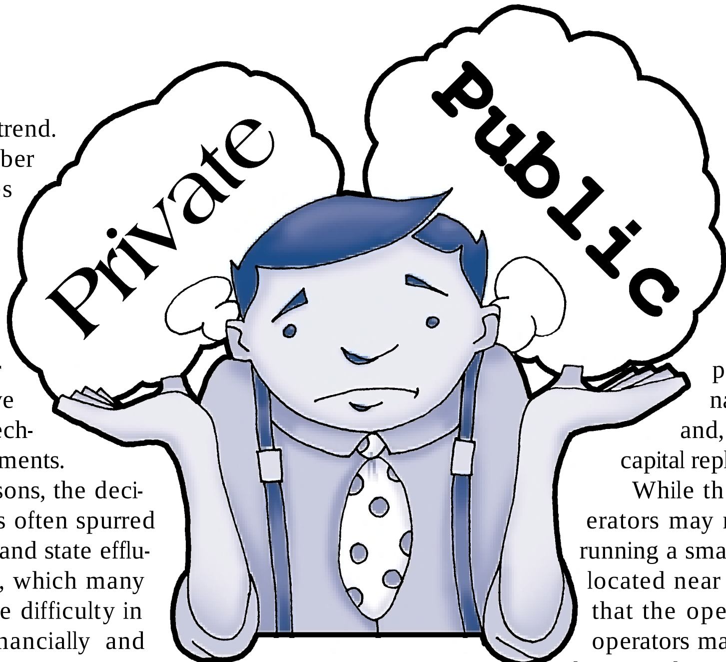
NODP II sites also have been used to help update the state's technical review committee, the group responsible for reviewing all new technologies submitted to the state for regulatory approval. "Committee members visit the sites once or twice a year to see what's new and how it is applied," said Loomis. Two of the technologies used at NODP II sites—the Bord na Mona Puraflo Peat Biofilter and the Biomicrobics FAST System—have now been approved by the technical review committee for use in the state.

CONTINUED ON PAGE 45

Should Small Communities Consider Privatization?

CONTRIBUTING WRITER

Michael Susman



It's a growing trend. A substantial number of municipalities around the country are contracting for the private operation and maintenance of their wastewater systems to achieve cost savings and technological improvements. Among other reasons, the decision to privatize is often spurred by stricter federal and state effluent requirements, which many communities have difficulty in meeting both financially and technologically. Private companies frequently are better able to operate and manage municipal wastewater systems by using trained and experienced personnel through economies of scale.

Although these private/public partnerships are becoming almost commonplace, small communities should proceed cautiously before throwing their hats into the privatization arena. In addition to carefully weighing all the pros and cons of privatizing a particular system, community leaders should be careful to select the right contractor and to develop an agreement that is tailor-made to protect the community and meet its needs.

Privatization Has Its Advantages

Recently, our legal firm represented two municipalities in Connecticut that privatized their wastewater treatment facilities. In each case we prepared requests for qualifications and proposals and drafted and negotiated contracts for the operation and maintenance of the municipality's wastewater treatment facilities by private third parties. Both of these communities will realize substantial savings over the fifteen-year terms of their agreements.

Often private entities are able to run wastewater facilities at a lower cost because they run other plants within the region. These firms are able to purchase chemicals and materials in bulk, obtain blanket insurance at a discount, and allocate labor costs among several different facilities. In addition to sharing the benefits of such cost savings, communities often are freed from the burden of operating and managing the wastewater facility, ensuring permit compliance, fielding customer complaints, and certain liabilities and other plant related expenses (e.g., maintenance and repair costs, and, in some cases, even capital replacements).

While the largest private operators may not be interested in running a small flows facility, if it is located near a larger flow facility that the operator services, such operators may bid on the project because their resources are already available nearby. Smaller regional operators will frequently be interested in managing even the smallest of plants. As a result, small flows facilities can reap the same benefits from privatization as larger systems.

What do operation and maintenance agreements entail?

Generally, privatization comes in two forms: a municipality may opt to enter into an operation and maintenance (O&M) agreement, or it may contract for the actual sale or lease of its system. Sales or leases of facilities remain rare. With an outright sale or lease of a municipal asset, a municipality must deal with difficult and complex financial, tax, and legal ramifications. Consequently, an agreement for the operation and maintenance of a wastewater system is the most prevalent choice.

An O&M agreement should cover at least the following topics:

- the term of the agreement;
- the scope of responsibilities;
- personnel matters;
- equipment, chemicals, materials and supplies;
- methods of operation;
- performance procedures, standards, and requirements;
- inspections;
- maintenance policy and standards;
- emergency plans;
- changes in law and uncontrollable circumstances;

- customer service;
- compensation;
- pass-through costs;
- performance and incentive payments;
- indemnification and liability limitations;
- default provisions; and
- dispute resolution and termination provisions.

Each privatization contract should be tailor-made to suit the needs of the community, and while the documents used by similar communities can be helpful, a municipality must exercise independent judgment in determining what is appropriate for it. Most importantly, the vendors must not be relied upon for advice or as consultants or to draft the O&M agreement. The municipality should decide its needs and priorities and set them out in the agreement. This is an important and time-consuming process, but it is the essence of a successful privatization.

Performance standards should be carefully considered so as to require that the vendor meet the more stringent of state or federal requirements and the standards set forth in the O&M agreement. Circumstances that constitute, or do not constitute, an uncontrollable circumstance or change in law need to be precisely set out so that all parties know their obligations and responsibilities.

Beware of Potential Tax Liabilities

If tax exempt bonds used to finance the facility are outstanding, as they usually are, a community must structure the terms and duration of the service agreement to conform to federal requirements, since the failure to do so could result in substantial tax liabilities.

In recent years, the Internal Revenue Service has expanded the number of years that a municipality may contract for the operation and maintenance of its public use facilities without jeopardizing its tax-exempt bond status. O & M agreements can be for a term of up to 20 years, as opposed to the five years previously allowed. As a result, local governments may take advantage of long-term contracting and its accompanying benefits. Additionally, federal law now permits municipalities to require the successful bidder to reimburse the municipality for its transactional costs, such as engineering and legal fees.

Select the Right Contractor

If permitted, bidders should be prequalified through a request for qualifications (RFQ) process by which they submit financial and field experience information. Once the qualified bidders are selected, a request for proposals (RFP) should be sent to each RFQ qualified bidder, with a draft O&M agreement as an attachment.

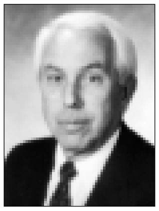
The RFP must comply with applicable procurement laws and should sufficiently define the process so that the bidders and the municipality know the scope of the undertaking from the start. The municipality should allow for a limited negotiation process during which the bidders may suggest alternate technical approaches, comment on the contract, and suggest revisions. The bidders may have technical suggestions to better accomplish some of the municipality's goals. In addition, allowing this dialogue materially reduces the risk of a legal challenge to the process for vagueness or unfairness.

Because each bidder will bid on the same O&M agreement, it should be relatively easy to evaluate the bid and select the lowest qualified bidder. The community does not have to second-guess whether a bidder has cut services in order to reduce its bid since the O&M agreement will already specify the services and performance standards that must be fulfilled by the successful bidder. This process also diminishes lobbying by prospective operators.

Address Labor Issues Upfront

Typically, labor issues are sensitive areas that must be addressed in the O&M agreement. Some union bargaining agreements may prohibit subcontracting of the facilities, and, therefore, it will be necessary to gain the union's consent and support in order to effectuate an O&M agreement. One of the ways to obtain a union's or employees' consent is to ensure job stability in the O&M agreement. The O&M agreement may require that the contract operator hire all of the current employees of the facility and prohibit layoffs other than for cause or by attrition for a set period or even the entire contract term. Also, the contract can require the payment of substantially similar wages and benefits packages currently provided by the community.

Privatization, regardless of the form, essentially creates a partnership between the private company and the municipality. The contract should address, in detail, the parameters of the relationship in order to avoid future confusion or disputes over the administration of the contract, or litigation. A municipality must understand that while it may be ridding itself of the risk of performing the service, it is not entirely rid of the obligations associated with the service. The municipality must pay close attention to its procurement process and create a contract that protects its citizens and actually realizes for it the benefits that motivate privatization in the first place. Finally, the municipality must assiduously monitor performance of an O&M agreement to ensure that the operator scrupulously complies with it. SF



Michael Susman is principal and co-founder of the law firm Susman, Duffy & Segaloff, P.C., located in New Haven, Connecticut. In addition to commercial and corporate law, his expertise includes real estate development and financing and municipal law, including wastewater treatment plant privatization. You may contact Susman at (203) 624-9830 or via e-mail at *ms@susmanduffy.com*.

The Best Wastewater Systems Consider

Flow Rate and Waste Strength

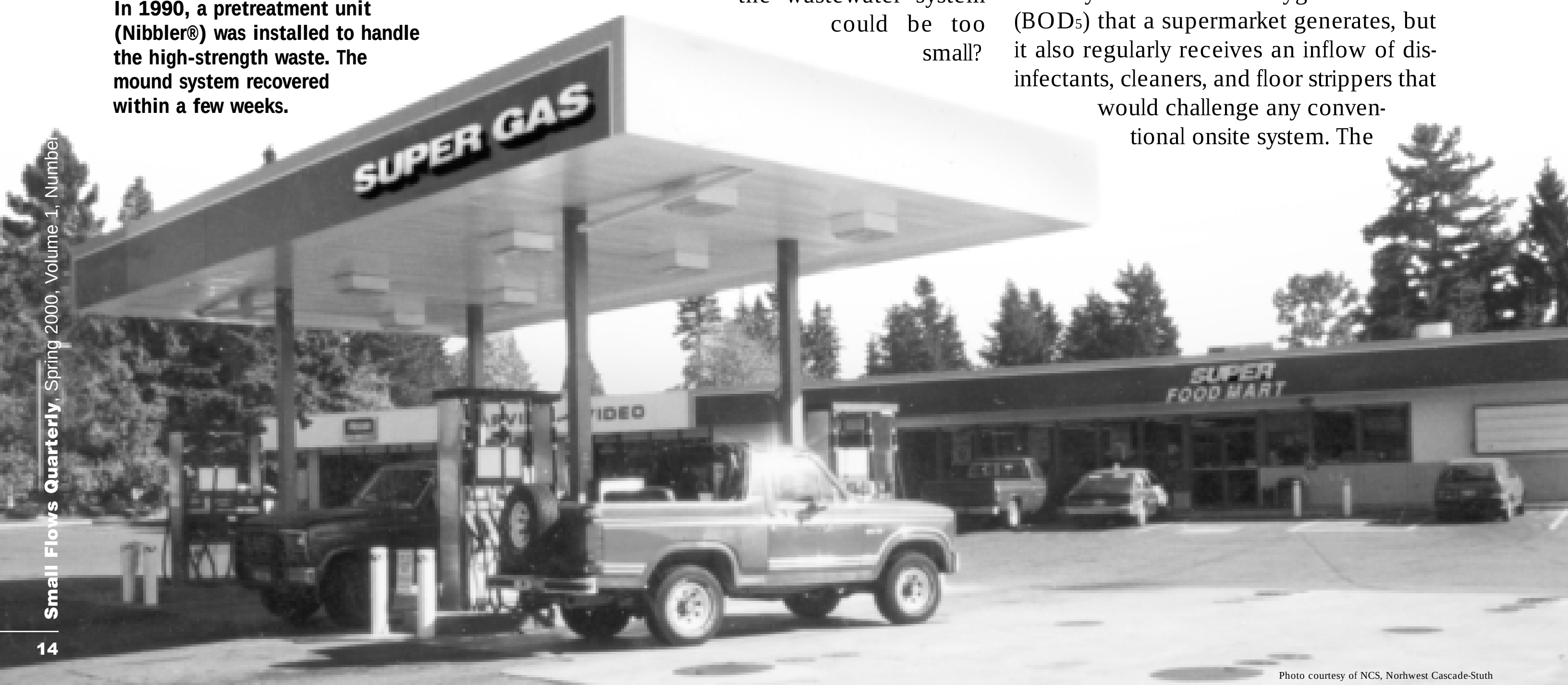
STAFF ENGINEERING SCIENTIST
Tricia Angoli

Your favorite supermarket is making you sick. How did this happen? You've shopped there dozens of times before and never noticed the foul odor that now seems to get worse with each visit. You know you won't go back.

Later you relate your experience to a friend from the county health department who tells you the foul odor is from raw sewage. "Untreated wastewater is surfacing from the shopping center's onsite system onto the ground," he explains. "The health department has received complaints and there is even talk of legal action against the supermarket." You wonder if the wastewater system could be too small?

Your friend explains that, in fact, the actual flows to the system are less than one-third of the design. Your puzzled look prompts him to further explain that flow rates are only part of the equation. If wastewater strength is not plugged into the equation from the beginning, then there is the risk of system failure.

"That's what happened when this shopping center's system was designed," he says. "Although the flow rates are well below capacity, the strength level is much higher than the system can handle. Not only does the wastewater system receive the additional fats, oils, grease, and five-day biochemical oxygen demand (BOD_5) that a supermarket generates, but it also regularly receives an inflow of disinfectants, cleaners, and floor strippers that would challenge any conventional onsite system. The



This gas station/convenience store near Everett, Washington, was originally served by a septic tank/mound system. In 1989, the convenience store added fast food, causing the system to malfunction. In 1990, a pretreatment unit (Nibbler®) was installed to handle the high-strength waste. The mound system recovered within a few weeks.

Photo courtesy of NCS, Northwest Cascade-Stuth result is a biologically overloaded drainfield and near-complete system failure."

Unfortunately, this story is not fictitious. It happened in Covington, Georgia. Cases like this support the claims of engineers who believe that wastewater systems fail because wastewater strength is not understood and its parameters are not considered in system design.

This was true of the supermarket in the above example. This particular store sent its wastewater to an activated sludge wastewater treatment system with the capacity to treat 20,000 gallons per day (gpd) of wastewater, two-thirds more than the supermarket actually produced. The system did not, however, have the capacity to handle the high BOD_5 and high levels of fats, oils, and grease typical of the supermarket and the other commercial businesses in the shopping center that shared its use.

Chemicals used to disinfect and clean the businesses were also part of the wastewater stream. It was clear the treatment system was on the verge of failing.

To remedy this particular problem, the supermarket installed a system designed to pretreat 10,000 gpd of wastewater and 73 pounds a day of BOD_5 loading. This system, designed by Northwest Cascade-Stuth (NCS), Puyallup Washington, even included provisions to treat flows from a major chain restaurant that was scheduled to open in the shopping center later in the year.

Wastewater Characteristics Affect System Performance

Wastewater from different community sources have different physical, chemical, and biological characteristics. Tables 1 and 2 show typical characteristics of residential (domestic), municipal, commercial, and industrial wastewater.

The characteristics of the different types of waste flowing into a wastewater system have a major impact on system performance. Depending on the concentrations of its various constituents, wastewater can be classified as strong, medium, or weak. Residential wastewater is usually termed weak while industrial wastewater is usually classified as strong. Commercial wastewater has the most diverse characteristics. From facility to facility, the strength of the wastewater will vary dramatically.

The type of constituents in wastewater and their concentration levels can vary according to the hour of the day, the day of the week, the month of the year, the type of facility from which the wastewater is generated, and its locale. In addition, the more the constituents vary in waste-

Table 1

Physical, Chemical, and Biological Characteristics of Wastewater and Their Sources

Characteristic	Sources
Physical Properties:	
Color	Domestic and industrial wastes, natural decay of organic materials
Odor	Decomposing wastewater, industrial wastes
Solids	Domestic water supply, domestic and industrial wastes, soil erosion, inflow/infiltration
Temperature	Domestic and industrial wastes
Chemical Constituents:	
Organic:	
Carbohydrates	Domestic, commercial, and industrial wastes
Fats, Oils, and Grease	Domestic, commercial, and industrial wastes
Pesticides	Agricultural wastes
Phenols	Industrial wastes
Proteins	Domestic, commercial, and industrial wastes
Priority Pollutants	Domestic, commercial, and industrial wastes
Surfactants	Domestic, commercial, and industrial wastes
Volatile Org. Compounds	Domestic, commercial, and industrial wastes
Other	Natural decay of organic materials
Inorganic:	
Alkalinity	Domestic wastes, domestic water supply, groundwater infiltration
Chlorides	Domestic wastes, domestic water supply, groundwater infiltration
Heavy Metals	Industrial wastes
Nitrogen	Domestic and agricultural wastes
pH	Domestic, commercial, and industrial wastes
Phosphorus	Domestic, commercial, and industrial wastes; natural runoff
Priority Pollutants	Domestic, commercial and industrial wastes
Sulfur	Domestic water supply; domestic, commercial, and industrial wastes
Gases:	
Hydrogen Sulfide	Decomposition of domestic wastes
Methane	Decomposition of domestic wastes
Oxygen	Domestic water supply, surface-water infiltration
Biological Constituents:	
Animals	Open watercourses and treatment plants
Plants	Open watercourses and treatment plants
Protists:	
Eubacteria	Domestic wastes, surface-water infiltration, treatment plants
Archaebacteria	Domestic wastes, surface-water infiltration, treatment plants
Viruses	Domestic wastes

Reproduced from *Wastewater Engineering: Treatment, Disposal, and Reuse, 3rd Edition, by Metcalf & Eddy, Inc.* (1991) by permission of McGraw Hill Companies.

water, the more difficult the wastewater is to classify and properly collect and treat. Communities that do not regulate wastewater characteristics entering the collection system have the greatest variations.

Even human demographics impact wastewater flow and composition in the community. Research shows that socioeconomic class, attitudes, and behaviors are some of the factors that can significantly increase or decrease water consumption and thus affect wastewater flow and composition.

For example, affluent communities often use more water, and, therefore, have greater wastewater flow rates than do economically depressed communities. In his book, *Wastewater Treatment Plants*, Syed R. Qasim lists the average water demand for single-family residential dwellings as follows:

- 270 liters (71.3 gallons) per person per day for low-income families,
- 310 liters (81.9 gallons) per person per day for middle-income families, and
- 380 liters (100.4 gallons) per person per day for high-income families.

One explanation for this variation is that homes in more affluent communities tend to have more water-using appliances, such as dishwashers, garbage disposals, and washing machines.

Even the types of foods consumed in a household can cause problems for onsite wastewater systems. For example, frequently pouring excess salad dressings, cream sauces, butter, and other foods high in oil and grease down the drain will strain the wastewater system.

Conversely, communities with environmental clubs or schools with environmental curricula can raise the awareness of residents and lower overall water use. Through education, individuals learn about the water conservation value of using low-flow fixtures and appliances.

The health of household residents is another factor often overlooked when evaluating wastewater characteristics. For example, long-term use of prescription medicines such as antibiotics in a household or nursing home can affect wastewater composition and can kill organisms that provide treatment in the system. This may eventually cause the system to fail.

Table 2

Composition of Typical Untreated Wastewater (Burks and Minnis, 1994)

Constituent	Unit	Range	Typical
Total Solids	mg/L	300-1200	700
Dissolved	mg/L	250-850	500
Fixed	mg/L	150-550	150
Volatile	mg/L	100-300	150
Suspended	mg/L	100-400	220
Fixed	mg/L	30-100	70
Volatile	mg/L	70-300	150
Settleable	mg/l	50-200	100
BOD_5	mg/L	100-400	250
TOC	mg/L	100-400	250
COD	mg/L	200-1,000	500
Total Nitrogen	mg/L	15-90	40
Organic	mg/L	5-40	25
Ammonia	mg/L	10-50	25
Nitrite	mg/L	0	0
Nitrate	mg/L	0	0
Total Phosphorous	mg/L	5-20	12
Organic	mg/L	1-5	2
Inorganic	mg/L	5-15	10
Chloride	mg/L	30-85	50
Sulfate	mg/L	20-60	15
Alkalinity	mg/L	50-200	100
Grease	mg/L	50-150	100
Total Coliform	/100ml	10^6-10^8	10^7
VOCs	µg/L	100-400	250

Planning System Size and Design

A variety of factors need to be considered in determining the best design and size for a system that will safely collect, treat, and dispose of wastewater. For example, the estimated daily wastewater volume and any short- or long-term variations in flow can affect the size requirements of many of the system components.

To design systems that can adequately handle the characteristics of the wastewater they were built to treat, reliable estimates of wastewater quality must be made as a first step in system design.

Three factors that must be considered when estimating wastewater characteristics are (1) water demand, (2) wastewater flow rates, and (3) wastewater quality (i.e., its physical, chemical, and biological characteristics). Together, these factors indicate overall wastewater strength. The goal of design is to provide a system capable of treating a wide range of wastewater characteristics and conditions while complying with effluent treatment requirements.

Designing Wastewater Systems

Many factors must be considered when designing wastewater treatment plants. These factors include the effluent limitations, wastewater characteristics, and the degree of treatment required.

Establishing variations in flow rates is a basic step in designing treatment facilities. Flow rates can vary with region, climate, and the type of facility producing the flow.

Flow rate data should include the average daily flow, the maximum daily flow, the peak hourly flow, the minimum daily flow, the minimum hourly flow, and the sustained flow. Each of these flow rates is used in the hydraulic design of both collection and treatment facilities.

Treatment plants are generally designed for average and peak flow rates and wastewater characteristics. Designing a treatment plant based only on average flows and wastewater characteristics will result in a treatment plant that may not be able to handle peak conditions. Conversely, designing a plant for peak conditions (peak flow rate and peak wastewater characteristics) may result in excessive capacity.

Generally, peak flow rates and peak constituent loadings (BOD and suspended solids) do not occur at the same time—but, as mentioned previously, treatment plants must be designed to effectively handle a wide range of wastewater conditions.

Industrial flow rates vary with the type and size of the facility, the degree of water reuse, and any onsite treatment methods. Typical design values can be used for industrial areas that have little or no wet-process. Or, if the nature of the industry is known, estimates can be based upon documented flow rates for similar industries.

Commercial wastewater flow rates often are based on anticipated future development or data collected from similar facilities. It is one of the most misunderstood wastewater types.

Designing Home Septic Systems

Designing a septic system for an individual home is very different from designing a commercial onsite system or a municipal wastewater treatment plant. Generally, onsite system design is based on the hydraulic loading rate and not the organic loading rate.

For example, septic tank capacity usually is based on the number of bedrooms per home and the number of people per bedroom. The average wastewater contribution is estimated to be around 45 gal/capita/day (EPA, 1980). When this is rounded up to 75 gal/capita/day (to provide a factor of safety) and is multiplied by the maximum number of people per bedroom (which usually is two), the resulting value is 150 gal/bedroom/day. A theoretical tank volume of two to three times the daily design flow is common, which results in a total tank design capacity of 300 to 450 gal/bedroom.

With two exceptions (California and Michigan), all states have state-level regulations or guidelines for the design, construction, and operation of onsite systems. Typically, septic tanks are sized according to state regulatory requirements such as the following:

- There usually is a minimum size (750 or 1,000 gal) tank that must be installed, no matter how many bedrooms in the house.
- The septic tank size increases in increments proportionate to the number of bedrooms in the house, up to, on average, six bedrooms. An additional 250 gal is added for each bedroom above six.

Drainfields for onsite systems generally are designed based on the soil percolation rate and the estimated daily wastewater flow. Other factors that can be used in drainfield design include soil depth, depth of rock, and trench width.

The Problem of Treating High-Strength/Commercial Wastewater

Many commercial establishments currently use residential wastewater systems. This works for some commercial establishments. For others, the high-strength wastewater generated would overload a residential system, causing it to fail.

Commercial wastewater can be

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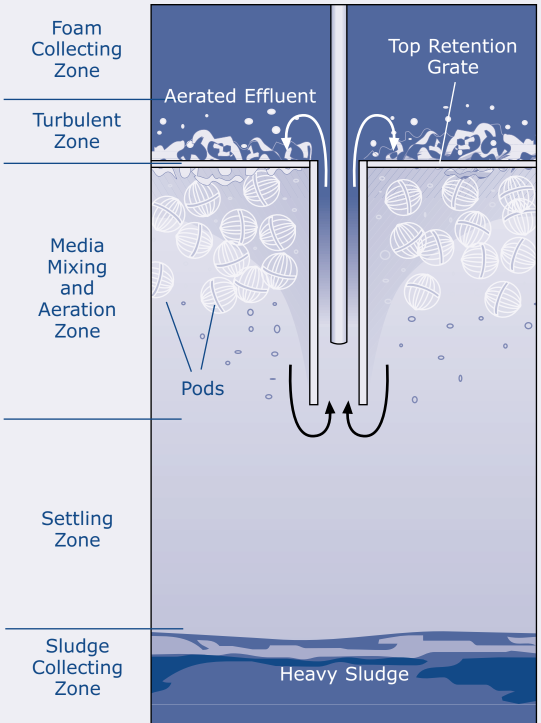
Establishing variations in flow rates is a basic step in designing treatment facilities. Flow rates can vary with the region, climate, and type of facility that produces the flow.

Onsite Commercial Wastewater Treatment Technologies



A variety of onsite wastewater treatment systems have been used to treat commercial strength wastewater. The Nibbler™ system (detail shown at left), manufactured by Stuth Company Inc., is a secondary onsite sewage treatment system specifically designed for high-strength wastewater. The system uses aerobic digestion with upflow aeration to treat the wastewater.

Other onsite systems and components that have been used for commercial wastewater systems include grease traps and grease interceptors, septic tanks, aerobic treatment units, sand filters, constructed wetlands, drainfields, drip irrigation, and mound systems.

In addition, the National Small Flows Clearinghouse's (NSFC) Manufacturers and Consultants database lists names of other manufacturers that specifically state that their systems handle commercial applications. These manufacturers include Santec Corporation, Hydro-Action, Inc.; AquaClear Technologies Inc.; CMS Group, Inc.; and Envirocycle Party Ltd. The database includes only those manufacturers who have requested to be listed and is in no way a comprehensive list.

If you would like a customized search of the NSFC's Manufacturers and Consultants database for manufacturers in your area, or if you would like your company to be listed in the database, contact NSFC technical assistance at (304) 293-4191 or (800) 624-8301.

Table 3

Wastewater Characteristics for Package Treatment Plant Sizing (Goldstein and Moberg, 1973)

Type of Facility	Flow* (gal/cap/day)	lbs. BOD_5† (cap/day)	Runoff (hours)	Shock Load Factor
Airports - per passenger	5	.020	16	low
Airports - per employee	15	.050	16	low
Apartments - multiple family	75	.175	16	med.
Boarding Houses	50	.140	16	med.
Bowling Alleys - per lane (no food)	75	.150	8	med.
Campgrounds - per tent or travel trailer site - central bathhouse	50	.130	16	med.
Camps - construction (semi-permanent)	50	.140	16	med.
Camps - day (no meals served)	15	.031	16	med.
Camps - luxury	100	.208	16	med.
Camps - resort - night and day, with limited plumbing	50	.140	16	med.
Churches - per seat	5	.020	4	high
Clubs - country - (per resident member)	100	.208	16	med.
Clubs - country - (per nonresident member present)	25	.052	16	med.
Courts - tourist or mobile home parks with individual bath units	50	.140	16	med.
Dwellings - single family	75	.170	16	med.
Dwellings - small, and cottages, with seasonal occupancy	50	.140	16	med.
Factories - gallons, per person, per shift, (exclusive of industrial wastes, no showers)	25	.073	8	high
Add for showers	10	.010		
Hospitals	250+	.518	16	med.
Hotels- (with private baths) 2 persons per room	60	.125	16	med.
Institutions - other than hospitals (nursing homes)	125	.260	16	med.
Laundromats	400	varies	12	high
Motels - per bed space	40	.083	16	med.
Motels - (with bath, toilet, and kitchen wastes)	50	.140	16	med.
Offices - (no food)	15	.050	8	high
Parks - picnic (toilet wastes only) -gallons per picnicker	5	.010	8	high
Parks - picnic (with bathhouses, showers, and flush toilets)	10	.021	8	high
Restaurants - (kitchen wastes) per meal served	7	.015	8-12	high
Restaurants - (toilet and kitchen wastes) per patron	10	.021	8-12	high
Restaurants - (additional for bars and cocktail lounges)	3	.006	8-12	high
Schools - boarding	100	.208	16	med.
Schools - day (without cafeterias, gyms, or showers)	15	.031	8	high
Schools - day (with cafeterias, but no gyms or showers)	20	.042	8	high
Schools - day (with cafeterias, gyms, and showers)	25	.052	8	high
Service Stations - per vehicle served	12	.021	16	med.
Shopping Centers - per sq. foot (no food)	0.1		16	med.
Shopping Centers - per employee	15	.050	16	med
Sports Stadiums	5	.020	4-8	very high
Stores - per toilet room	400	.832	16	med.
Swimming Pools and Bathhouses	10	.021	8	high
Theaters - drive-in - (per car space)	5	.010	6	high
Theaters - movie - (per auditorium seat)	5	.010	6	high
Trailer Parks - per trailer	150	.350	16	med.

* L/cap/day = 3.8 x gal/cap/day.
† g/cap/day = 454 x lbs/cap/day.

Table 4

Suggested Daily Flows and BOD Considerations (Goldstein and Moberg, 1973)

Class	Persons Per Unit	gal/cap/ day	lbs BOD_5/cap/day Avg.	lbs BOD_5/cap/day with Garbage Grinder	BOD_5 (mg/L)
Subdivisions, Better	3.5	100	0.17	0.25	205
Subdivisions, Average	3.5	90	0.17	0.23	220
Subdivisions, Low Cost	3.5	70	0.17	0.20	290
Motels, Hotels, Trlr.Pks.	2.5	50	0.17	0.20	400
Apartment Houses	2.5	75	0.17	0.25	225
Resorts, Camps, Cottages	2.5	50	0.17	0.20	400
Hospitals	per bed	200	0.30	0.35	200
Factories or Offices	per person	20	0.06	-	360
Factories with showers	per person	25	0.07	-	340
Restaurants	per meal	5	0.02	0.06	450
Schools, Elementary	per student	15	0.04	0.05	320
Schools, High	per student	20	0.05	0.06	360
Schools, Boarding	per student	100	0.17	0.20	205
Swimming Pools	per swimmer	10	0.03	-	360
Theaters, Drive-in	per stall	5	0.02	-	450
Theaters, Indoor	per seat	5	0.01	-	250
Airports, Employees	per employee	15	0.05	-	450
Airports, Passengers	per passenger	5	0.02	-	480
Bars, Employees	per employee	15	0.05	-	450
Bars, Customers	per customer	2	0.01	-	800
Dairy Plants	per 1000#milk	100-250	0.56	to 1.66	650-2000
Public Picnic Parks	per picnicker	5-10	0.01	-	250
Country Clubs, Residents	per resident	100	0.17	0.25	205
Country Clubs, Members	per member	50	0.17	0.20	400
Public Institutions (non-hospital)	per resident	100	0.17	0.23	205

relatively nonhazardous and similar in composition to domestic wastewater. However, depending on the type of commercial operation, one or more constituents in commercial wastewater can exceed typical domestic wastewater ranges.

There is not a lot of information available about the wastewater characteristics for the different commercial facilities that utilize onsite wastewater treatment systems. However, there is a great deal of information about determining the quantities of wastewater generated at different commercial facilities. Tables 3 and 4 present information about commercial wastewater flow rates and characteristics.

"The design practice of commercial systems has normally been substantially the same as that utilized for household systems," write James Converse, Damann Anderson, and Robert Siegrist, research engineers from the University of Wisconsin, in their paper titled "Commercial Wastewater On-Site Treatment and Disposal."

"As a result," continue the authors, "design and operation of commercial systems generally has not accounted for wastewater flow variations, organic loading, or other factors commonly considered in engineering of non-soil absorption wastewater facilities."

For example, a ski resort owner might size the wastewater system to handle an average daily flow based on flow data collected throughout the year. The flow during summer months would likely be low, while the flow during winter months would be high. Because of the extreme variance in flow rates, the average flow data calculation for the wastewater system will be skewed. This means that the system will be undersized and unable to handle the larger flow of the winter months. The end result is system failure.

Conversely, a church might have low flows Monday through Saturday. On Sundays the flow significantly increases. If the onsite system were designed to treat the peak daily flow, the system size would be based on Sunday's flow rate. This system would be costly and too large to function properly during the rest of the week.

Designing Onsite Systems To Treat High-Strength Commercial Wastewater: Do We Really Know What We're Doing?

Designs for industrial and municipal wastewater treatment are based on the quantity and characteristics of wastewater generated. The different steps in the treatment and design process reflect this. However, onsite commercial wastewater treatment system design generally is not based on wastewater characteristics. System size is determined by the wastewater flow rate generated in the commercial facility.

Most state regulations include a table of estimated sewage design flow rates for different types of facilities. The table identifies the type of establishment and the gallons/unit/day generated at that particular establishment. A few states (Colorado, Hawaii, Louisiana, Pennsylvania, and Virginia) include a column for pounds of BOD_5/unit/day in the table. Virginia includes a column for pounds of suspended solids/unit/day.

Effectively designing onsite systems to treat commercial wastewater presents a difficult challenge for engineers. Commercial wastewater has not been defined or categorized by wastewater characteristics or flows. Onsite wastewater systems for commercial establishments use the same treatment components found in onsite residential wastewater systems: septic tanks, drainfields, sand filters, etc. Sometimes this will work. Other times it is not just a matter of if, but when the system will fail.

Wastewater Characteristics May Limit Options

The wastewater's physical, biological, and chemical characteristics and the concentrations of its various constituents might exclude some treatment and disposal options. Filtration, for example, would be too impractical and expensive to use as a primary wastewater treatment for establishments that produce an abundance of solids, grease, or oil because the filters could become too easily plugged, requiring expensive backwashing.

More than 10,000 new organic compounds have been synthesized each

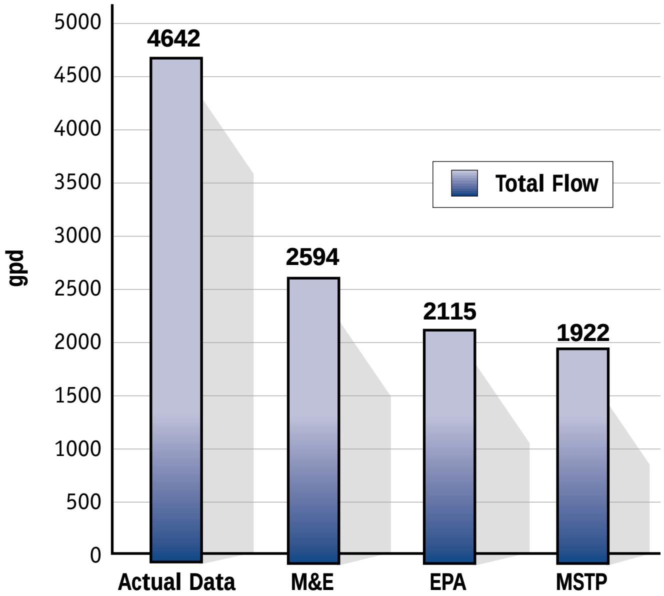


Figure 1

Flow Estimates Using Various References (Supermarket)

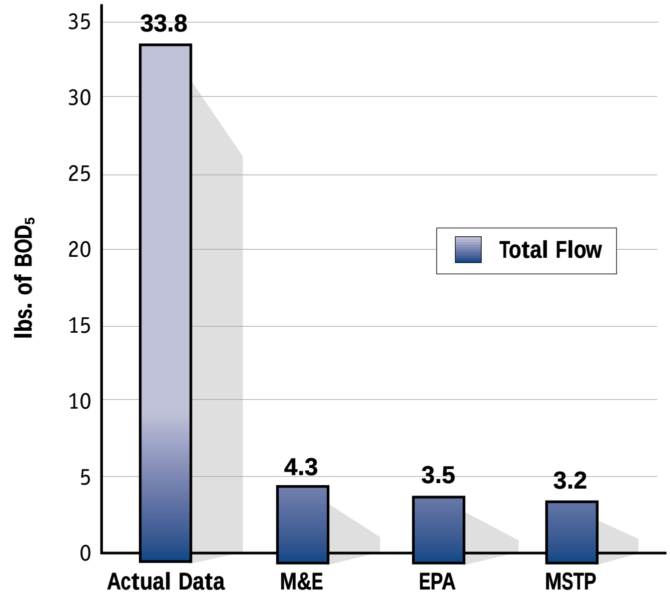


Figure 2

BOD_5 Load Estimates Using Various References (Supermarket)

Key: M&E = (Metcalf & Eddy, 1991), EPA = (EPA, 1978), MSTP = (Manual for Septic Tank Practices, USPHS 1959)

Figures 1–4 from Stuth and Garrison, 1995

year since the early 1900s and these compounds have found their way into community wastewater. Sometimes these compounds contain more organic material, nutrients, metals, or toxic substances than is 'typical.' This makes them less amenable or resistant to conventional treatment or even damaging to the system.

What Are the Implications For Communities?

By its very nature commercial/high strength wastewater is highly variable, both in its wastewater characteristics and flow rates. This variability will affect the design and operation of an onsite wastewater treatment system. If the system can not adequately handle the peak flows and peak loading rates, then failure is imminent.

Treatment for municipal and industrial wastewater has evolved over time. The variability in wastewater characteristics and flow rates has been measured and recorded. Alternatives for treatment were researched and evaluated. And, the industry learned from its mistakes. Today there are well-known standards for design, construction, operation, and maintenance of both municipal and industrial wastewater treatment plants.

Onsite wastewater treatment systems are designed with a safety factor. The system is normally designed/sized to treat a greater amount of wastewater than will actually be generated. This allows the variability in the flow or characteristics of household wastewater to be handled adequately by the onsite system without immediate risk of failure.

Although regulations for onsite system designs differ from state to state, there are enough similarities in the designs among the states to show a standard or baseline criteria that has been developed over time, with monitoring, research and evaluation.

Commercial onsite wastewater treatment system designs are based upon data collected from municipal and onsite systems. There is some question as to how accurately this data reflects the wastewater quantities and characteristics generated by the commercial establishments.

A paper titled "An Introduction to Commercial Strength Wastewater" (Stuth and Garrison, 1995) addresses the issue of how reliable the estimates provided by various references are with regard to the actual data generated by different establishments.

Information was taken from systems that are routinely monitored by Aqua Test Inc. The information used in the comparison was average daily flow and pounds of BOD_5 waste strength. The actual data collected was compared to flow volume estimates from the following reference texts: *Wastewater Engineering, Treatment—Disposal—Reuse* (Metcalf & Eddy, 1991); *Onsite Wastewater Treatment and Disposal Systems, Design Manual* (EPA, 1980); and *Manual for Septic Tank Practices* (USPHS, 1959).

The references use meals per day or number of seats to estimate flow for restaurants. To estimate flow from a supermarket, the following factors are evaluated: the number of parking spaces, bathrooms (public and private), utility sinks, floor drains, and employees. A residential waste strength of 200 milligrams per liter is assumed since design codes are based on residential flow and flow volume is generally the only factor considered when designing a system.

Figures 1 and 2 show flow estimates and BOD_5 load estimates for a supermarket, and figures 3 and 4 show flow estimates and BOD_5 load estimates for a large full-service restaurant compared to the actual data.

These tables illustrate the large differences in flow rates and waste strength between what is actually gen-

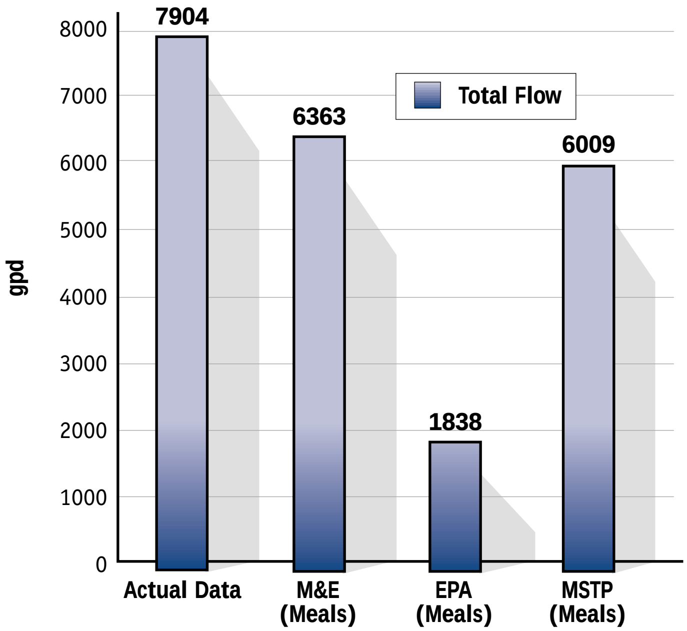


Figure 3

Flow Estimates Using Various References (Large, Full-Scale Restaurant)

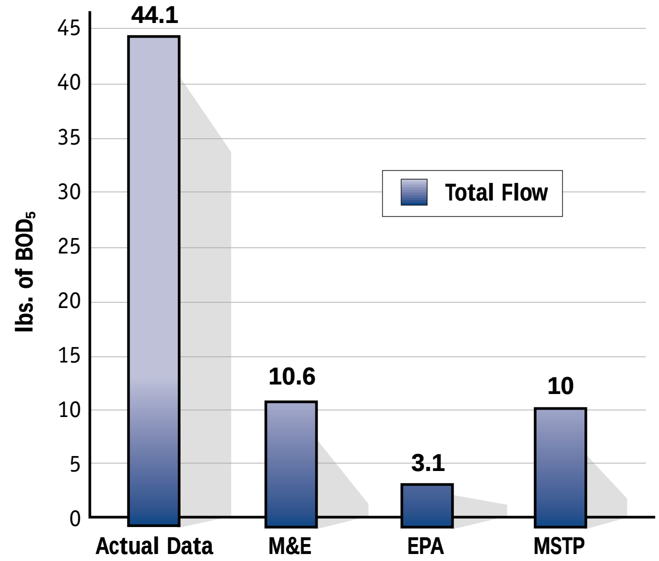


Figure 4

BOD_5 Load Estimates Using Various References (Large, Full-Scale Restaurant)

erated by one of these establishments and the criteria/references used to design an onsite system for the same establishment. If any one of the references had been used in the onsite system design for the establishments shown, a failure would have been almost guaranteed.

Information about flow rates and waste strengths for various commercial establishments is just beginning to be collected by people throughout the onsite industry. Much more information will be needed before a baseline design standard is developed for onsite wastewater treatment systems for commercial establishments.

"The nature of the wastewater must be fully predicted and understood before the system is designed," write Mary Margaret Minnis and Bennette D. Burks in their book, *Onsite Wastewater Treatment Systems.* But the scarcity and complexity of this information often lead to installing a system that doesn't fit the facility's needs. SF

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Not Even The Experts Agree

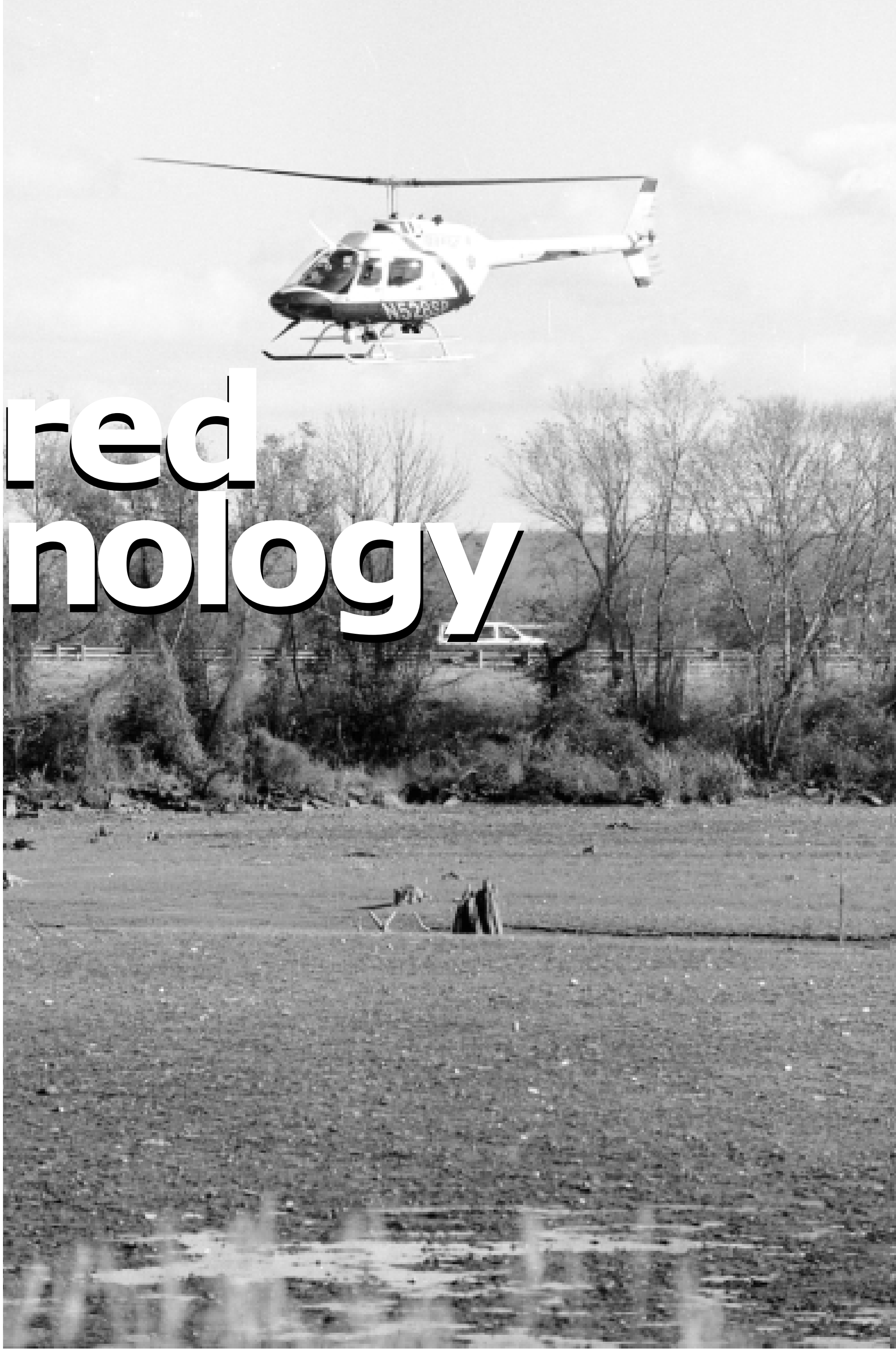
Not even the experts have a precise definition for high-strength/commercial wastewater. Defining this type of wastewater is one of the goals of the pilot program sponsored by the Environmental Protection Agency and the National Sanitation Foundation International. The group conducting this program, the High Strength/Commercial Waste Technology Panel, generally agrees that high-strength commercial waste would have characteristics greater than domestic strength in key waste parameters such as BOD; suspended solids; fats, oils, and grease (FOG); and possibly nutrients.

For more information about the High Strength Waste Technology Panel, contact Ray Frederick at (732) 321-6627 or Tom Stevens at (734) 769-5347.

Arkansas Sanitarian Uses

Infrared Technology

To Track Down Sewage



STAFF WRITER
Natalie Eddy

The rhythmic pounding of the helicopter blades mark a continuous beat as the state police aircraft makes another swoop along the shore of Lake Conway, Arkansas. The helicopter, equipped with a sophisticated infrared heat detection system, seeks out the culprit below.

Sounds like a scene from "Cops." Well, that's just where John Church, a registered sanitarian, got the idea.

The only twist is Church is not a police detective, but an environmental health specialist II with the Arkansas Department of Health (ADH), and the helicopter is not looking for escaped suspects, but sewage runoff.

Lake Conway, located 30 miles northwest of Little Rock, has a suspected problem with septic effluent (from failing septic systems and straight piping) flowing into the lake. Contacted by the Lake Conway Conservation Committee (LCCC), a grassroots organization of residents dedicated to cleaning up the lake, Church had to find a way to establish the sources of the lake pollution.

"I was racking my brain trying to figure out how to do a survey of the malfunctioning septic systems around the lake. I kept coming up with plans and discarding them. One night, I was sitting at home watching an episode of 'Cops' using an infrared system to track someone down, and it hit me," he said.

"Why not use the same heat detection system to pinpoint the sewage? The water temperature of septage is much warmer than the lake water."

To accomplish the survey, Church used an Arkansas State Police Bell Helicopter equipped with a Forward Looking Infrared (FLIR) imaging system, video equipment, and a global positioning system (GPS).

The Arkansas Department of Health uses a helicopter equipped with an infrared imaging system, video equipment, and global positioning system to locate and map sewage runoff entering Lake Conway.


Photo courtesy of Log Cabin Democrat

"That way, when we got a hit with the infrared unit, we would videotape it, and then write down the GPS location to refer back to the map with longitude and latitude."

Management—the Goal

The LCCC's long-term goal is to establish community-based sewer and water management districts around the lake to ensure public health and the quality of the lake water.

A March 1999 preliminary report by the LCCC states that there are conservatively more than 1,000 improperly installed or seasonally failing septic systems influencing the lake, noting that more than 90 percent of the residences within one mile of the lakeshore have onsite septic systems.

The report adds that many of the lakeshore lots have septic systems that are more than 30 years old and are located on small lots, ranging from 50 by 75 feet to 50 by 100 feet.

Making matters worse, the report adds that many of the septic systems were installed before state requirements were imposed.

The report states, "It is virtually impossible to repair some of these failing systems because of the high seasonal water table and the lack of space on the lot. Further, anaerobic conditions are thought to occur frequently because of the lake's shallow depth and limited water flow. Thus, treatment of the effluent within the lake to reduce the public health hazard is not possible at times."

Drinking water for lakeshore residents is also a concern with between 1,600 to 2,100 residences being served by private wells, which also may be affected by the failing septic systems. Another concern is the inflow to the lake from Stone Dam Creek, the receiving stream for the nearby city of Conway's municipal wastewater facility and some industrial discharge.

Testing the Water

In December 1998, the LCCC took nine water samples from the perimeter of the lake and one in Stone Dam Creek, which the report says, indicates that an additional sampling and analysis program is justified. With similar testing parameters, the sample collected on Stone Dam Creek before it flows into the lake and a sample in the immediate area of the creek's discharge had a greater than 2,429/100 milliliter (mL) total coliform count, while the sample collected on Stone Dam Creek had 147/100 mL *Escherichia coli*. This sample was taken upstream from the municipal treatment plant.

Another study by the Arkansas Department of Pollution Control and Ecology (ADPC&E), conducted in October 1998, found elevated levels of chemicals, metals, and pesticides.

A July 1996 ADPC&E water sample study of Stone Dam Creek also found elevated levels of chemicals and nutrients.

Some Facts

Lake Conway is located in Faulkner County, population 300,000. It is a 6,700-acre manmade lake used mainly for recreational fishing. Built in 1947 by the Arkansas Game and Fish Department, the lake's average depth is five feet.

More than 75 subdivisions are located on or near the lakeshore and many were platted before septic permits were required by the state. Of the 2,500 to 3,500 residents living within 300 feet of the lake, only 250 are connected to a public sewer.

Church said, "It's a pretty sad situation. There are a lot of malfunctions and even straight piping. Although the fish have been tested and were determined safe, since this began, recreational use of the lake has dropped, dramatically impacting some businesses."

During 1997 and 1998, the ADH investigated 40 valid septic complaints for lots within 300 feet of the shoreline: 30 for malfunctioning septic systems and 10 for lakefront lots with sewer pipes running directly into the lake.

The report states that "most of the system failures were for undersized systems on small lots with marginally suitable soil. In most cases, repair involved adding as many lines as the lot size and setback requirements would allow and hoping the problem was solved."

What the Heat Detected

The infrared searches were conducted on November 17 and 30, 1998. The police helicopter flew at elevations between 200 and 500 feet, allowing Church to see approximately 200 feet inland and 100 feet of lake bed at one time.

Although vegetation covers much of the area, the aerial view allowed Church to discover 19 sites with one or more pipes that probably discharge effluent straight into the lake.

The FLIR system located an additional 11 probable discharge sites, many that seemed to be "intentionally hidden under old boats, buckets, brush piles, and other items," according to the LCCC report.

The effluent, approximately 70 to 80 degrees Fahrenheit, was estimated to be 20 degrees warmer than the ambient ground temperature at the time of the flights. The infrared camera is sensitive to plus or minus three degrees.

The LCCC report suggests that the 11 FLIR detected pipes are thought to represent less than 5 percent of the effluent pipes discharging into the lake based on calculations of how long flows may be detected before the temperature of the inflows cool to the lake temperature.

A conservative estimate, according to the report, is approximately 220 pipes.

The report continues, "The septic effluent problem appears to be even worse. This is because 75 percent of the valid septic complaints on or near the lakefront investigated by the ADH were for failing systems, not pipes running into the lake. This would infer that there are (three) failing systems for every site discharging directly into the lake."

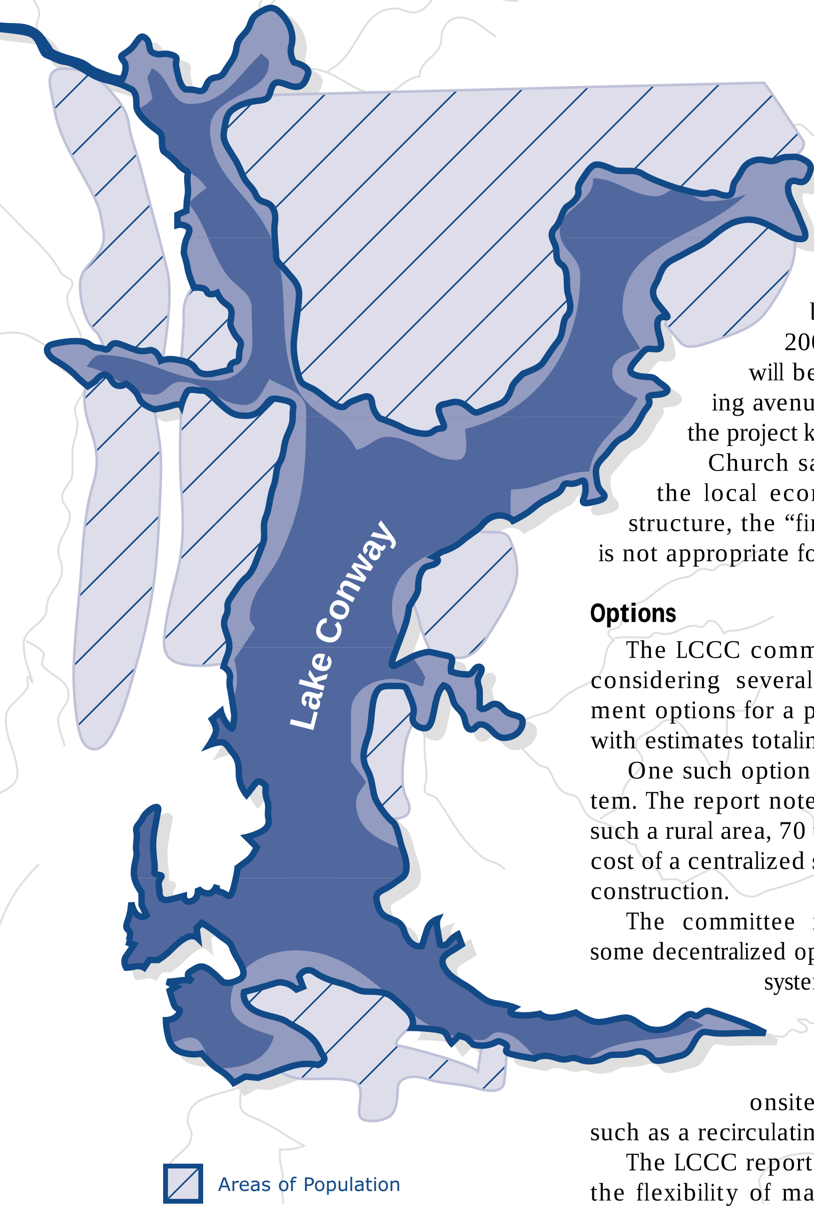
Using these figures, the report estimates that there are conservatively 660 seasonally failing systems.

In total, the report finds that there are an estimated 380 malfunctioning and improperly constructed septic systems among the 2,500 to 3,500 residences within 300 feet of the lakefront.

The report adds that the problem of seasonal runoff from the additional 4,000 to 5,000 residents within 300 feet to one mile of the lakeshore is difficult to estimate. However, based on complaints to the ADH, past experience, and growth rate, the report estimates that 5 percent of these residences, or 225, may have failed systems.

Progress to Date

Cleanup of Lake Conway is a work in progress. A facilities board in charge of sewer and water improvement districts has been formed, and DMC Engineering of



Huntsville has been contracted to do a preliminary feasibility study for public sewer and water around the lake.

Church said the study is due to be released in March 2000. "At that time, we will be able to start pursuing avenues of funding to get the project kicked off," he added.

Church said that because of the local economy and political structure, the "fine and fix" method is not appropriate for the lake area.

Options

The LCCC committee members are considering several wastewater treatment options for a public sewer project with estimates totaling $20 million.

One such option is a centralized system. The report notes, however, that for such a rural area, 70 to 90 percent of the cost of a centralized system would be for construction.

The committee is also considering some decentralized options, such as cluster systems where several residences would be connected to a small community onsite treatment system, such as a recirculating sand filter.

The LCCC report adds, "At this time, the flexibility of maintained decentralized options with a centralized management network appear appropriate for the lake area . . . primarily due to the diversity around the lake in building patterns, terrain, soil, and other conditions."

A Journey of a Thousand Miles . . .

Defining the potential pollution problem was just the starting point for the LCCC, and the infrared heat detection system helped to set the stage.

Church estimates that thousands of dollars were saved by using this tracking procedure instead of the traditional shoeleather method of locating sources on foot. Time, another valuable commodity in pollution prevention, also was saved.

However, he had one piece of advice for anyone thinking about emulating this method of source tracking.

"I had to borrow my equipment and could use it only when it was available. For the sake of accuracy, it would have been better if I could have done my fly-over survey at peak times—early in the morning or late in the evening. I think you would get a more accurate gauge," he said.

He added that the information garnered by using the system could be helpful in securing grants at a later time.

"We're going through a lot of uncharted area here that has never been tackled before," said Church. "We're kind of having to feel our way as we go. It's a good learning experience. It will be helpful for others to see how it works out for us. The whole project will be quite extensive, but we are committed. We're pushing forward."

For more information, contact Church at (501) 450-4941. SF

Starbuck

Washington State's Biggest Self-Help Wastewater Project

CONTRIBUTING WRITER
Jolene Lawton

Photo courtesy of Carol Wildman.

The photo above shows the homegrown treatment facility at Starbuck, Washington. Two clusters of upflow and textile filters can be seen in the right foreground. Two 20,000-gallon dosing tanks and two 10,000-gallon recirculating tanks plus piping are buried, as are three to four acres of subsurface drainfield.

In 1995, graywater ran into the yards of several residences in the town of Starbuck, Washington. The town was unable to meet new state-mandated lot-size requirements for individual onsite wastewater treatment systems. Near the end of 1995, the small community decided to implement a self-help project to fix its wastewater problems.

The project has saved the town and its people thousands of dollars, but it cost the community volunteers valuable time and tested their physical and mental endurance.

Carol Wildman, Starbuck's clerk/treasurer, has many stories to tell about the community's accomplishments and the impact that this huge project, carried out mostly by volunteers, had on the everyday lives of those involved.

Starbuck is a low-income community. Most of its 165 residents are over 60. The project, which involved the installation of a recirculating gravel filter system with a dripline irrigation system, was estimated to cost 1.8 million.

Wildman had been working with the Washington Department of Ecology to find an affordable solution for Starbuck when members of the Rensselaerville Institute of New York presented their Small Town Environmental Program (STEP), a self-help approach to solving wastewater problems in such communities.

"We knew we wouldn't get all the money we needed through grants," says Wildman. "The community gave a really positive response to STEP, and then the council made it official."

Washington's Department of Ecology has overseen 12 self-help projects in the state, but Starbuck was the first in which the volunteers installed an entire system.

The town received $30,000 from a Planning Only Community Development Block Grant and $10,000 from the U.S. Department of Agriculture (USDA) Forest Service for planning, which enabled them to hire an engineer to officially identify the sewer problems in a formal facilities plan. In the fall of 1997, however, the young project was at a standstill.

"Certain issues between the engineers and the Department of Ecology were not getting resolved," said Wildman, "so we let that engineering group go."

The town replaced the first engineers with an engineering firm out of Austin, Texas, experienced in working with small community projects. The facilities plan was promptly finished, and the next step was to look into site and treatment possibilities.

The community chose Wildman to be the "sparkplug" or leader for the project. When the design and construction plan was approved, she divided the volunteers (approximately 95 percent of the community) into five committees. Each committee was assigned a job ranging from warehouse duty to food coordination, and each had a liaison to handle questions or concerns of the group. Volunteers also helped with paperwork. For instance, several citizens collected simple easements from everyone in town, which allowed for access to lots for installation and maintenance.

"I probably over-plan, but using committees was a great way to start," Wildman explained. "Once construction was underway, everyone just started working together. Our natural skills surfaced and we all gravitated toward the areas we felt most comfortable in."

"Good planning is the key," said Janice Roderick, coordinator for STEP in Washington's Department of Ecology. "You also have to be able to solicit the help you need. We find the majority of people will help if asked."

Washington State allotted an additional $700,000 to Starbuck through a Community Trade and Economic Development Grant, and the USDA Forest Service granted $200,000 for construction. Help also came from an unexpected outside source—the Washington State Department of Corrections. While it was not in Wildman's original plan,

CONTINUED ON PAGE 56

Removal Efficiency of Standard Septic Tank and Leach Trench Septic Systems for MS2 Coliphage

CONTRIBUTING WRITERS

John Higgins
George Heufelder
Sean Foss

A series of virus recovery experiments are being conducted at the Alternative Septic System Test Center (ASSTC) on three identical standard septic tank-leachfield septic systems at various points in the treatment process. This article presents the initial results of replicated testing of the standard septic system, and very preliminary previously unpublished results of effluent testing of various innovative and alternative (I/A) technologies for comparison.

Introduction

The ASSTC, located at the Otis Air National Guard Base in Sandwich, Massachusetts, is a collaborative effort involving the Buzzards Bay Project, the Barnstable County Department of Health and the Environment, the University of Massachusetts Center for Marine Science and Technology, and the Massachusetts Department of Environmental Protection (MADEP). Designed to assess the efficiency of I/A onsite wastewater treatment technologies, this newly constructed facility received funding from the USEPA Environmental Technologies Initiative (ETI) Program, with additional funding provided by MADEP, Massachusetts Environmental Trust, Barnstable County, and others.

The role of the ASSTC is to provide I/A technology vendors the opportunity to both accelerate Massachusetts regulatory approvals and reduce the substantial cost of the monitoring necessary to receive permits for sale of onsite systems in Massachusetts. The information collected at the ASSTC may also be useful in obtaining approvals for I/A elsewhere. The ongoing verification testing at the ASSTC is one part of the Commonwealth of Massachusetts' overall effort to facilitate and promote new and innovative environmental technologies.

Methods and Materials

Three standard septic systems were tested. These systems, which are the focus of this article, will ultimately serve as controls for comparison with alternative technologies at the test facility. The systems each include a 5,678-L (1,500-gal.) single-compartment septic tank, a Dipper™ distribution box, and a leaching trench with bottom and sidewall dimensions of 0.61 m (2 ft).

The trenches were installed in medium sand fill that met the Massachusetts specifications for fill material (less than 5 percent pass a #200 standard sieve). The hydraulic loading rate was adjusted to 3 cm/day (0.74 gal/sq ft/day). Calibrations of dosing rates occurred weekly. Testing locations included the septic tank influent, septic tank effluent, pan collection devices located at elevations of 30.5 cm (1 ft), 61 cm (2 ft), and 152 cm (5 ft) beneath the leaching trench, and in the sump underdraining the leaching facilities at a depth of 168 cm (5.5 ft) below the leaching trenches (see figure 1).

To avoid the problems associated with the handling of human pathogenic viruses, a surrogate virus, MS2 male-specific coliphage, was chosen because it is innocuous and approximately the same size and shape as pathogenic animal viruses commonly found in wastewater. In brief, the method of detecting these viruses in wastewater entails collecting a sample, filtering the bacteria from the sample (or alternatively adding antibiotics to the media to prohibit unwanted bacteria), depositing serial dilutions of sample into an agar-filled petri dish along with a host bacteria that selectively promotes the growth of the desired virus, and incubating the plates and their contents for approximately 16 hours.

The appearance of plaques (absence of bacterial growth on an otherwise dense growth pattern) signifies the presence of viable viruses. Plaque numbers ranging from 20 to 100 plaques per plate

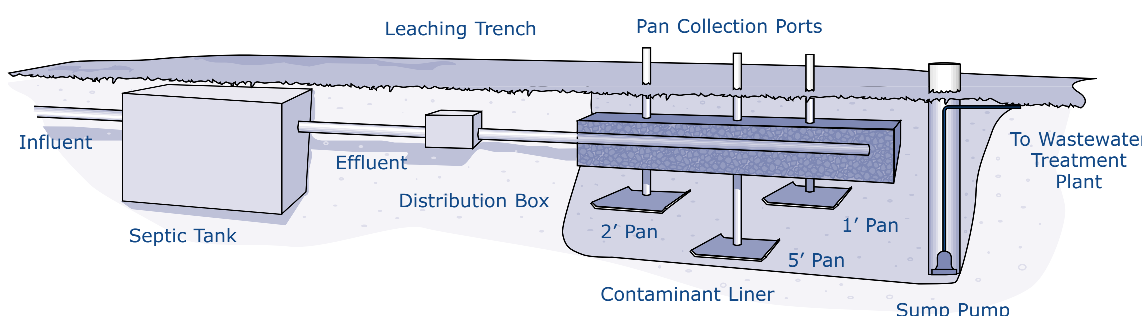
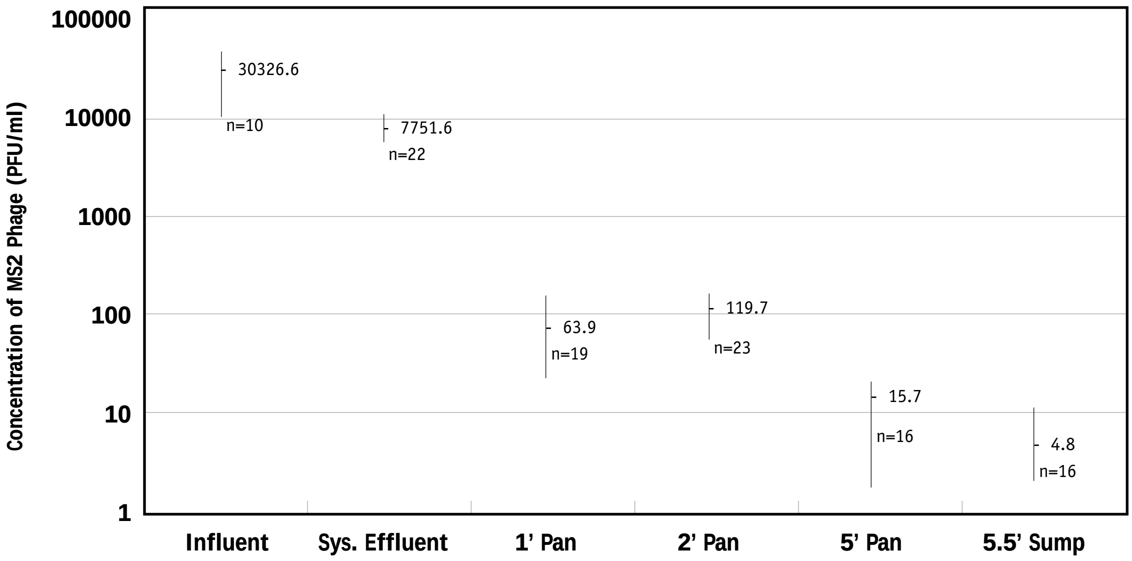


Figure 1

Schematic of sampling locations for MS2 coliphage at standard septic systems located at the Massachusetts Alternative Septic System Test Center

are considered countable for statistical purposes. All plates are run in triplicate and control plates are run to test the sterility of all media.

Experiments conducted from May to August 1999, under the guidance of Dr. Oscar Pancorbo, Massachusetts Department of Environmental Protection, Wall Experimental Station, Lawrence Massachusetts, led to the conclusion that background levels of MS2 coliphage were adequate to obtain meaningful treatment results. Virus detection techniques prior to the creation of the test center relied upon seeding a septic tank with a known concentration of MS2 coliphage and collecting samples over a period of weeks to months until the background levels (generally less than 10 plaque-forming units [PFU] per milliliter) of virus were again reached.



[a] Sample collected in sump represents drainage from entire Title 5 system

Figure 2

Mean Density of MS2 Phage Virus Using an Ampicillin-Resistant *Eschericia coli* Host at Selected Locations in Treatment of a Standard Septic Tank and Leachfield Septic System (Mean and 95 percent confidence interval)

Delivering a single high titre (10^{5-6}) of virus posed a question of whether these results adequately reflected the more common scenario of a steady influx of viruses. To avoid this dilemma, initial experiments at the test center focused on determining if levels of MS2 virus in incoming sewage (from approximately 600 housing units at the U.S. Coast Guard unit on the Massachusetts Military Reservation) were adequate. Samples were taken from the system at the above-referenced locations. MS2 virus concentrations of 10^4 in the system influent and 10^1 to 10^0 in the collection pans beneath the system indicated promise for alleviating the need for seeding.

Results and Discussion

The reduction in densities of MS2 coliphage at various points in the treatment train are represented in figure 2. There was generally a decrease in MS2 density with successive treatment stages. Reductions across the septic tank were significant (≈ 74 percent). This level of reduction compares favorably with results of Payment et al. (1986) who found a 75 percent reduction in enteric viruses with primary settling, such as would occur in a septic tank. A range of 24 to 83 percent virus removal during primary settling has been reported by Roa et al. (1981).

The mechanism for reduction of viruses in the septic tank is likely sedimentation. Viruses are rarely free and isolated in the environment, but tend to be in aggregate form or linked with organic matter or suspended solids. In addition to biological digestion, the purpose of the septic tank is to allow time for suspended solids to settle. In general, the septic tanks at the study site remove 30 to 50 percent of the suspended solids, which concurrently removes the associated viruses from the effluent.

Within the first 30.5 cm (1 ft) of soil passage, an additional 99 percent of the virus particles were removed. Unexplained, however, is the fact that there was a slight increase (although not significant at the 95 percent confidence level) in coliphage densities between the 30.5 cm-deep collection device and the 61 cm-deep collection device that occurred in all three replicates. Combining the observations taken at the one- and two-ft pan collectors yields an average removal rate of 98.9 percent within the first 61 cm beneath the leaching trenches. This removal rate (0.064 $\log_{10}$) per cm of soil passage compares with observations of Butler et al. (1954) (as cited in Yates 1987) who reported a 0.051 $\log_{10}$ per cm of soil passage at this loading rate in sandy soil.

The removal of virus particles with passage through the sand is again likely due to the concurrent removal of suspended organic matter through the filtering process. Actual filtering of the unadsorbed viruses is unlikely since the critical pore space for medium sand (effective size 0.5 mm, critical pore size .072 mm) exceeds 1,000 times the diameter of the virus (0.00002 to 0.00003 mm). This would allow for easy passage of single unadsorbed viruses.

Data from samples taken 152 cm (5 ft) beneath the leaching trenches suggest that the efficiency of the virus removal diminishes with depth. For the 92 cm (3 ft) of soil passage between the 61 cm (2 ft) and the 152 cm (5 ft) collection devices, there was an 83 percent removal of the residual viruses. This compares with a 98.9 percent removal in the first 30.5–61 cm (1 to 2 ft) of passage. Diminished removal capability may be related to the initial virus concentration.

Collectively, the data suggest that the Massachusetts regulations requiring a 5 ft vertical separation between the bottom of the leaching facility (for sandy soils with a percolation rate of less than 2 minutes per inch) and groundwater provide for nearly a 3 $\log_{10}$ or 99.9 percent removal of viruses at the allowable loading rate (3 cm/day or 0.74 gal/sq ft/day).

One purpose of these experiments is to enable state regulators to eventually determine the degree to which alternative onsite septic system technologies "compensate" for soil treatment relative to

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Barriers to Alternative Systems

Perceptions and Realities

STAFF WRITER

Marilyn Noah

with technical assistance from
Andrew Lake, NSFC Engineering Scientist

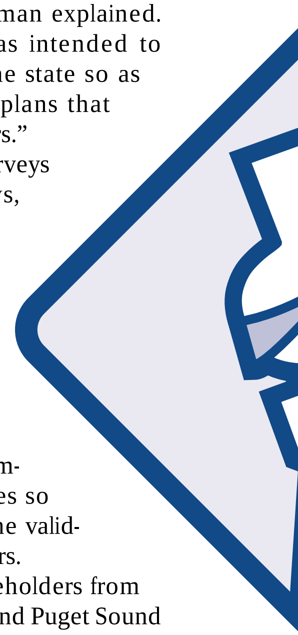
You know there is some good technology out there. You know there are better ways of doing things than you see being applied in the field. Have you ever wondered why the new ideas aren't being used and wished you knew how to encourage the acceptance of new technologies?

A study conducted in June of 1997 for the Washington State Department of Health hoped to address these issues.

Conducted by Adolfson Associates, Inc., in association with Barney & Worth, Inc., "Barriers Assessment Study and Action Plan for Alternative Onsite Sewage Systems" was a two-phase project. The intent of phase one, titled "Barriers Assessment Study," was to identify and evaluate the financial, institutional, and informational barriers to the use of alternative onsite sewage system technologies in the Puget Sound region. The second phase of the project, "Action Plan," determined the validity of the barriers and provided possible guidelines for overcoming them.

"Washington State, like many other regions in the nation, is rapidly using up the building sites where the conditions are suitable for the use of simple, conventional septic tank and gravity drainfield systems," explained Mark Soltman, supervisor of the Wastewater Management Program, part of the Office of Environmental Health and Safety with the Washington State Department of Health. "This is particularly true in the 12 Puget Sound area counties, where the most rapid population growth is occurring, much of it on onsite sewage systems."

In response to this need, Washington State has reviewed and developed standards for a large and increasing variety of alternative onsite systems. "Several years ago it became apparent that there was not widespread acceptance or use of these technologies," Soltman explained. "The Barriers Project was intended to provide information to the state so as to facilitate future work plans that would address the barriers."



Through the use of surveys and telephone interviews, the Barriers Assessment Study gathered the opinions of professionals and lay persons experienced with alternative systems. The researchers also collected data documenting the actual use and performance of these technologies so that they could analyze the validity of the identified barriers.

A broad range of stakeholders from the 12 counties that surround Puget Sound were involved: county planners, maintenance providers, homeowners, local health agency staff, onsite designers, tribes, lending institutions, realtors, and representatives of environmental organizations. The researchers also contacted a number of state agencies and departments, representatives of the U.S. Environmental Protection Agency, and representatives of certain commercial organizations, such as the Pacific Coast Oyster Growers Association, and the Pacific Northwest Indian Fisheries Commission to gather data beyond this 12-county region.

The use of alternative wastewater treatment systems in the Puget Sound region has been encouraged due to the capability of alternative systems to use reduced disposal areas and to achieve higher levels of wastewater treatment than that accomplished by conventional onsite systems—attributes especially important near sensitive environmental areas.

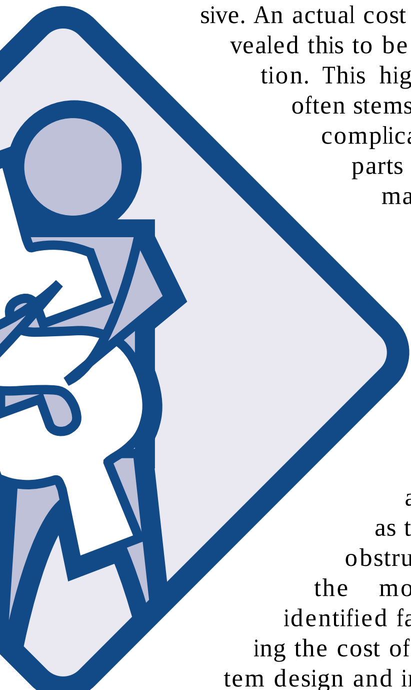
Barriers Identified

Specific barriers identified from the stakeholder survey were

- high costs of installation, design and maintenance;
- complicated state rules and policies;
- confusing local approval processes;
- weak enforcement mechanisms for operation and maintenance;
- misconception that alternative systems are prone to failure; and
- lack of education.

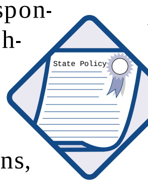
Cost of Installation and Maintenance

Respondents indicated that when compared to the design and installation costs of conventional systems, alternative systems are considerably more expensive. An actual cost comparison revealed this to be a valid perception. This higher cost most often stems from the more complicated working parts required by many of the alternative technologies compared to the more simple, conventional, gravity-fed systems. Challenging site characteristics, such as topography and obstructions, were the most frequently identified factors influencing the cost of alternative system design and installation, and the report indicates that little can be done to effectively address this problem. This report suggests that reducing some of the more rigorous design standards could lower installation costs.



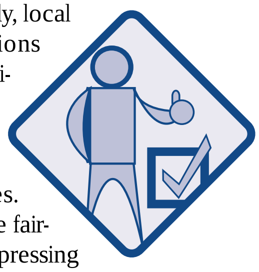
State Policies

Most of the stakeholders responded that state legislation represented a significant barrier to using alternative onsite sewage systems. While Washington State has been a national leader in positive achievements related to alternative system use, survey respondents indicated that problems still exist. Respondents specifically noted Washington's poorly defined system for approving new technologies, overly rigorous guidelines for system designs, and the approval of systems without adequate supporting data.



Local Review and Approval Processes

Not surprisingly, local health jurisdictions have created diverse and highly individualized review and approval processes. Respondents were fairly consistent in expressing their dissatisfaction with the



- cost of review and permit fees,
- length of the review processes, and
- limited acceptance of alternative technologies.

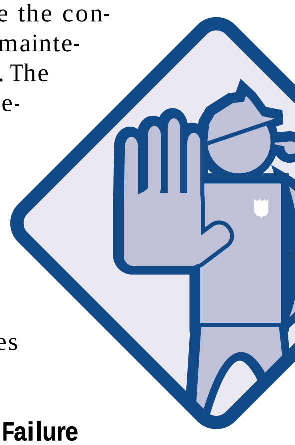
The study reviewed the actual permitting fees and determined that there is little difference between conventional and alternative permitting fees. Some counties charged nothing extra for an alternative systems permit; the largest special fee levied was only $175.

The complaints about especially long permit processing times also turned out to be a misperception. A closer look at the length of review processes revealed that there was no difference between reviews for alternative systems and those for conventional ones.

After interviewing local health department officials and reviewing local regulations, researchers concluded that the local jurisdiction policies do significantly favor the use of one type of alternative system over another. The preponderance of certain types of alternative systems in certain districts indicated a clear pattern. Justifications for these obvious preferences included public health officials being uncomfortable with their ability to enforce the maintenance of certain systems, certain systems being unable to meet required disinfection levels, and some systems requiring more paperwork and frequency of maintenance—essentially being more "trouble" for the homeowner than others.

Inability To Enforce Operation and Maintenance

Local health officials indicated they were especially concerned about their inability to enforce the continued operation and maintenance of certain systems. The report revealed that designing strong, enforceable guidelines for all systems is complicated due to difficulties in determining what represents an appropriate level of maintenance for the various types of systems.



Perception of Frequent Failure and Public Acceptance

The survey revealed a strong perception that alternative onsite sewage systems are prone to failure. To determine the validity of this barrier, the study attempted to collect failure rate data from local health jurisdictions. Unfortunately, very limited data were available that provided an actual breakdown of failure by system type or that indicated why systems had failed.

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Could the Term "Alternative" Be a Barrier?

In the wastewater treatment industry, an "alternative" onsite system is any system other than the "conventional" septic system with its leachfield.

According to the Washington State Department of Health's "Barriers Assessment Study and Action Plan for Alternative Onsite Sewage Systems," the term "alternative," when used in the context of onsite wastewater treatment systems often carries a negative connotation. The study suggested that this negative implication stems from the perception that such systems are relatively unproven and therefore prone to failure, or because the use of an alternative technology indicates the building site is below standard.

Some survey respondents felt that the term "alternative" should be applied to specific technologies and not others. Many respondents felt that the "alternative" system designation should apply only to those systems that provide a significant increase in treatment efficiency over that provided by conventional gravity systems. It was the opinion of others that all approved systems, both conventional and alternative, should be viewed as equally valuable and that the designation "alternative" be dropped from general usage.

Onsite System Management Can Take Many Forms

SMALL FLOWS QUARTERLY ASSOCIATE EDITOR

Cathleen Falvey

Photo courtesy of the Chapel Hill/Orange County Visitors Bureau

University Lake in Orange County, North Carolina, (seen here and on page 32) is part of a watershed recently designated by the state for protection. The lake is one of many reasons the county is expanding its current onsite system management program.

For the past eighteen months, officials with the Orange County Health Department in North Carolina have been struggling with an important public health question, one which faces many other communities across the country: namely, how to provide effective management for the onsite wastewater systems without breaking the bank.

To say the county is experiencing growth would be an understatement. Located almost equal distances from the mountains and the beach, it has both Chapel Hill, home of the University of North Carolina, and the town of Hillsborough within its borders. The county has been permitting an average of 500 new onsite systems per year. Many of these residents have never lived in a home served by an onsite system. Clearly, the time for management has come.

"We started monitoring certain onsite systems in our area about five years ago when the state began requiring it and when people expressed concern about the potential for pollution from failing systems," explains Greg Grimes, an official with the Orange County Health Department. "We regularly inspect all alternative onsite systems in the county, all low-pressure pipe systems, conventional systems with more than one pump, and residential and nonresidential systems with flows greater than 3,000 gallons per day." According to Grimes, the county's limited onsite system management program has been a positive step, but it also has underscored the need of extending services to include more systems.

"Right now, the frequency of the inspections vary depending on the type and complexity of the system," says Grimes. "We're finding that many systems in the program would benefit from more frequent monitoring, which has increased our concern about the status of the many smaller and individual home systems not in the program."

In response to this concern, the Orange County Board of Commissioners in conjunction with the Orange County Board of Health appointed a task force committee to explore the county's options for expanding the current program.

"The committee is considering the entire spectrum of possibilities," says Tom Konsler, who along with Ron Holdway and two other officials represent the county health department on the task force. "We are looking into everything from managing each system in the county through its entire life cycle, to focusing only on new construction, repaired systems, or systems at the time of transfer of property. We also want to include systems located in environmentally 'sensitive' or densely developed areas where residents also use drinking water wells."

Many management options exist

But exactly what options does the county have for successfully managing its onsite systems? Is it essential that a community oversee every stage in the life cycle of every system in its jurisdiction? Or can effective management be achieved through more limited means?

According to Graham Knowles, program coordinator for phase IV of the National Onsite Demonstration Project, which focuses on the study of onsite system management, it is possible for a community to tailor onsite system management programs according to their individual needs and resources.

"There is no doubt that centralized management of onsite systems is the wave of the future," says Knowles. "Management programs are essential for safeguarding public health and the environment. But while it may be ideal for communities to oversee every stage of the planning, construction, installation, and maintenance of every onsite system, a limited program is better than no management at all.

"In the real world, onsite management takes many forms," Knowles adds. "Programs vary in the level of responsibility they assume and require of system owners, and communities can take heart in the fact they have many options for improving local onsite system performance and longevity."

Although onsite management programs vary widely in scope and focus, they tend to share common elements. Communities often draw from the following options when implementing onsite system management:

- regulations and permit requirements,
- public education,

Demystifying the Management "Mantra"

At wastewater conferences around the country, one theme seems to be recurring on a regular basis—onsite system management. In fact, presentations, workshops, and training sessions increasingly are focusing on the subject. It is as if there is some kind of industry-wide "management mantra."

So, the editors at the *Small Flows Quarterly* decided to discuss this trend with Graham Knowles, the NODP Program Coordinator leading the national management initiative.

SFQ: *Is the "mantra" we are hearing at conferences about onsite system management something new, or are we just discussing the topic more these days?*

GK: Yes and no. Let me explain. Yes in the sense that what we are hearing about at conferences is a new wave of interest with new ideas. No, in the sense that onsite system management has its roots in early initiatives taken back in the mid '70s.

The need for and advantages of managing onsite systems is not a new idea. As early as the 1970s, serious efforts were made to address this very topic. A simple random review of literature in the field indicates that management was on the minds of professionals and on the agenda for several years. Now some of us are striving to look at early "ad hoc" efforts from a new perspective.

SFQ: *What do you mean by a "new perspective"?*

GK: Simply put, it appears that early management initiatives during the '70s focused primarily on managing new and emerging onsite technologies. In a sense, it was a technology driven approach. It's what I refer to as the technology management era, engineered by professionals and technical experts in the field independently of management experts.

John Mori, our executive director, along with others felt the need to revisit the concept of onsite wastewater management from a new perspective. He believes that we should address onsite wastewater management from a "holistic" community perspective. That's why I am on the team. My background and experience is in management, communication and community development. Over the past 18 months we have explored all aspects of onsite wastewater management—identifying approaches, themes, trends, and commonalties among onsite management initiatives.

SFQ: *You say that onsite system management has existed for several years in varying shapes and forms. Could you give us specific examples of early management entities?*

GK: Absolutely. Early onsite wastewater management efforts that come to mind are documented as far back as the early 1950's. In fact, the first onsite management system was conceptualized and developed not far from where we are sitting today. It was in Fairfax County, Virginia. A good friend of mine, Dennis Hill, directs that management effort. Recently, Dennis completed an excellent case study in which he discusses exactly how early management initiatives evolved in Fairfax County. Auburn Lake Trails, managed by the Georgetown Divide Rural Utility District, is another example, along with Stinson Beach and Sea Ranch, all of which are located in California. Lake Panorama, Iowa, also immediately comes to mind when thinking of early efforts.

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- homeowner incentives,
- certification or licensing of onsite system professionals,
- scheduled or required system inspection, monitoring, or maintenance, and
- establishing a local onsite management entity or authority.

Regulations and Permit Requirements

Regulations form the basis of onsite system management in many communities. Most states have codes governing aspects of onsite system design, such as system siting and size. For example, most state regulations require onsite systems to be sited at minimum setback distances from wells, groundwater, and surface water sources. However, exact laws vary among states and even locally within states.

Many local health agencies exercise some measure of control over onsite system performance through the issuance of permits. The permitting office of a local health department often acts as the principal management entity. It may restrict system design or require site evaluations as conditions of permit approval. Health departments also commonly oversee new system construction and installation or perform inspections before final ground cover as part of permit requirements.

Communities also often require permits whenever onsite systems are altered or undergo extensive repairs, or when homes are redesigned or expanded. They also may require operating permits for alternative or complex onsite systems. Operating permits must be periodically renewed and ongoing monitoring and maintenance usually are defined as conditions for renewal. Local health officials may monitor the quality of the effluent, groundwater, or nearby surface water sources to approve permit renewal. A community's costs for inspections and lab work often can be offset through permit renewal fees.

Communities also may use permits to require regular inspections, monitoring, and maintenance of conventional onsite systems. And inspections or maintenance of preexisting systems may be required at the time of sale or transfer of property.

"In our current program, all newly installed alternative and pumped systems are automatically entered into our inspections program as part of the permitting process," says Holdway. "Some of the options we're considering for expanding the program include extending the permit requirement only to new or repaired conventional onsite systems, to systems only at the time of sale of the home, or only to those systems located near designated watersheds. Each option has its pros and cons. The disadvantage always is that some systems are left out."

It would be difficult for any community to effectively manage its onsite systems through regulation alone. For example, older systems can fail or develop serious and costly problems long before a home is sold. New systems can malfunction before the next scheduled inspection or maintenance visit, especially if homeowners don't know how to properly operate them. In addition, adequate enforcement of system regulations can be difficult and costly.

Therefore, to avoid leaving public health and the environment unprotected, communities usually combine regulatory programs with other onsite system management initiatives, such as public education, scheduled maintenance, or homeowner incentives.

Public Education

In its proposal to the Orange County Commission, the task force is giving one item special emphasis: the need for public education.

"We take public education very seriously," explains Holdway. "In fact, we want to hire a full-time health educator to work for the county as a first step in implementing our new program."

Orange County has identified the following public education program goals:

- promoting and protecting public health,
- preserving local water resources,
- increasing public knowledge about wastewater treatment, and
- changing public behavior to ensure optimal functioning of systems.

The county hopes to achieve these goals by increasing public awareness about the dangers of pollution from onsite system failures and the need for system management.

"In addition to hiring a full-time health educator, we plan to build community support for the program by identifying and developing materials for various target audiences, such as system installers, pumper/haulers, builders, lending institutions, developers, realtors, attorneys, and homeowner associations," says Holdway. "We also plan to make good use of local media outlets by submitting news articles and developing brochures and flyers."

The county will distribute the materials at public outlets, such as pharmacies, hardware stores, libraries, and churches. Brochures and other materials will describe the management program and its benefits and give tips for system operation and maintenance. County officials also are thinking of hosting an "information day" for the community about the program.

"We have plans to develop educational courses to train homeowners, inspectors, and maintenance professionals," adds Holdway. Some of the proposed modules include proper inspection, monitoring, and reporting techniques for inspectors and possibly for homeowners to help them offset the costs of hiring someone."

The county may offer a certification program for homeowners to teach them how to check solids levels in their tanks or help neighbors troubleshoot their systems. Course materials would include a technical/mechanical manual for homeowners, a list of "preferred pumpers," how to troubleshoot or spot a failing system, and even video on home system maintenance. There also would be safety information for residents and professionals who will be inspecting or maintaining systems.

While Orange County's proposal is ambitious by any measure, it is important for every onsite management program to include a public education component. Simply educating homeowners about how systems work and how to operate and maintain them can go a long way in prolonging system life and protecting public health and the environment. A good program will make homeowners experts on such topics as the importance of conserving water, the importance of leaving land set-aside for system repairs intact, how to spot system problems, and when systems should be pumped.

Homeowner Incentives

One tried and true method for building support for onsite system management is to offer homeowner incentives, such as discounts on permit renewal fees for well-maintained systems or extensions on required inspections.

Orange County is considering extending the frequency of inspections for homeowners who check and pump their systems according to recommended guidelines. For example, if inspections of septic systems were to be required every five years, the county could extend that to ten years if homeowners provide documentation of regular maintenance or become certified in system operation and inspection.

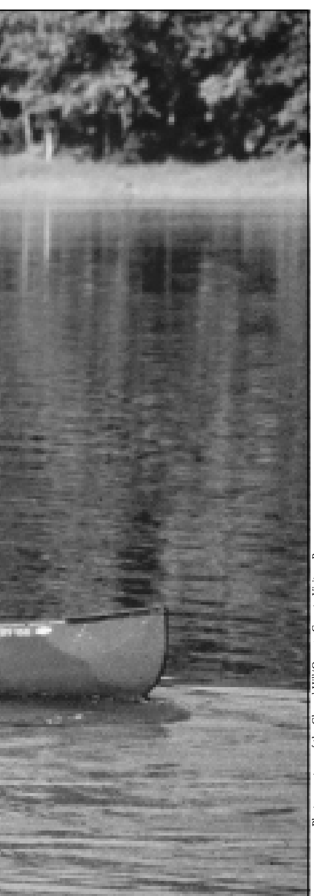

Photo courtesy of the Chapel Hill/Orange County Visitors Bureau

Certifying/Licensing Professionals

Another management program component Orange County is considering is educating inspectors and pumper/haulers on how to properly measure the depth

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SFQ: *Are there more recent examples of onsite management initiatives?*

GK: As I said, absolutely. For instance, Dr. Richard Rose, a member of the NODP Expert Panel, identified a sanitary district at Pena Blanca, New Mexico formed specifically to manage onsite systems. Other members of the Expert Panel have located good faith efforts in Idaho and Washington State, Florida in the Southeast and New Jersey, New York, Massachusetts and Vermont in the Northeast. Not forgetting, of course, several onsite management systems operating successfully in the Midwest. To be candid, we have worked diligently and tirelessly for over a year exploring, investigating, documenting and learning from some fine community onsite management initiatives.

SFQ: *Do you have a listing of all of the onsite management systems in the nation?*

GK: That's our intention. It's a sizable task though. It also is a work in progress. We are building a directory—a database. At the last count we had located more than 125 communities of varying size and scope specifically managing onsite systems with differing degrees of sophistication around the country.

SFQ: *Did you expect to find so many onsite management initiatives when you started looking?*

GK: That's an interesting question. You have to remember that I came into this position with no background in onsite wastewater. I was just starting out. Early indications from conversations with EPA officials in Washington, D.C., seemed to indicate that there were very few onsite management systems in place. Some suggested a range of only ten to fifteen entities. At one national conference, I was told that there were hardly any and that many people had tried to develop local initiatives but had failed.

As I reflected on what was shared with me, I quietly set a goal to find 50 good-faith efforts around the country. I was confident that such efforts must be out there. Well, it did not take too long to reach the 50 mark, then 75, and then the triple figures. It has been an absolute delight to be a part of something so dynamic and vibrant.

With the assistance of the NODP IV Expert Panel, the Practitioner Council, and other input, we feel that we have made great strides in covering the country. Of course, we would like to hear about any and all new initiatives.

SFQ: *You mentioned that the communities differ in size and sophistication of management. Do all onsite management systems have a particular management model that they are using?*

GK: No. However, some similarities between management entities in terms of their management models do exist. What is so interesting is to learn about the novel approaches developed and tailored to specific community situations. So, we can certainly say there is no one-size-fits-all management model.

Of course, from a management perspective, we never expected one model. In fact, that's what is so exciting. To learn about unique entities across the country that have evolved within differing social settings, economic environments and regulatory realms. I would say that the only real similarity is the application of correct management principles to effect sustainable solutions.

SFQ: *How many management models are out there?*

GK: To be honest we do not really know at this stage. Identifying another entity may very well unearth a different management model. I guess it's like asking how many models of vehicles are on the road. The range of options is significant. We have RVs, SUVs, trucks, vans, buses—a myriad of alternatives. What is common is that they are all modes of transport.

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of solids in systems and to pump only when needed to reduce unnecessary septage disposal. Professionals also may receive training to assess the condition of filters, clean or replace them as needed, and report this information to the health department.

Certification programs can prepare professionals to properly perform site evaluations, oversee the construction and installation of new systems, inspect existing systems, and perform system maintenance. Pennsylvania, for example, trains and certifies sewage enforcement officers to perform site evaluations and oversee new system installations. These professionals are the only ones authorized to approve new system permits in their state.

Some states require certification or licensing for pumper/haulers to ensure that local systems are properly maintained and that the septage pumped from them is safely handled and disposed of in the community. The National Association for Waste Transporters (NAWT) offers a national training and certification program for pumper/haulers, which also is used by many state and community onsite management programs. They can be contacted at their headquarters at (800) 236-NAWT.

Inspections and Maintenance

One of the most common reasons that onsite systems fail is a lack of ongoing maintenance. This is why many communities focus their onsite system management efforts on providing regularly scheduled inspections and maintenance. In some communities, this may be the management program's sole function.

Many wastewater treatment technologies require regular maintenance to be effective. Systems also need regular inspections so that the need for maintenance or repairs can be identified and addressed quickly. Therefore, health agencies typically do require regular maintenance for alternative or more complex onsite systems, such as mound systems and home aerobic treatment units. In the case of home aerobic units, homeowners may be required as a condition of permit renewal to renew a maintenance service contract with a local manufacturer's representative.

Health agencies that require regular onsite system inspection and maintenance may carry out these duties themselves or via a management district or entity established for this purpose. Some communities send registered sanitarians to perform the inspections and then contract out the system pumping or other maintenance, if needed, to reputable local contractors.

There are almost as many possible scenarios for managing onsite system maintenance as there are communities. A management entity may own its own maintenance personnel and equipment or it may allow homeowners to contract state licensed or certified contractors to perform these services at required intervals. Homeowners would be required to provide documentation on the condition of the system and proving that maintenance took place.

"One of the more difficult things we had to work out in our program proposal is how often to require system maintenance," says Holdway. "The committee debated extensively about whether to set the inspection frequency at every three years or every five years. We agreed to set the re-inspection frequency at every five years with a notice going to each homeowner in the initial maintenance packet and also in the second year of operation."

Ideally, conventional systems should be inspected yearly and pumped as needed. Experts estimate that properly designed and operated conventional septic systems should have solids pumped from the tank once every three to five years or longer. While it may be prudent to inspect all onsite systems yearly, it is especially important for new systems and old systems with new, inexperienced owners. However, communities must balance the many needs of the residents and onsite systems in their jurisdiction with the available resources.

For example, communities may decide that it less important to provide yearly inspections for all conventional systems than it would be to provide low-interest loans or grants to low-income residents to replace failing systems. Or communities may decide it is more cost-effective to educate homeowners about the advantages of initiating yearly onsite system inspections.

Establishing a Local Management Entity

Communities have several options for administering onsite system management. Programs can be run by the town, county, or state, or by a public agency, such as the local health department. In other cases, they can be administered by existing organizations, such as homeowner associations, or special entities formed expressly for this purpose. In some states, enabling legislation is needed to allow special entities to manage onsite systems.

Examples of special management entities include sanitary, water, and sewer districts; public utility districts; and multiple purpose special districts. Rural utility cooperatives and private corporations sometimes manage onsite systems through public/private partnerships.

The scope of a management entity's authority can vary greatly. Usually, individual onsite systems are privately owned and management entities oversee their inspection, maintenance, and repair. But entities also may own all the systems in their jurisdiction and assume complete responsibility for their operation and maintenance.

The following list, adapted from the Spring 1996 issue of the National Small Flows Clearinghouse (NSFC) publication *Pipeline* (Item # SFPLNL05), illustrates the scope of responsibilities and powers that local governments, public agencies, organizations, or other types of management entities may assume:

- the power to propose legislation and establish rules and regulations for the management program;
- the authority to plan or approve system designs and applications for systems, land use planning, and the issuance of system permits;
- the ability to construct or install new systems or to oversee or inspect their construction and installation;
- the authority to perform routine system inspection and maintenance or to contract these services;
- the authority to regulate and manage septage handling and disposal;
- the ability to perform local water quality monitoring;
- the ability to keep records, perform database maintenance, bookkeeping, billing, payment processing, and other administrative responsibilities;
- the ability to perform grant writing, fundraising, and public relations;
- the authority to set rates, collect fees, levy taxes, acquire debt, issue bonds, make purchases, and other financing powers;
- the authority to obtain easements for access to property when needed or to acquire land when necessary;
- the authority to enforce regulations and require the repair or replacement of failed systems;
- the authority to acquire land; and
- the ability to educate, train, and certify professionals and the public.

The importance of two of these responsibilites may easily be overlooked. Keeping accurate records is vital to a management program's success. Inspectors and maintenance professionals need information such as the precise location of individual systems, descriptions of the systems, and records from previous inspections and maintenance. Also, the ability to perform billing, payment processing, and bookkeeping is vital and adds extra costs to running the program.

In addition, it is often necessary for management entities to have authority to obtain easements for all of the systems in their jurisdiction. Enabling legislation sometimes is needed to make this possible.

Paying for it All

Communities have several options for funding onsite system management programs. For most, cost will be the most important consideration in program design. One option is to charge fees, such as permit fees, member fees, annual service fees, or fees for specific services, like septic tank pumping. Some management entities will have authority to levy taxes, issue bonds, or receive state or local funding. Most will choose a combination of strategies.

"Our county is considering several options," says Holdway. "One is to take the money needed from the county's general fund. Although this approach would eliminate the problem of collecting money from those that cannot or will not pay, municipal residents will be paying for the inspection of a county resident's septic system. The benefit to municipal residents would be protection of their watersheds."

Orange County also is considering setting up a special fund or an enterprise fund and charging monthly fees to system owners enrolled in the program. Other options under consideration include fees for inspections and other services, a sewer tax district, or a combination of approaches. The county also will attempt to establish a revolving fund loan program to assist homeowners repair their failing systems.

According to Knowles, communities should remember to emphasize the benefits of management when proposing funding options to the public.

"It is important to remind residents that the costs of providing central management for onsite systems in rural areas rarely equals the costs of constructing, operating, and maintaining a centralized sewerage system and wastewater treatment plant. Onsite system management also is a bargain when compared to the costs of cleaning up a polluted water supply. In fact, in addition to offering convenience, managing systems improves property values and helps a community to retain its rural character—the very thing that attracts prospective buyers and the reason that residents want to live their whole lives in a small community."

For more information about Orange County's proposed onsite system management program, contact Ron Holdway at (919) 245-2360. For more information about the National Onsite Demonstration Project, read the interview with Graham Knowles with this article, or contact him at (800) 624-8301, ext. 5573. SF

CONTINUED FROM PAGE 33

Likewise a management model is a means to an end. Onsite wastewater management is a way of doing business. Whether or not it is a public utility model, a sanitary district approach, a homeowner association, an intermunicipal agreement, or a compliance-based model is not entirely important. What is key is whether or not it works. Does the chosen model get the job done effectively? I mean, are community objectives achieved? If so, we must obviously consider it an effective onsite management system.

SFQ: *What are you doing with all this data?*

GK: That's a good question. Data gathering for the sake of the exercise would not be at all valuable to the country at large. We are gathering data so as to generate information to add to the knowledge base of the industry. Our intention is simply to put data into context, to generate information. Once we put the information into context we will have knowledge, valuable insights into onsite wastewater management. In this way we are better positioned to assist America's small communities and to fast-track long-term solutions in the context of their individual situation and desired outcomes.

SFQ: *We understand that you developed something called SepticStats. What is SepticStats, and is there any connection between it and your onsite management activities?*

GK: Yes, it's true that I did develop SepticStats, and, yes, there is a definite connection between SepticStats and onsite wastewater management. SepticStats has two data sets compiled from U.S. Census data from 1970, 1980, and 1990. It includes information on the means of sewage disposal by state and county as of 1990 and bar charts by state indicating thirty-year trends in terms of the means of sewage disposal. SepticStats is an effort to heighten community awareness of the number of local housing units utilizing an onsite system as a means of sewage disposal.

Let's face it, if you cannot count it, you sure can't manage it, can you? You would be amazed how many communities know that they need to manage the systems in their jurisdiction yet do not know how many systems are even in their area, let alone where those onsite systems are located.

SFQ: *What are you currently busy working on?*

GK: Right now we are wrapping up the first stage of this project—what I refer to as the "hunter gatherer stage." We are delighted with the outcome and have learned a tremendous amount. We have been working on a management strategy to assist America's small communities develop effective onsite management systems. It's now complete and under review. We are also working on developing a set of tools to assist communities take practical steps in effecting long-term local solutions to onsite wastewater issues. It's a fascinating subject, which has stimulated tremendous interest nationwide.

Graham Knowles directs the National Onsite Demonstration Program onsite management initiatives at the National Research Center for Coal & Energy located on the campus of West Virginia University. Graham has over twenty years of international private-sector management experience, in Europe and Africa. Currently, he heads-up NODP Phase IV addressing all aspects of onsite wastewater management in the United States. SF

Field Assessment of Onsite Rock-Plant Filters in Kansas

CONTRIBUTING WRITERS

Kyle R. Mankin
G. Morgan Powell

ABSTRACT: Three residential sites in southeastern Kansas using rock-plant filters were monitored for two years. At each site, septic tank effluent passed through a lined rock-plant filter composed of coarse limestone gravel planted with common reed *(Phragmites australis)* and designed for a residence time of seven days at 1.1 m^3/day (300 gpd) loading. Monthly grab samples were collected at the inlet and outlet of each system. Overall treatment at each site was similar to that reported in the literature for five-day biochemical oxygen demand (BOD_5) (84 to 87 percent reduction), total suspended solids (33 to 91 percent), ammonium-nitrogen (48 to 65 percent), total phosphorus (52 to 75 percent), and fecal coliforms (78 to 94 percent). Average monthly BOD_5, ammonium, and phosphorus treatment followed seasonal water temperature variation. However, variation in monthly treatment levels was significant, with removal of some parameters falling near or below zero percent during some months. This variability suggests the need for more rigorous septic tank maintenance and designs with more consistent, reliable treatment.

Residents of rural Kansas typically use a septic tank with soil absorption laterals to treat their onsite wastewater. However, throughout eastern Kansas, tight subsoils limit water infiltration in soil absorption systems. Heavy spring or autumn rains commonly saturate these soils causing effluent to surface and leading to surface flows of only partially treated wastewater. Several other conditions common in Kansas, including seasonally high water tables, shallow soils, steep slopes, and/or very highly permeable sand soils, also may cause water quality concerns with the typical septic system. Public health officials and other interested parties in Kansas seek cost-effective, low-maintenance alternative systems for onsite wastewater treatment.

Constructed wetlands increasingly are being used for wastewater treatment, taking advantage of the combination of physical, chemical, and biological processes characteristic of natural wetlands. A rock-plant filter is a type of constructed wetland that uses emergent macrophytes grown in a gravel medium for secondary wastewater treatment. Wastewater flows beneath the gravel surface through the plant root zone. The emergent macrophyte roots are intended to leak oxygen to help support fixed microbial growth, the cornerstone of wetland biological treatment (Bedford and Bouldin, 1994; Sorrell and Armstrong, 1994; Bedford et al., 1991; Reddy et al., 1989).

A number of guidelines have been developed for designing rock-plant filters for onsite wastewater treatment (Sievers, 1993; U.S. EPA, 1993; Steiner and Watson, 1993; Crites, 1994; Cooper, 1990; Kadlec and Knight, 1996). A comparison was made among the published guidelines found in these references. For purposes of comparison, a baseline household (five-person, three-bedroom) was selected. Wherever possible in the design process, consistent assumptions were maintained among the various designs: 25-mm (1-in.) diameter gravel, 0.5 percent slope, and design for mean January conditions (water temperature of 4˚C). A summary of recommended dimensions for the baseline household is shown in table 1.

These design guidelines show a wide range in recommended wetland sizes; i.e., flow rates from 0.87 to 1.3 m^3/day (240 to 360 gpd), retention times from 1.2 to 6.5 days, length to width ratios of 0.5:1 to 52:1, and water depths from 0.3 to 0.75 m (12 to 30 in.). With the substantial differences seen among the various established design criteria, selection of appropriate design parameters for Kansas is a major concern for this project.

OBJECTIVES

The objectives of this project were to evaluate the treatment effectiveness of three demonstration wetlands in southeast Kansas based on two years of monitoring data and to develop preliminary criteria for design and construction of rock-plant filters in Kansas.

Table 1

Summary comparison of rock-plant filter designs using published guidelines, assuming a 5-person, 3-bedroom household with 4 °C mean January temperature, 0.5 percent slope, and 25-mm (1-in.) diameter gravel. English units are used by convention.

Reference	Water Depth (in.)	Width (ft)	Length (ft)	HRT (days)	Flow Rate (gpd)	Media Type [saturated hydraulic conductivity (ft/day)]
Kadlec & Knight, 1996	18	36	19	1.2	238	Not specified [800, assumed]
U.S. EPA, 1993	30	3.2 [a]	59	4.7	300	1.25 in. gravel [10,000]
"	24	4.0 [a]	59	4.7	300	"
"	12	8.0 [a]	59	4.7	300	"
TVA, 1993	18	7.5	42	3.6	360	0.5 in. river gravel [850]
"	12	11	42	3.6	360	"
Sievers, 1993	12	12	87	6.5	360	1 in. rock [800]
Cooper, 1990	24	11	20	5.6	238	0.25-0.5 in. fine gravel [280]
Wolverton et al., 1983; Amberg, 1988 [b]	18	2.0	105	2.4	≤400	1-3 in. rock [not specified]

[a] Width needed to meet flow requirements for given depth. Note that the L:W ratio were not subsequently adjusted to 0.4:1 to 3:1, as recommended by guidelines.

[b] Procedure summarized in U.S. EPA, 1993.

MATERIALS AND METHODS

Design and Construction of Demonstration Rock-Plant Filters

The systems installed in southeastern Kansas were designed by the Kansas Department of Health and Environment (Snethen, 1994) based upon guidelines presented for Missouri conditions by Sievers (1993). The design parameters included a 1.1-m^3/day flow rate (4 residents • 75 gpd/resident = 300 gpd), a treatment cell surface area of 74 m^2 per m^3/day (3.0 ft^2/gpd), septic tank effluent with 150-mg/L five-day biochemical oxygen demand (BOD_5), rock-plant filter effluent with 150-mg/L BOD_5, 0.5-m (18-in.) water depth, 25-mm (1-in.) diameter gravel with a hydraulic conductivity of 250 m/day (800 ft/day), and a 0.25 percent bed slope. The resulting wetland was designed to be 5.3 m (width) • 15.8 m (length) • 0.6 m (depth) (17.5 • 52 • 2.0 ft). The actual as-built wetlands were somewhat smaller, as discussed below.

In the common version of this system, effluent is transported from the existing septic tank to a plastic-lined rock-plant filter and then to an unlined absorption cell, trench, or bed for disposal (see figure 1 below). Wetland and absorption cells were constructed in March (the Carlson Site), April (the Beery Site), and May (the Brown Site) of 1994 in close proximity to each residence (refer to the photo on page 40).

Shoreline common reed *(Phragmites australis)* was established in 25- to 38-mm (1- to 1.5-in.) graded limestone in each wetland cell. Absorption cells contained the same limestone rock without plants. Each wetland cell was 5.2 m wide and 14 m long (17 • 46 ft) with 0.5-m (1.5-ft) gravel depth. Corresponding dimensions of the absorption cells were 5.2 m (width) • 7.3 m (length) • 0.3 m (depth) (17 • 24 • 1 ft).

During plant establishment, water levels were maintained at or near the surface, after which water levels were set at 0.3 m (1 ft) deep. The total installed cost of each rock-plant filter system averaged $3,000 to $3,500. This translates to $2.50 to $3.00 per ft^2, slightly higher than the $2.00 per ft^2 average cost for submerged flow wetlands from a survey by Reed and Brown (1992).

Data Collection and Analysis

Sampling and data analysis were performed monthly under the direction of Dr. Joe Arruda, Associate Professor, Department of Biology, Pittsburg State

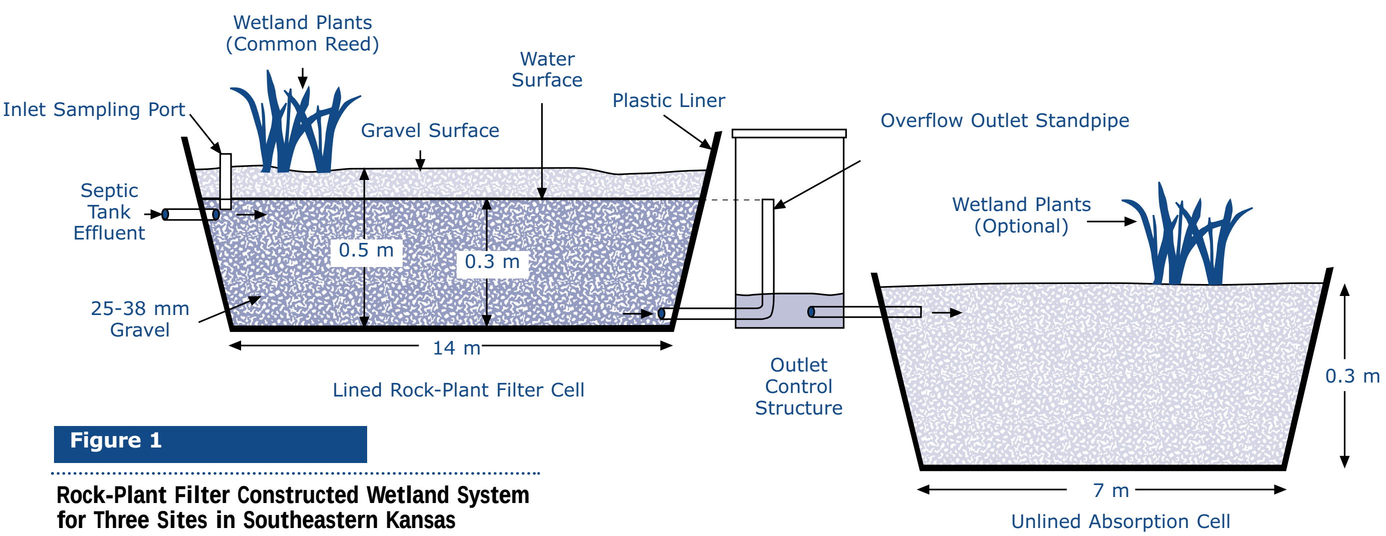

Figure 1

Rock-Plant Filter Constructed Wetland System for Three Sites in Southeastern Kansas

University, from June 1994 to June 1996. At each site, grab samples were collected from both the influent sampling port and the flexible effluent discharge pipe. The samples were collected by dropping an open plastic bottle into the orifice and pulling up and down to “integrate” the sample. Two samples were collected at each inlet and outlet to ensure adequate volumes for analysis. Samples for the analysis of BOD_5, total suspended solids (TSS), total phosphorous (TP), ammonium-nitrogen (NH_4-N), nitrate-nitrogen (NO_3-N), and fecal coliform (FC) bacteria were iced and transported to the lab within 18 hours of collection. All laboratory analyses were performed according to EPA methods. Temperature, pH, and conductivity were measured onsite when samples were collected.

The general condition and status of the rock-plant filtration systems were assessed on each sampling trip. Notes were taken and summarized concerning odors, extent of plants, condition of plants, condition of the wetland-cell rock bed and absorption-cell rock bed, the nature of any discharge, and other relevant conditions.

Pollutant reduction in rock-plant filters has two goals: meeting acceptable outlet concentrations and reducing overall pollutant mass. Grab sample methods assess the concentration criteria, at least at distinct points in time, but must be coupled with the measurement of inlet and outlet flow rates to assess mass pollutant reduction. Flow rates were not measured, so approximations were made using the following method:

First, a design inlet flow rate of 1.1 m^3/day (300 gpd) was assumed. This assumption was corroborated with monthly water meter data ranging from to 0.7 to 1.1 m^3/day (200 to 300 gpd) at one site. Daily precipitation and climatic data were obtained from a weather station maintained at Parsons, Kansas, centrally located to the demonstration sites. Potential evapotranspiration was estimated from these data on a daily basis using the Priestly-Taylor method (equation 1):

$$\lambda ET = \alpha \frac{\Delta}{\Delta+\gamma}(R_n - G) \qquad [1]$$

where
- ET = potential evapotranspiration ($kg\ m^{-2}\ s^{-1}$),
- λ = latent heat of vaporization ($J\ kg^{-1}$),
- α = constant (1.26),
- Δ = slope of vapor pressure curve ($Pa\ ^\circ C^{-1}$),
- γ = psychrometric constant ($Pa\ ^\circ C^{-1}$),
- R_n = net radiation flux at surface ($W\ m^{-2}$), and
- G = water/ground heat flux ($W\ m^{-2}$).

Table 2

Removal rates (%) by subsurface flow rock-plant wetlands. Negative values are shown in parentheses.

Source	Constituent[a] BOD_5	TSS	TN	NH_4-N	TP	FC
SE Kansas Data	84-87	33-91	--	48-65	52-75	78-94
Arkansas Data[b]	64-89	64-86	--	--	--	34-82
Looney et al. (1997)	25-97	0-90	6-96	1-100	0-95	43-100
Conley et al. (1991)	64-96	71-98	24-61	57-94	13-68	--
U.S. EPA (1988)	64-86	28-93	25-88	--	28-57	99
U.S. EPA (1993)	20-92	56-96	--	(50)-94	0-95	90-99

[a] BOD_5 = 5-day biochemical oxygen demand, TSS = total suspended solids, TN = total nitrogen, NH_4-N = ammonium-nitrogen, TP = total phosphorus, FC = fecal coliforms

[b] Gross (1996, unpublished)

Infiltration was negligible due to the wetland liner. Net extraneous water flux was estimated as the difference between daily precipitation and potential evapotranspiration. Mass treatment was determined using equation 2.

$$\Delta mass = \frac{I(Q) - O(Q - ET + P)}{I(Q)} \qquad [2]$$

where
- Δmass = constituent mass-reduction (%);
- I, O = inlet, outlet constituent concentration ($mg\ L^{-1}$);
- Q = inlet flow rate ($L\ d^{-1}$); and
- ET, P = total daily evapotranspiration, precipitation rate ($L\ d^{-1}$).

Data collected at the three rock-plant filter demonstration sites in southeastern Kansas were entered into a commercial spreadsheet software program. These data were analyzed for trends indicative of wetland performance during the initial two-year period of operation. The significance of specific comparisons was determined using calculated standard errors; treatments for which standard errors did not overlap were judged to be significantly different. Comparisons were made between these results and results from analyses of other similar systems.

RESULTS AND DISCUSSION

Analysis of Rock-Plant Filter Data

Overall treatment rates of the wetlands appeared to meet design expectations. The wetlands were originally designed to provide 97 percent BOD_5 treatment in average January conditions, though the reduced surface area and depth of the as-constructed cells reduced the predicted design treatment rate to 86 percent. This compared well with the 84 percent average monthly treatment (ranging from 79 to 95 percent) during the design-temperature month, January, as well as the 83 percent overall average annual treatment (ranging from 82 to 85 percent) at all three cells. Average removal rates were similar to those reported in the literature (see table 2).

The wetlands provided significant reductions in BOD_5, FC, TSS, NH_4-N, and PO_4-P as indicated by nonoverlapping standard errors between the inlet and outlet at each site (see figure 2). Only TSS reduction at the Beery site was not significant. Treatment of some parameters varied considerably by site.

Both inlet loads and outlet effluent levels varied among sites. Influent loads to the rock-plant filters were considered to be very high. By comparison, data in figure 2 greatly exceed measured mean septic tank effluent from a two-bedroom duplex serving a similar rock-plant filter system in Texas (145 mg/L BOD, 1.3 • 10^4 col/100 mL FC, 25.7 TSS, 26 mg/L NH_4-N, and 0.63 mg/L P) (Nerella et al., 1998).

Where influent loads were high, even high percentage rates of treatment were not adequate to reduce effluent levels to surface-discharge-level targets. For instance, BOD_5 loads are often assumed for design purposes to be 150 mg/L, whereas average BOD_5 influent ranged from 250 to 600 mg/L for the three sites studied. And only one site had average effluent levels that met the U.S. EPA

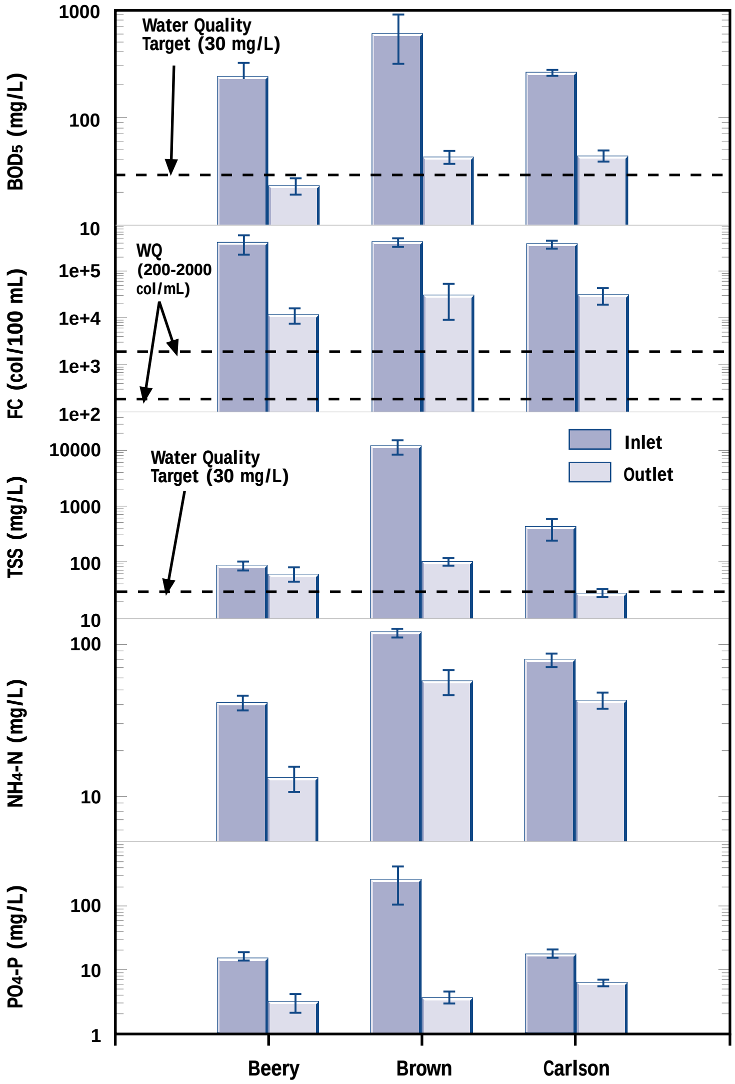

Figure 2

Average inlet and outlet concentrations for three rock-plant filters in southeastern Kansas. Presented are means and standard errors based on 25 monthly samples at each site.

(1988) target level of 30 mg/L. Another notable instance was the 10,000-mg/L average TSS inlet concentration at the Brown site, which was believed to be due to a poorly functioning septic tank.

These unacceptably high wetland influent (i.e., septic tank effluent) and wetland effluent concentrations clearly indicate the need for system improvements. Existing septic tanks were not inspected or serviced before wetland installation. This was recognized to limit system effectiveness. A properly functioning septic tank that produces a reasonable primary effluent is essential for the rock-plant filter system to function properly.

In practical terms, this means that the septic tank must be checked for leaks, structural integrity, and inlet and outlet baffle or tee function before installing the rock-plant filter system. Checking involves pumping septic tank contents (septage) to permit a visual inspection. Further, rock-plant filter systems may need to provide improved treatment rates to accommodate the higher loads seen in practice and produce the target effluent quality.

Figure 3 shows how mass treatment rates varied on a monthly basis throughout the year. Similarity was seen particularly among treatment of BOD_5, NH_4-N, and PO_4-P; in each case, treatment rate in spring was less than in autumn. Specifically, treatment of BOD_5 was significantly less in each month from January to June than in each month from July to October, except in August. Similarly, NH_4-N treatment was significantly less in January to May than in June to November, and PO_4-P treatment was significantly less in February to April than in July to October. These treatment rates tended to follow average water temperatures. During the study, the lowest average temperature was in February while the highest was in August (see figure 3).

Reductions in FC and TSS were not as closely linked to temperature and showed less distinct overall trends. Treatment rates for FC were generally high (86 to 99 percent) except during June and July. Rates in June were significantly lower than those for all but two other months (July and August). Treatment of TSS averaged above 80 percent each month from May to October (except July), and above 70

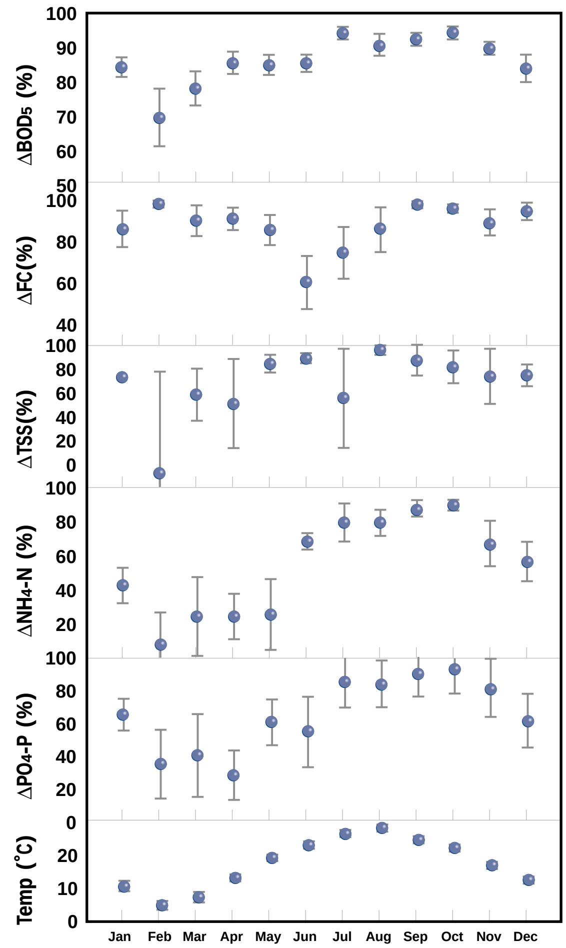

Figure 3

Monthly average treatment rate (% mass reduction between inlet and outlet) and mean water temperature for three rock-plant filters in southeastern Kansas. Presented are means and standard errors based on 2 years of data at each site.

percent November to January but was extremely variable in the late winter to early spring months of February to April. The initiation of this period coincided with the first month with mean water temperature below 10°C (February).

Table 3

Rock-plant filter treatment as a function of mean water temperature – first-order linear regression (y = a + bx) parameters and coefficients of determination (r^2).

	Contituent[a]				
	BOD_5	FC	TSS	NH_4-N	PO_4-P
a	71.6	98.6	25.7	0.61	26.8
b	0.81	-0.62	2.5	3.1	2.2
r^2	0.73	0.19	0.46	0.68	0.56

[a] BOD_5 = 5-day biochemical oxygen demand, FC = fecal coliforms, TSS = total suspended solids, NH_4-N = ammonium-nitrogen, PO_4-P = phosphate-phosphorus

Linear regression between mass treatment of each constituent and mean water temperature supported the relationships discussed above (see table 3). The highest coefficients of determination (r^2) for the linear regression model were found for BOD_5 and NH_4-N and the lowest for FC. This is consistent with the use of temperature in models for treatment of BOD_5 and NH_4-N and not TSS and PO_4-P by Reed et al. (1995). However, the literature yields mixed results on the relationship between temperature and pollutant treatment rates.

Looney et al. (1997) found a general correlation between temperature and removal efficiencies of some pollutants in a Kentucky study of two rock-plant filter sites. As temperature increased, BOD_5 treatment improved slightly, while NH_4-N treatment rates decreased. Again, treatment of FC and TP were independent of temperature. In another recent study, Leonard and Swanson (1997) found BOD_5 reaction rates in northern Alabama to be only weakly dependent on temperature.

It is also important to note the large standard error bars associated with treatment of several parameters in specific months. The largest variability in TSS, NH_4-N, and PO_4-P generally occurred during the February to May period with treatment rates of TSS and NH_4-N near or below zero percent during February. The February to May period combined low temperature and lack of plant activity, which might have contributed to the net generation of NH_4-N in the wetland. Nitrification of NH_4^+ to NO_2^- and NO_3^- ceases under anaerobic conditions, which likely were present because of inactive plant roots, although NH_4^+ input to the wetland may have continued because of decomposition of organic matter and direct input of new septage. The specific mechanisms for the low, variable treatment rates evident for TSS and PO_4-P are not clear from the data in this study.

Studies from other states have found similar results. A two-year monitoring effort of four similar rock-plant filters in Arkansas (Gross, 1996, unpublished) found overall treatment levels were fairly high (see table 2). However, ranges in biweekly treatment levels were variable: FC had a net negative treatment rate during numerous periods, and both BOD_5 and TSS reductions fell below 50 percent on a number of occasions. Performance of two rock-plant filters in Kentucky also ranged widely, as is indicated in table 1 (Looney et al., 1997). This was attributed to "occasional spikes in the effluent concentrations."

Reasons for the inconsistencies in treatment within and among studies are not clear. Seasonal climatic factors, such as precipitation or temperature, can have significant effects on rock-plant filter treatment in some cases. Rainfall can influence treatment rates through effects on hydraulic loading and rock-plant filter residence time. For example, in Kansas a 10-year, 24-hour storm providing about five inches of rainfall can add enough water to completely fill an 18-inch depth rock-plant filter cell. Depending on the outlet configuration, this type of input can short-circuit treatment by exchanging rainwater for partially treated wastewater. Temperature is included in most design criteria as a primary factor for biological treatment. Sensitivity of rock-plant filter treatment rates to temperature relates, in part, to the relative importance of microbe and plant uptake and transformations versus adsorption and particulate settling.

In addition to climate, household usage patterns and septage composition can vary over time and influence treatment. In order to help elucidate fates and processes of pollutant treatment in the complex environment of established rock-plant filter cells, studies that include a mass-balance accounting of wastewater components are necessary.

The Carlson Site system with established common reed *(Phragmites australis)*. A rock-plant filter can be an attractive component of a residential landscape.

Current Rock-Plant Filter Recommendations for Kansas

Wetlands remain attractive because of their low cost, low technology, and relatively low maintenance. But available monitoring data from this and other studies on wetlands constructed according to current design guidelines show periods of inadequate treatment. When combined with the potential for periodic overflow from soil absorption fields or unlined absorption cells, especially in areas of high clay subsoils found in eastern Kansas, the potential persists for surface discharge of inadequately treated wastewater. This is unacceptable and limits the usefulness of rock-plant filters for secondary onsite wastewater treatment.

Design guidelines based on this reality have been developed and are outlined in two Kansas State Research and Extension publications: *Rock-Plant Filter Design and Construction for Home Wastewater Systems* (Powell et al., 1998a), which is written for designers and installers and is available online at *www.oznet.ksu.edu/library/h20ql2/samplers/mf2340.htm*, and *Rock-Plant Filter Operation, Maintenance, and Repair* (Powell et al., 1998b), which is for homeowners and available online at *www.oznet.ksu.edu/library/h20ql2/samplers/mf2337.htm.*

These two publications were

written in response to interest expressed by homeowners and public health officials for reasonable design guidelines that would provide adequate treatment and protect public safety while also meeting public demand for alternative onsite treatment systems. The goal of these guidelines is to incorporate constructed wetlands as part of a system with adequate capacity to retain 100 percent of the system flow, thus avoiding the potential hazards from surface-flow of partially treated wastewater.

An example of one such system, as currently proposed for a three-bedroom home in northeastern Kansas, includes the following components in series:

- septic tank—4500 L (1200 gal.) preferred, 3800 L (1000 gal.) required;
- septic tank effluent filter required;
- lined rock-plant filter cell—3.5 (width) • 15 (length) • 0.5 (depth) m (12 • 50 • 1.5 ft), with approximate 5-day detention time;
- unlined sand-plant absorption cell—3.5 m (width) • 15 m (length) • 0.5 m (depth) (12 • 50 • 1.5 ft), with approximate 5-day detention time and medium to coarse sand; and
- shallow, free-water-surface overflow wetland cell—approximately 140 to 185 m^2 (1500 to 2000 ft^2) surface area, 0.6 m (2 ft) deep, to handle excess flows during wet periods.

This system design is site-specific and is not a "blanket guideline" for all cases. Although these guidelines are considered preliminary, the authors believe a system with these basic components has potential to provide effective treatment while containing both wastewater and rainfall flows.

CONCLUSIONS

Rock-plant filters in southeast Kansas provide reasonable reductions of BOD_5 (>80 percent), FC (>90 percent), TSS (>75 percent), NH_4-N (>50 percent), and PO_4-P (>50 percent) during most months. Final effluent concentrations will not be acceptable, however, unless septic tanks are functioning adequately and producing reasonable effluent levels. When retrofitted into existing systems, inspection and corrective actions to septic tanks are essential.

Erratic treatment can be expected during some months, particularly during the late winter and early spring. The initiation of this period appears to coincide with the first month in which mean water temperature falls below 10˚C.

ACKNOWLEDGEMENTS

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Kyle R. Mankin is an assistant professor in the department of biological and agricultural engineering at Kansas State University (KSU) and has studied the use of wetlands to treat onsite and agricultural wastes for the past five years.

G. Morgan Powell is a professor of biological and agricultural engineering at KSU, extension water quality engineer with Kansas State Research and Extension, and director of the Kansas Environmental Leadership Program. He has worked with water quality issues for the past 30 years, including 10 years experience with onsite systems.

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).
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Hydrogen Peroxide not Recommended to Unclog Failed Drainfields

ENGINEERING SCIENTIST
Tricia Angoli

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 hydrogen peroxide, call (800) 624-8301 or (304) 293-4191 and ask to speak with technical assistance.

I've heard of hydrogen peroxide being used to treat clogged drainfields. What is hydrogen peroxide, and how does it treat clogged drainfields? Is this a good option to use for unclogging a failed drainfield?

Hydrogen peroxide (H_2O_2), which at one time seemed a viable option for treating clogged drainfields, is not. It destroys the structure of soils, especially finer textured soils, and appears to create an impermeable barrier due to soil boiling during treatment. Although not all sandy soils are affected by H_2O_2 treatments, it is not recommended for use on sandy soils either. It has not yet been determined which sandy soils are not affected by H_2O_2 treatments. The best advice is not to use H_2O_2 to treat a failed/clogged drainfield, no matter what the soil type.

Hydrogen peroxide is a chemical used mainly as an oxidizing agent, for bleaching, as an antiseptic, and as a propellant. Its value as an oxidizing agent is the reason it has been tried to treat clogged drainfields. To understand why H_2O_2 was thought to work to unclog drainfields, the clogging mat that develops in the drainfield needs to be understood.

The Biomat

As septic tank effluent is discharged into the soil absorption system, a restrictive layer, the biomat, develops beneath the distribution lines at the gravel-soil or bed-soil interface. Although one of several names may describe this phenomenon, clogging mat, clogging zone, biocrust, and biomat are the most common. Two phases of clogging mat formation exist: (1) accumulation of suspended solids, and (2) bridging of the solids and soil particles by the bio-produced material that accumulates over time.

Characterized as a "black slimy layer" in the infiltrative surface, and anaerobic in nature, the clogging mat is composed of accumulated suspended solids, minerals, bacterial cells, microorganism fragments, polysaccharides, and polyuronides. Most matter found in the biocrust is organic and biodegradable; however, only partial decomposition of the organic matter occurs due to the biocrust.

As the biomat forms, its composition slowly changes from aerobic to anaerobic. The matter that can be used and broken down by the bacteria also changes. Under anaerobic conditions, sulfate (SO_4^{-2}) is the major compound available that bacteria can use. Sulfate is reduced to sulfide (S^{-2}) and then combines with metals found in the soil or wastewater, such as iron, manganese, nickel, copper, magnesium, and zinc.

These insoluble inorganic sulfides settle out and create a black layer underneath and around the gravel. The sulfides help contribute to the slowing down, and partial stopping, of effluent through the drainfield. However, the sulfides also contribute to another situation that causes drainfield clogging.

Many of the elements organisms require in the soil and wastewater to break down organic matter are bound up with the sulfides. Without being able to use these elements, the organisms cannot break down the organic matter, and it continues to build up in the drainfield and contribute to the clogging layer.

Flow of effluent through the biomat becomes severely restricted, and eventually the biomat can become impenetrable. Since the effluent cannot flow through the drainfield, it will move through alternate routes, such as up to the ground surface or back up into the house.

Trying To Reduce the Clogging Layer

To prevent an impermeable barrier so that effluent can continue to percolate through the soil, the sulfides in the biomat need to be removed. In the early to mid 1970s, a number of oxidizing agents were evaluated for this purpose but rejected due to their cost or environmental impact. Some of the oxidizing agents included chlorine or oxychlorides (found to cause sterilization of the drainfield) and permanganate or dichromate (too expensive and works only under acidic conditions).

Hydrogen peroxide did not create any dangerous byproducts and was considered inexpensive. Early laboratory testing showed that the H_2O_2 converted sulfides to sulfates, freeing the needed elements for use by the bacteria. Hydrogen peroxide also formed large oxygen bubbles that moved up to the surface, breaking up the biocrust and creating air and wastewater pathways. Reports stated that H_2O_2 restored the soil almost to its original permeability.

Due to the initial positive laboratory results, H_2O_2 was tried in field experiments to see if the positive laboratory results could be reproduced. Results in the field replicated the laboratory results, and H_2O_2 began to be used to unclog failed (or clogged) drainfields.

The use of H_2O_2 as a routine maintenance procedure was also evaluated. To use H_2O_2 in treating a failed drainfield, the stagnant effluent sitting on top of the crust must be removed first. That can be a costly and time-consuming task. Also, the amount of H_2O_2 needed to treat a clogged drainfield is relatively large and can be costly (although compared to other methods the price would be considered inexpensive). Therefore, it was believed that using H_2O_2 routinely for maintenance would be less costly than waiting for the drainfield to clog.

A patent was granted for the use of H_2O_2 to rehabilitate clogged drainfields. This rehabilitation method became known as the POROX® process or POROX® treatment.

The Need for More Research

By the early 1980s there were conflicting stories about the successes and failures of using H_2O_2 to rehabilitate failed absorption systems. These conflicting stories created the need to re-evaluate the known research and studies documenting the use of H_2O_2 and to fund new research to fill in the gaps in known information. Previous laboratory research with H_2O_2 had been performed on only hand-packed, structureless sands, and field studies were performed on sands, "glacial till," and "heavy clay."

The Small Scale Waste Management Program at the University of Wisconsin at Madison conducted a detailed study on H_2O_2 and its effectiveness in treating clogged drainfields. The study was divided into three parts: field experience with the POROX® process, a survey of commercial experience in Wisconsin with the POROX® process, and laboratory studies with H_2O_2. The results of the field experience and laboratory studies are presented in more detail below. The results of the survey of commercial experiences were felt to be inconclusive.

Field Studies

The field studies were performed on 18 experimental, clogged, in-situ absorption systems. The researchers knew the soil type, layout, wastewater application, and permeability history of the systems. The systems' infiltration rates were determined prior to H_2O_2 application. The initial infiltration rates of all systems, prior to any clogging, were also known.

Six of the 18 systems were not treated with H_2O_2 and were used as controls for comparison to the treated systems. These untreated systems were also used to evaluate the effectiveness of natural resting. The remaining 12 systems were all treated with H_2O_2. Infiltration rates were measured for all 18 systems five days after the application to ensure that all the residual H_2O_2 in the treated systems had decomposed. The systems treated with H_2O_2 showed lower infiltration rates after treatment.

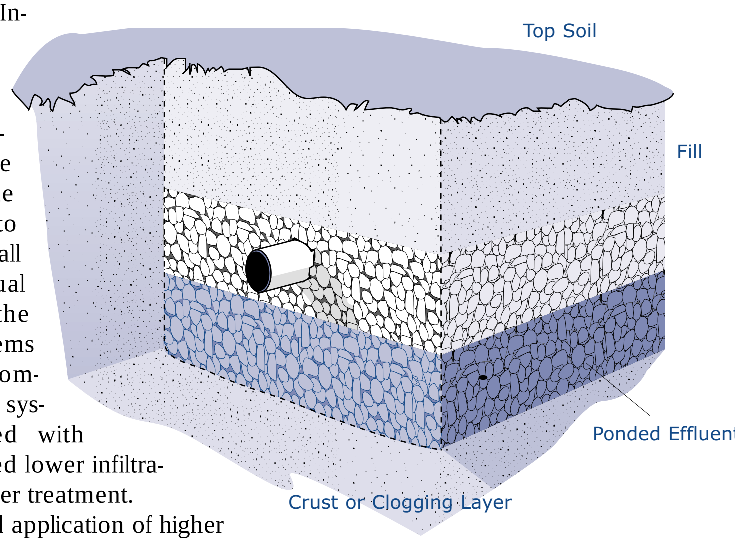


Figure 1

Cross Section of a bed showing the ponded effluent within the fill due to crust formation

A second application of higher concentration H_2O_2 was suggested to achieve the desired results. A second application of H_2O_2 is a common field practice and is consistent with the guidance included in the POROX® manual distributed to licensees. Researchers applied a second H_2O_2 application, at a higher concentration than the first, to six of the 12 treated systems. Several days after the second application, the infiltration rates on all 18 systems were monitored again.

The infiltration rates of the six systems treated with a second application of H_2O_2 showed an even greater decline than after the initial treatment. The infiltration rates were even lower than the infiltration rates of the six systems when severely clogged.

System monitoring was continued for one year after treatment. No wastewater was applied to any of the systems during this time. The six systems using natural resting showed a gradual increase in infiltration rate. The infiltrative capacity of the six systems treated once improved gradually over the year. The six systems treated twice showed no improvement and measured the same infiltrative rate as when they were clogged.

The change in infiltration rates suggested that the soil structural units were annihilated and the particles moved around. This movement probably changed the distribution of pore-sizes and pore continuity. The results also seemed to indicate a positive correlation between the loss in infiltrative rate and the number of H_2O_2 treatments.

Laboratory Studies

The laboratory studies evaluated the effects of H_2O_2 on soil properties in a variety of clogged and nonclogged soil types. The studies were broken down into three parts: the effects of H_2O_2 on the permeability of unclogged, undisturbed soil cores; the impact of H_2O_2 applications on soil morphology and porosity; and the effects of H_2O_2 treatments on four different clogged soil types. Only the results from the first part are presented. The second and third sections of laboratory studies corroborated the first laboratory study and the field studies.

Twenty-five subsoil horizons from 13 soil series and sites were selected for the study on the effects of H_2O_2 on unclogged, undisturbed soil. The subsoils represented a wide range of textures and natural organic matter content. Each of the 13 soil series tested were also used for subsurface or alternative soil absorption systems in Wisconsin, under the requirements of the Wisconsin Administrative Code at the time of the study.

The POROX® patent states that H_2O_2 treatment of a failed absorption system should result in infiltration rates comparable to the initial infiltration rate. Based on this it would then be reasonable to expect that there would be no serious side effects on unclogged soil permeability when applying H_2O_2. Not so.

Four H_2O_2 concentrations and one hydraulic loading rate were used on 25 soil samples. Three of the 25 soils had four H_2O_2 concentrations at three hydraulic loading rates applied. The range of H_2O_2 concentrations applied and hydraulic loading rates utilized covered the range of concentrations and hydraulic loadings applied commercially and in previous research. One set of 25 samples was kept as a control.

For most of the soils, any application of H_2O_2 resulted in a loss of infiltration rate in the soil. Following all of the H_2O_2 treatments, 22 of the 25 soils had lower infiltration rates than the control systems. One soil (Port Byron B21) showed statistically significant differences among the different H_2O_2 concentration treatments. The other two soils (Plainfield soils–loamy sand [C2 horizon] and sand [C3 horizon]) showed no harmful effects on the infiltration rates from the treatments, and the H_2O_2 treated samples averaged a higher rate than the control infiltration rate.

A violent reaction occurred when H_2O_2 was added to the soil samples. It began as a gentle bubbling or effervescing, but escalated to an extremely violent reaction within a few minutes, especially at higher H_2O_2 concentrations. The exothermic decomposition of H_2O_2 generated steam and heat.

After approximately five minutes, the H_2O_2 decomposition slowed, and the soil particles suspended in the H_2O_2 solution slowly settled out on the disturbed, but intact, soil beneath. This reaction changes the porosity of the soil. The soil particles were placed in suspension, mixed about, and then settled out. The soil structure prior to H_2O_2 application was very different from what it was following treatment. When solids settle out of suspension, the larger particles settle out first, with the size of particles getting smaller and smaller, until the smallest particles are on top. These small, fine particles present an impermeable barrier at the top of the disturbed/settled zone.

This explains the reaction, or lack of one, in some sandy soils. Sands are structureless and have a relatively low fine content. So structure does not play an important role in sand porosity, and there are not enough fines to form an impermeable barrier after the H_2O_2 mixing.

In summary, H_2O_2 is not recommended for use in unclogging failed drainfields. Early studies evaluated H_2O_2 treatment on only a few soil types. However, in-depth evaluation on a wide range of soils showed the harmful effects created by applying H_2O_2 to the soil.

For a copy of the complete report, "Chemical Rehabilitation of Soil Wastewater Absorption Systems Using Hydrogen Peroxide: Effects on Soil Permeability" please call the NSFC at (800) 624-8301 or (304) 293-4191 and ask for L001504. The cost of the paper is $12.90 plus a shipping fee. SF

NODP to Develop National Database

A database of all demonstration projects in the U.S. is currently being developed as part of the National Onsite Demonstration Project's Phase 2. This database is designed to house a wide variety of information on as many domestic wastewater demonstration projects as can be located.

The database will provide information for a number of purposes. For example, it will enable those interested in setting up their own demonstration projects to connect with others who have done so, or provide contacts for those interested in obtaining more information on a new or modified technology being demonstrated outside their county or state.

If you are an owner, operator, manager, regulator, researcher, or involved with a domestic wastewater demonstration project, you can help others meet their wastewater needs.

For more information concerning the database and the information collection form, please contact Eric S. Menear at: National Demonstration Projects Database NODP II, National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-9900. E-mail address is *emenear@wvu.edu*.

NODP Phase II Systems at-a-Glance

Green Hill Pond Watershed, Rhode Island

SYSTEM 1

Original System: 700-gallon cesspool—auxiliary drainfield line hydraulically overloaded
Home/Lot Characteristics: 3-bedroom home on 0.30 acres
Site Characteristics: Stony site with boulders; soils of glacial till, high large coarse fragment content; 1-foot water table
Selected Technology: 1,250-gallon 2-compartment septic tank; 32 square-foot Orenco Systems, Inc., Reactex Trickling Filter; 5-foot by 15-foot raised bottomless sand filter

SYSTEM 2

Original System: 700-gallon cesspool—hydraulically functioning, but in direct contact with water table
Home/Lot Characteristics: 3-bedroom home on 0.11 acres
Site Characteristics: Very small, flat lot; soils of glacial outwash parent material
Selected Technology: 1,250-gallon, 2-compartment septic tank; 32 square-foot Orenco Systems, Inc., Recirculating Reactex Filter; three, 30-foot by 1-foot shallow pressurized drainlines

SYSTEM 3

Original System: 400-gallon cesspool—hydraulically failed and surfacing
Home/Lot Characteristics: 3-bedroom home on 0.29 acres
Site Characteristics: Flat lot; soils of glacial outwash parent material
Selected Technology: 1,250-gallon, 2-compartment septic tank; 1,250-gallon dosing tank; American Manufacturing, Inc., Septic Drip Irrigation System; three 60-foot by 1-foot shallow pressurized sand-lined trenches (off-line at present time)

SYSTEM 4

Original System: 1,000-gallon septic tank with bed-type drainfield—hydraulically failed
Home/Lot Characteristics: 3-bedroom home on 0.46 acres
Site Characteristics: Densely developed area with soils of glacial outwash parent material
Selected Technology: 1,500-gallon septic tank; 15-foot by 15-foot single pass sand filter; three 40-foot by 1-foot shallow pressurized drainlines

SYSTEM 5

Original System: Two 55-gallon steel drums, 300-gallon steel septic tank, 600-gallon cesspool in series—system hydraulically failed and surfacing
Home/Lot Characteristics: 2-bedroom home on 0.11 acres; well water
Site Characteristics: Very small lot directly on pond; soils of glacial outwash parent material
Selected technology: 1,250-gallon, 2-compartment septic tank; 32 square-foot Orenco Systems, Inc., Recirculating RX30 Reactex Filter; four 20-foot by 1-foot shallow pressurized drainlines

SYSTEM 6

Original System: 1,000-gallon septic tank with bed-type drainfield—system hydraulically functioning, but bed shows signs of clogging
Home/Lot Characteristics: 2-bedroom home on 0.46 acres
Site Characteristics: Soils of glacial till parent material
Selected Technology: 1,500-gallon, 2-compartment septic tank; Bord na Mona Puraflo Peat Biofilter; ultraviolet disinfection unit; four 25-foot by 1-foot shallow pressurized drainlines

SYSTEM 7

Original System: 325-gallon steel septic tank with cesspool—hydraulically functioning but direct contact with water table during wet season
Home/Lot Characteristics: 3-bedroom home on 0.11 acres
Site Characteristics: Lot directly abuts pond edge; soils of glacial outwash parent material
Selected Technology: 1,500-gallon, 2-compartment septic tank; Biomicrobics FAST System; ultraviolet disinfection unit; four 25-foot by 1-foot shallow pressurized drainlines

NODP II Helps Rhode Island Improve Coastal Pond

CONTINUED FROM PAGE 11

URI-OWTC Efforts To Continue

Perhaps one reason for NODP II's success in Rhode Island is the experience Loomis and Dow have brought to the project. Through the URI-OWTC, they have been involved in a number of other state-funded onsite system demonstrations. In 1997, 18 existing and emerging technologies were installed in the Narragansett Bay Watershed. According to Loomis, these systems perform as well as the NODP II systems.

And even though the NODP II funding will expire this year, the work in the Green Hill Pond area will continue. According to Loomis, a new four-year project funded by the EPA began in March 2000. The Block Island and Green Hill Pond Watershed, Rhode Island, Environmental Protection Agency National Community Decentralized Wastewater Treatment Demonstration Project will build on the accomplishments of the NODP II activities.

"This new project will introduce technologies as well as create management ordinances to establish specific long-term treatment levels," said Dow. "The wastewater management plan will encompass the whole watershed. The communities are investigating risk-based wastewater management ordinances to replace cesspools and failing septic systems based on resource protection needs and site and soil characteristics."

Loomis summed up the future of onsite systems in Rhode Island: "We are steadily moving from unmanaged substandard conventional septic systems to managed alternative systems capable of achieving much higher treatment levels."

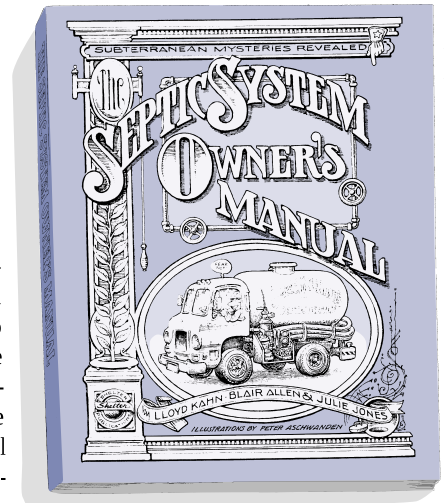
For information about the Rhode Island project, contact Loomis at (401) 874-4558 or Dow at (401) 874-5950. For information about NODP II, call Clement Solomon, program coordinator, at (800) 624-8301 or (304) 293-4191. SF

Jill A. Ross is a former NSFC editor and current owner of J.A.R. Enterprises, a technical communications/public relations firm located in Morgantown, WV.

Onsite Wastewater Software Program Available

A software program is available on the Internet that provides operation and maintenance information for onsite wastewater systems such as septic systems. Developed by Purdue University and funded by the U.S. Environmental Protection Agency (EPA) Region 5, the program details specific operation and maintenance procedures for septic tanks, aerobic units, lagoons, sand filters, and more. General management information and a listing of federal and state onsite wastewater systems contacts are also included. To view or download the program, go to the EPA Web site at *http://www.epa.gov/glnpo/seahome/decent.html*.

The Septic System Owner's Manual



The Septic System Owner's Manual, by Lloyd Kahn, Blair Allen, and Julie Jones, is a do-it-yourself guide to the natural process that takes place underground and the simple technology needed to make it work. The heart of the book is the conventional septic system, where power is provided by gravity (no pumps, no electricity), and purification is provided by naturally occurring microorganisms in the soil as the wastewater filters downward.

This book covers the basics of septic systems (tank and drainfield), and explains

- how to maintain and inspect the system,
- daily household tips for promoting healthy systems,
- what to do if things go wrong, and
- when to call for help.

The Septic System Owner's Manual is profusely illustrated with clear, often humorous drawings by Peter Aschwanden, noted illustrator of the best-selling *How to Keep Your Volkswagen Alive*. There is information on the new generation of composting toilets and descriptions of simple graywater systems. The chapter on alternative systems describes mounds, sand filters, and wetlands—increasingly in use these days. For the history lover, there is a chapter on the history of human waste disposal.

The 176-page book sells for $14.95, and is published by Shelter Publications, Inc. Individual orders can be placed at (800) 307-0131. SF

LGEAN Offers Free Animal Feeding Operation (AFO) Publication

The Local Government Environmental Assistance Network (LGEAN) is offering a free AFO guide for local officials titled, *Animal Feeding Operations: The Role of Counties*. Produced by the Conference of Southern County Associations (CSCA), with assistance from the National Association of Counties (NACo), the guide provides county officials with a roadmap for dealing with issues relating to AFOs, and describes the role officials can play in addressing these issues. AFOs are livestock raising operations, such as hog, cattle and poultry farms, that confine and concentrate animal populations and their wastes. If not sited, designed, and managed properly, these operations can endanger the environment and public health, as well as create nuisance odors. The guide includes

- why county officials need to be concerned with AFOs;
- implications of AFO industrial trends for counties;
- the role of counties in protecting environmental quality and public health;
- the role of federal, state, and county government in siting AFOs;
- information on AFO ordinances; and
- how the National Pollutant Discharge Elimination System Permit System can apply to concentrated AFOs.

Please note, free copies of this publication are available only as long as supplies last. To order, contact LGEAN at (877) TO-LGEAN (865-4326) or e-mail *lgean@icma.org*. SF

New Financing Resource Available

A Guidebook of Financial Tools: Paying for Sustainable Environmental Systems, is a new resource providing a wide range of environmental financing information. It is the result of a collaborative effort among the U.S. Environmental Protection Agency's (EPA) Environmental Financial Advisory Board, the directors and staff of eight university-based Environmental Finance Centers, EPA's Environmental Finance Program, and numerous other contributors. The guidebook presents information about approximately 340 financial "tools" that can assist local governments in funding environmental programs and activities.

The guidebook is broken into ten sections containing information about financial tools that can be used for activities, such as raising revenue, borrowing capital, enhancing credit, building public-private partnerships, lowering costs, encouraging pollution prevention and recycling, paying for community-based environmental protection, and financing brownfields redevelopment. Each tool is described along with its actual and potential uses, advantages and limitations, and references for further information. The guidebook also contains a search page, enabling users to quickly locate information on topics of interest.

The guide is available on the EPA Web site at *http://www.epa.gov/efinpage/guidbk98/index.htm*. This is the only source for the handbook, as no hard copies are available for distribution. SF

Funding Resources for Small Communities

Federal Funding for Small Community Wastewater Systems

Federal Funding for Small Community Wastewater Systems is a publication that contains information about federal funding sources for small community wastewater systems is now available on the Internet. Produced by the U.S. Environmental Protection Agency's (EPA's) Office of Wastewater Management, the publication contains ten fact sheets of funding sources that can help small, rural communities attain adequate wastewater systems. The fact sheets provide information on the amounts of funding offered, what parties are eligible for assistance, and how to reach program contacts. To download the publication, go to the EPA's Web site at *http://www.epa.gov/owm/eparev.htm*.

Solid Waste Funding

Solid Waste Funding: A Guide to Federal Assistance provides a description of funding resources available to state and local governments from the EPA and other federal agencies. The funds are available for solid waste research and management programs. The brochure is available by calling the Resource Conservation and Recovery Act Hotline at (800) 424-9346 or by downloading from the EPA's Web site at *http://www.epa.gov/epaoswer/non-hw/grants/grants.txt*.

EPA Grant Writing Tutorial

The EPA Grant Writing Tutorial walks users through an actual grant proposal. Topics covered include enhancing grant proposals, completing grant application forms, a mock grant writing activity, and more. The tutorial can be found on the EPA's Web site at *http://www.epa.gov/seahome/grants.html*.

Pipeline Issue on Funding Sources

The Fall 1999 issue of *Pipeline* outlines a variety of sources that small communities can contact if they are in need of funding for wastewater treatment projects. The issue lists the most commonly-used federal funding sources as well as less well-known funding avenues, such as regional programs and nonprofit organizations. It even includes information about funding programs for homeowners wanting to install or repair onsite systems.

To order this *Pipeline* back issue or to request a subscription, contact the National Small Flows Clearinghouse at (800) 624-8301 or (304) 293-4191 and request Item #SFPLNL19. The cost is $0.20. Subscriptions to *Pipeline* are free. SF

New Funding Guide Available for Small Governments

The National Center for Small Communities (NCSC) has recently published a guidebook to help small local governments. *Keys to Successful Funding* describes the major components that mark successful proposals for public and private financial assistance:

(1) planning,
(2) eligibility,
(3) affordability,
(4) fundability, and
(5) manageability.

The publication identifies major federal and foundation funding sources and strategies for developing applications. In addition to grant and loan funding, the guide identifies free or affordable sources of planning and technical and administrative expertise, as well as contacts, hotlinks, and Internet sites of particular value. *Keys to Successful Funding* may be ordered on the Internet at *http://www.natat.org/ncsc/Pubs/Funding.htm* or by calling NCSC at (202) 624-3550. The cost is $14.95 for members and $24.95 for non-members.

New NSFC Products Are Available

All NSFC Products Half Off To Celebrate Spring!

If you've been thinking about ordering products from the National Small Flows Clearinghouse (NSFC), June 20 would be a good time to do so.

In celebration of spring, all National Small Flows Clearinghouse (NSFC) products will be half price for all orders placed by phone, fax, or e-mail on Tuesday, June 20, 2000. Regular shipping charges still will apply. Phone orders must be placed between 8 a.m. and 5 p.m. Eastern Time. Orders placed by fax or e-mail will be accepted until midnight, June 20.

A complete list of the products available from the NSFC can be found in the "Products List" section of this magazine. In addition, the NSFC's Products Guide catalog provides descriptions of each product and can be downloaded from the NSFC's Web site at *www.nsfc.wvu.edu*.

To take advantage of this special spring offer, place your order by calling (800) 624-8301 or (304) 293-4191. Orders also may be faxed to (304) 293-3161 or sent via e-mail to *nsfc_orders@mail.estd.wvu.edu*.

The NSFC accepts VISA, MasterCard, Discover, checks, and money orders for payment. However, some restrictions apply to international orders.

Please note that actual shipping charges apply to all orders. Most orders are filled within 48 hours; however, please allow two to four weeks for delivery.

Recirculating Sand Filters for On-Site Treatment of Domestic Wastes

This booklet from the University of Wisconsin-Madison provides a basic knowledge of recirculating sand filter principles, design, construction, and maintenance. Sand filter technology has been available for many years; however, new advances, as well as increased environmental regulations, have made the technology more attractive and reliable. This 23-page booklet can serve as a resource for public health officials, state regulatory agencies, researchers, contractors/developers, and engineers.

The cost for this booklet is $3.35. Ask for Item #WWBLDM87.

Small Community Wastewater Treatment: Management and Myths

Produced by Ayres & Associates in Eau Claire, Wisconsin, this video discusses how onsite wastewater treatment systems are a viable and reliable option for small communities. The video emphasizes that properly working onsite systems produce effluent that is comparable in quality to centralized advanced treatment systems and perform more consistently and reliably. A properly designed, operated, and maintained onsite system should last indefinitely. Although onsite systems do leach nitrates into the groundwater, they can be designed to meet any water quality standard. Management is the key to onsite systems. Third parties can be used to take care of onsite systems, lessening the homeowner's responsibility. Highlighted in this video is a lakefront community in Washington County, Minnesota, that had cesspools under water. They opted for onsite systems over a centralized system with a third party (public utility) providing and overseeing the management of all systems. Another case study in the Florida Keys is briefly detailed in this video. Both case studies are successful examples of how onsite systems—when properly designed, installed, and maintained—provide high quality wastewater treatment and protect the environment and the health of the public at a substantial cost savings over centralized treatment. This 10-minute video could be useful to contractors/developers, local officials, managers, planners, public health officials, and the general public.

The cost for this video is $10.00. Ask for Item #WWVTPE47.

Septic Systems: Making the Best Use of Nature

Produced by the Pennsylvania Septage Management Association, this video discusses the use of septic tanks and the components of rural onsite septic systems. Components mentioned include cesspools, seepage pits, mound systems, trenches, and soil absorption systems. The basic components of septic tanks also are described. The video explains the necessity and criteria of inspections and the inspection process. Some of the criteria highlighted are site location, siting, use, permit availability, treatment methods, management, and the history of the septic system. This 10-minute video could be helpful to local officials, the general public, state regulatory agencies, state officials, and public heath officials.

The cost for this video is $10.00. Ask for Item #WWVTGN135.

Land Application of Animal Manure

Developed by The Ohio State University Department of Agronomy and the Ohio Cooperative Extension Service, this "Best Management Practices" fact sheet addresses the major factors for the safe and efficient use of animal manures. Although developed to assist farmers and handlers of animal waste in Ohio, others across the country will find this document useful for determining livestock waste production rates, land application rates, nutrient values of various livestock wastes, soil factors, and runoff potential. This eight-page fact sheet could serve as a reference for engineers, planners, researchers, state and public health officials, and the general public.

The cost for this product, item #WWFSOM38, is $1.15. SF

To place an order…

To place an order, call the NSFC at (800) 624-8301 or (304) 293-4191, or use the order form on page 54 and fax your request to (304) 293-3161. You also may send e-mail to *nsfc_orders@mail.estd.wvu.edu*. Be prepared to give the item number and title of the

Products List

Item Number Breakdown

First two characters of item number: (Major Product Category)
WW Wastewater
FM Finance and Mangement
GN General Information
SF Small Flows

Second two characters of Item number: (Document Type)
BK Book, greater than 50 pages
BL Booklet, less than 50 pages
BR Brochure
FS Fact Sheet
JR Journal
NL Newsletter
PL Pipeline
PK Packet
PS Poster
SW Software
VT Video Tape

Third two characters of item number: (Content Type)
CM Computer search
CS Case Study
DM Design
FN Finance
NL Newsletter
OM Operation and Maintenance
PE Public Education
PP Public-Private Partnerships (P3)
RE Research
RG Regulations
TR Training

Last two characters of item number:
Uniquely identifies product within major category

☐ Highlighted products are new

* Indicates changes in title, item number, and/or price

product you wish to order. Shipping and handling charges apply to all orders.

Abstracts of many products are provided in the NSFC's new 1998-1999 Products Guide. The guide may be downloaded via the NSFC's Web site at *http://www.nsfc.wvu.edu*.

Case Studies

WWBLCS02	Vacuum Collection System (Cedar Rocks, West Virginia)	$1.30
WWBLCS03	Variable Grade Effluent Sewers (Maysville Area, Muskingum County, Ohio)	$1.90
WWBLCS04	Alternating Bed Soil Absorption Systems (Crystal Lakes, Colorado)	$2.05
WWBLCS05	Intermittent Sand Filter (Gardiner, New York)	$1.45
WWBLCS06	Overland Flow (Kenbridge, Virginia)	$2.45
WWBLCS07	Wetlands/Marsh (Cannon Beach, Oregon)	$2.05
WWBLCS09	Slow Rate Land Treatment (Craigsville, Virginia)	$1.90
WWBLCS10	Year-Round Slow-Rate Land Treatment (Hershey's Mills, Pennsylvania)	$1.90
WWBLCS11	Flat Grade Sewers (Ericson, Nebraska)	$1.05
WWBLCS12	Grinder Pump Pressure Sewers (Augusta, Maine)	$1.15
WWBLCS13	Minimum Grade Effluent Sewers (Dexter, Oregon)	$1.45
WWBLCS14	New York State Free Access Intermittent Sand Filter	$2.45
WWBLCS18	New York State Septic Tank Effluent Collection and Sand Filter Treatment	$2.20
WWBLCS21	Pollution Prevention at POTW's	$0.00
WWBKCS22	Combined Sewer Overflows and the Multimetric Evaluation of Their Biological Effects: Case Studies in Ohio and New York	$0.00

Computer Searches

WWBKCM01	Constructed Wetlands, May 1998	$19.70
WWBLCM02*	Composting Toilets, May 1998	$5.35
WWBKCM03	Failing Systems, May 1998	$13.95
WWBKCM04	Greywater, May 1998	$8.50
WWBLCM05	Onsite Management, May 1998	$6.90
WWBKCM06	Mound Systems, May 1998	$10.10
WWBKCM07	Pressure Sewers, May 1998	$7.80
WWBKCM08	Sand Filters, May 1998	$17.70
WWBKCM09	Septage, May 1998	$7.90
WWBKCM10	Wastewater Characteristics, May 1998	$13.40
WWBKCM11	Water Conservation, May 1998	$12.95
WWPCCM12	Customized Bibliographic Database Search	Varies
WWPCCM15	Facilities Database Search	Varies
WWPCCM16	Manufacturers and Consultants Database Search	Varies
WWBKCM17	Lagoons, May 1998	$21.70
WWBLCM18	Drip Irrigation, May 1998	$2.75
WWBLCM19	Spray System, May 1998	$6.75
WWBKCM20	Additives, May 1998	$2.05
WWBKCM21	Low-Flush Toilet, May 1998	$2.75
WWBKCM22	Operator Health and Safety, May 1998	$2.90
WWBKCM23	Disinfection, May 1998	$12.25
WWBKCM24	Site Evaluation, May 1998	$8.50

Computer Software

WWSWDM39	Airvac Version 3.2 and Users Guide	$6.90
WWSWDM55	Station Version 3.0 and Users Guide	$6.45
WWSWDM58	User Documentation: POTW Expert Version 1.0	$30.75

WWSWDM77	Gravity Sewer Design Version 3.1M and Users Guide	$6.05
WWSWDM79	Variable Grade Effluent Sewer Design Version 2.2M and Users Guide	$9.20

Design

WWBLDM01	Subsurface Soil Absorption of Wastewater: Artificially Drained Systems	$2.45
WWBKDM02	Cost Effectiveness Analysis	$7.65
WWBLDM03	Onsite Wastewater Disposal: Distribution Networks for Subsurface Soil Absorption Systems	$6.65
WWBLDM04	Onsite Wastewater Disposal: Evapotranspiration and Evapotranspiration/Absorption Systems	$2.30
WWBLDM07	Low-Pressure Sewer Systems	$6.75
WWBLDM08	Management Plans and Implementation Issues: Small Alternative Wastewater Systems Workshops	$3.05
WWBKDM09*	Design Modules: Wisconsin Mound Soil Absorption System Siting, Design, and Construction Manual and Pressure Distribution Network Design*	$7.65*
WWBLDM12	Site Evaluation for Onsite Treatment and Disposal Systems	$5.65
WWBLDM13	Design Workbook for Small-Diameter, Variable-Grade, Gravity Sewers	$6.65
WWBLDM14	Subsurface Soil Absorption of Wastewater: Trenches and Beds	$3.60
WWBLDM15	Vacuum Sewerage	$7.05
WWBLDM16	Subsurface Soil Absorption System Design Work Session: New Development--Stump Creek Subdivision	$6.20
WWBLDM18	Onsite Wastewater Treatment: Septic Tanks	$2.20
WWBLDM20	Technology Assessment of Intermittent Sand Filters	$5.20
WWBLDM22	Variable Grade Sewers: Special Evaluation Project	$2.45
WWBKDM31	Planning Wastewater Management Facilities for Small Communities	$22.30
WWBKDM34	Land Application of Municipal Sludge	$0.00
WWBKDM35	Onsite Wastewater Treatment and Disposal Systems	$45.00
WWBKDM36	Municipal Wastewater Stabilization Ponds	$47.25
WWBKDM37	Septage Treatment and Disposal	$0.00
WWBKDM38	Constructed Wetlands and Aquatic Plant Systems for Municipal Wastewater Treatment	$10.00
WWBLDM40	Sequencing Batch Reactors	$3.45
WWBKDM41	Phosphorus Removal	$17.70
WWBKDM42	Dewatering Municipal Wastewater Sludges	$0.00
WWBKDM43	Odor and Corrosion Control in Sanitary Sewage Systems and Treatment Plants	$0.00
WWBKDM44	Seminar Publication: Composting of Municipal Wastewater Sludges	$10.20
WWBKDM46	Retrofitting POTWs	$0.00
WWBKDM47	Fine Pore Aeration Systems	$0.00
WWBLDM48	EPA Environmental Regulations and Technology: The National Pretreatment Program	$4.20
WWBKDM49	Municipal Wastewater Disinfection	$37.50
WWBKDM50	Identification and Correction of Typical Design Deficiencies at Municipal Wastewater Treatment Facilities	$59.35
WWBKDM53	Alternative Wastewater Collection Systems	$25.00
WWBKDM57	Control of Slug Loadings to POTWs Guidance Manual	$15.00
WWBKDM59	Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program	$51.30
WWBKDM64	Assessment of Single-Stage Trickling Filter Nitrification	$0.00
WWBLDM65	General Design, Construction, and Operation Guidelines: Constructed Wetlands Wastewater Treatment Systems for Small Users Including Individual Residences (Second Edition)	$5.00
WWBKDM67	Sewer System Infrastructure Analysis and Rehabilitation	$13.95*
WWBKDM68	Technical Support Document for Water Quality Based Toxics Control	$0.00
WWBKDM69	Ultraviolet Disinfection Technology Assessment	$0.00
WWBKDM70	Wastewater Treatment and Disposal Systems for Small Communities	$16.55
WWBKDM71	Retrofitting POTWs for Phosphorus Removal in the Chesapeake Bay Drainage Basin	$0.00
WWBKDM72	Guidelines for Water Reuse	$30.00
WWBKDM73	Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors	$0.00
WWBKDM74	Subsurface Flow Constructed Wetlands for Wastewater Treatment	$12.25
WWBKDM75	Combined Sewer Overflow Control	$0.00
WWBLDM76	Mound Systems: Pressure Distribution of Wastewater Design and Construction in Ohio	$2.75
WWBKDM78	Nitrogen Control	$46.10
WWBKDM80	In-Vessel Composting of Municipal Wastewater Sludge	$0.00
WWBKDM81	Surface Disposal of Sewage Sludge and Domestic Septage	$42.95
WWBKDM82	Land Application of Sewage Sludge and Domestic Septage	$44.10
WWBKDM83	Handbook of Constructed Wetlands: Volume 1, A Guide to Creating Wetlands for General Considerations the Mid-Atlantic Region	$10.10
WWBLDM84	Handbook of Constructed Wetlands: Volume 2, Domestic Wastewater	$4.35
WWBLDM85	Handbook of Constructed Wetlands: Volume 3, Agricultural Wastewater	$4.60
WWBLDM86	Handbook of Constructed Wetlands: Volume 5, Stormwater	$5.50
WWBLDM87	Recirculating Sand Filters for On-Site Treatment of Domestic Wastes	$3.35
WWPKDM89	Producing Watertight Concrete Septic Tanks (Video); and Septic Tank Manufacturing Best Practices Manual (Booklet)	$48.15
WWBLDM90	Onsite Sewage Treatment and Disposal Using Sand Filter Treatment Systems	$5.65

Fact Sheets

WWFSGN84	Constructed Wetlands/Natural Wetlands	$0.30
WWFSGN98	Ultraviolet Disinfection (A General Overview)	$0.00
WWFSOM20	Ultraviolet Disinfection (A Technical Overview)	$0.00
WWFSGN99	Chlorine Disinfection (A General Overview)	$0.00
WWFSOM21	Chlorine Disinfection (A Technical Overview)	$0.00
WWFSGN100	Ozone Disinfection (A General Overview)	$0.00
WWFSOM22	Ozone Disinfection (A Technical Overview)	$0.00
WWFSGN101	Fine Bubble Aeration (A General Overview)	$0.00
WWFSOM23	Fine Bubble Aeration (A Technical Overview)	$0.00
WWFSGN102	Trickling Filters: Achieving Nitrification (A General Overview)	$0.00
WWFSOM24	Trickling Filters: Achieving Nitrification (A Technical Overview)	$0.00
WWFSGN103	Recirculating Sand Filters (A General Overview)	$0.00
WWFSOM25	Recirculating Sand Filters (A Technical Overview)	$0.00
WWFSGN104	Intermittent Sand Filters (A General Overview)	$0.00
WWFSOM26	Intermittent Sand Filters (A Technical Overview)	$0.00
WWFSGN105	Mound Systems (A General Overview)	$0.00
WWFSOM27	Mound Systems (A Technical Overview)	$0.00
WWFSGN106	Composting Toilet Systems (A General Overview)	$0.00
WWFSOM28	Composting Toilet Systems (A Technical Overview)	$0.00
WWFSGN107	Low-Pressure Pipe Systems (A General Overview)	$0.00
WWFSOM29	Low Pressure Pipe Systems (A Technical Overview)	$0.00
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WWFSOM31	Septage Management (A Technical Overview)	$0.00
WWFSGN110	Evapotranspiration Systems (A General Overview)	$0.00
WWFSOM32	Evapotranspiration Systems (A Technical Overview)	$0.00
WWFSGN111	Water Efficiency (A General Overview)	$0.00
WWFSOM33	Water Efficiency (A Technical Overview)	$0.00
WWPKGN112	Complete Package of ETI Fact Sheets (A General Overview)	$0.00
WWFSOM38	Land Application of Animal Manure	$1.15
WWPKOM34	Complete Package of ETI Fact Sheets (A Technical Overview)	$0.00
WWFSGN118	Concentrated Animal Feeding Operations (CAFO's) and Their Effect on Water Pollution	$0.30
WWFSGN119	NPDES Regulations Governing Management of Concentrated Animal Feeding Operations	$0.30

WWFSGN120	NPDES Regulations Governing Management of Concentrated Dairy Cattle Feeding Operations	$0.30
WWFSGN121	NPDES Regulations Governing Management of Concentrated Horse Feeding Operations	$0.30
WWFSGN122	NPDES Regulations Governing Management of Concentrated Poultry Feeding Operations	$0.30
WWFSGN123	NPDES Regulations Governing Management of Concentrated Sheep Feeding Operations	$0.30
WWFSGN124	NPDES Regulations Governing Management of Concentrated Slaughter and Feeder Cattle Feeding Operations	$0.30
WWFSGN125	NPDES Regulations Governing Management of Concentrated Swine Feeding Operations	$0.30
WWFSGN131	On-Site Wastewater Treatment Systems: Conventional Septic Tank/Drain Field	$1.00
WWFSGN132	On-Site Wastewater Treatment Systems: Subsurface Drip Distribution	$1.00
WWFSGN133	On-Site Wastewater Treatment Systems: Low-Pressure Dosing	$1.00
WWFSGN134	On-Site Wastewater Treatment Systems: Spray Distribution	$1.00
SFFSGN136	Fact Sheet: The National Onsite Demonstration Program: Phase III	$0.00
SFFSGN137	Fact Sheet: Overview of the National Onsite Demonstration Program	$0.00
SFFSGN138	Fact Sheet: The National Onsite Demonstration Program: Phase I	$0.00
SFFSGN139	Fact Sheet: The National Onsite Demonstration Program: Phase II	$0.00
SFFSGN140	Fact Sheet: The National Onsite Demonstration Program Projects Database	$0.00
SFPKGN141	Complete Package of the National Onsite Demonstration Program Fact Sheets	$0.00

Finance and Management

FMBKCS21	Cost Savings Models for Environmental Protection: Helping Communities Meet Their Environmental Goals	$13.40
WWBLFN01	Clean Water State Revolving Fund: How to Fund Nonpoint Source Estuary Enhancement Projects	$0.00
WWBRFN02	EPA's Clean Water Act--Indian Set-Aside Grant Program	$0.00
FMBLFN03	A Water and Wastewater Manager's Guide for Staying Financially Healthy	$0.00
WWBLFN03	Answers to Frequently Asked Questions About the U.S. EPA Clean Water Indian Set-Aside Grant Program	$0.00
WWFSFN04	Rural Community Assistance Program (RCAP) Help for Small Community Wastewater Projects	$0.00
WWBLFN05	Rural Communities Hardship Grants Program Implementation Guidelines; Notice	$1.30
WWFSFN06	Clean Water State Revolving Fund Program	$0.00
FMBKFN06	Combined Sewer Overflows: Guidance for Funding Options	$5.00
FMBKFN12	Alternative Financing Mechanisms for Environmental Programs	$17.50
FMBLFN13	A Utility Manager's Guide to Water and Wastewater Budgeting	$0.00
FMBLFN14	State and Local Government Guide to Environmental Program Funding Alternatives	$3.75
FMSWFN16	Determining Wastewater User Service Charge Rates A Step By Step Manual	$5.00
FMBLFN17	The Road To Financing: Assessing and Improving Your Community's Credit Worthiness	$0.00
FMBKFN18	Financing Models for Environmental Protection: Helping Communities Meet Their Environmental Goals	$0.00
FMBLFN19	Evaluating Municipal Wastewater User Charge Systems	$5.50
FMBLFN20	Clean Water State Revolving Fund	$0.00
FMBKFN22	Beyond SRF: A Workbook for Financing CCMP Implementation	$0.00
FMBLFN25	Clean Water State Revolving Fund Funding Framework	$0.00
FMBKFN26	CSOs: Guidance for Financial Capability Assessment and Schedule Development	$0.00
FMFSFN27	Hardship Grants Program for Rural Communities	$0.00
FMBLFN28	State Match Options for the State Revolving Fund Program	$0.00
FMBLFN29	Federal Funding Sources for Small Community Wastewater Systems	$0.00
FMFSFN30*	Cleaning Up Polluted Runoff with the Clean Water State Revolving Fund	$0.00
FMFSFN31	Protecting Wetlands with the Clean Water State Revolving Fund	$0.00
FMFSFN32	Rurak Community Assistance Plan (RCAP) Help for Small Community Wastewater Projects	$0.00
FMBKGN01	It's Your Choice: A Guidebook for Local Officials on Small Community Wastewater Management Options	$7.50
FMBLGN04	Looking at User Charges: A State Survey and Report	$5.20
FMBKGN11	Andrew W Breidenback Environmental Research Center Small Systems Resource Directory	$0.00
FMBLGN14	Watershed Approach Framework	$0.00
FMBLGN15	Why Watersheds?	$0.00
FMBLPE32	Economic Benefits of Runoff Controls	$0.00
FMBKPP03	Public-Private Partnerships for Environmental Facilities: A Self-Help Guide for Local Governments	$0.00
FMBLPP06	Developing Public/Private Partnerships: An Option for Wastewater Financing	$0.00
WWBKMG02	Biosolids Management Handbook for Small Publicly Owned Treatment Works	$37.05
WWBLMG03	Septage Management in Ohio	$1.25
WWBKMG04	A Manual for Managing Septic Systems	$25.75
FMBLMG05	Septic Systems and Ground Water Protection: An Executive's Guide	$2.05
WWBKMG05	Draft Framework for Watershed-Based Trading	$0.00
WWBKMG07	Environmental Planning for Small Communities: A Guide for Local Decision Makers	$15.00
GNBLMG08	Animal Agriculture: Waste Management Practices	$1.50
WWBLMG09*	Choices for Communities: Wastewater Management Options for Rural Areas	$0.50
WWBKMG10	Ohio Livestock Manure and Wastewater Management Guide	$2.00

General Information

GNBKGN02	Federal Agency Ground Water Technical Assistance Directory	$0.00
GNBLGN03	Watershed Protection Approach	$0.00
GNBLGN04	ENVEST: Engineers Volunteering Environmental Service Teams	$0.90
GNBLGN07	Redoximorphic Features for Identifying Aquic Conditions	$5.00
GNBRGN06	Watershed Approach	$0.00
WWBKGN05	Small Town Task Force	$5.00
GNBLGN09	Office of Compliance: An Introductory Guide	$0.00
GNBKGN10	Top 10 Watershed Lessons Learned	$0.00
GNBLGN11	Section 319 National Monitoring Program: An Overview	$0.00
GNBKGN12	Community-Based Environmental Protection: A Resource Book For Protecting Ecosystems and Communities	$0.00
GNBLGN13	Environmental Indicators of Water Quality in the United States	$0.00
GNBKGN14	Watershed Protection: A Statewide Approach	$0.00
GNBLGN15	Water Pollution Control: Twenty-five Years of Progress and Challenges for the New Millenium	$0.00
WWBRGN15	Water Reuse via Dual Distribution Systems	$0.00
WWBLGN16	Report on the Use of Wetlands for Municipal Wastewater Treatment and Disposal	$5.75
WWBRGN19	Natural Systems for Wastewater Treatment in Cold Climates	$0.00
WWBRGN20	Innovations in Sludge Drying Beds: A Practical Technology	$0.00
WWBLGN31	Inflow/Infiltration: A Guide for Decision Makers	$6.20
WWBKGN35	Municipal Wastewater Reuse: Selected Readings on Water Reuse	$10.50
WWBKGN36	Waste Water Justice? Its Complexion in Small Places Appendix	$0.00
WWBKGN39	Septic Tank Siting to Minimize the Contamination of Ground Water by Microorganisms	$13.95
WWBLGN40	EPA Journal Reprint: Protecting Ground Water, The Hidden Resource	$4.60

WWBLGN55	GAO Report: Water Pollution--Information on the Use of Alternative Wastewater Treatment Systems	$2.00
WWBKGN58	Guide to Septage Treatment and Disposal	$0.00
WWBLGN59	Biosolids Recycling: Beneficial Technology for a Better Environment	$0.00
WWBLGN62	Office of Wastewater Management Primer	$4.35
WWBRGN63	Clean Water...A Better Environment: Wastewater Management at EPA	$0.00
WWBRGN64	Source Reduction, An Integral Part of the MWPP Program	$0.00
WWBLGN65	Marine and Estuarine Protection Programs and Activities	$0.00
WWBKGN67	Summary Report: Small Community Water and Wastewater Treatment	$12.35
WWBLGN71	Combined Sewer Overflows: Screening and Ranking Guidance	$0.00
WWBKGN72	Combined Sewer Overflows: Guidance for Long Term Control Plan	$0.00
WWBKGN73	Combined Sewer Overflows: Guidance for Permit Writers	$0.00
WWBLGN78	United States Census Data: 1980 and 1990	$0.90
WWBLGN79	Combined Sewer Overflow Control Policy: A Consensus Solution to Improve Water Quality	$0.60
WWBKGN85	Guide to the Biosolids Risk Assessment for the EPA Part 503 Rule	$0.00
WWBRGN88	Clean Vessel Act: Keep Our Water Clean--Use Pumpouts	$0.00
WWBKGN89	National Onsite Wastewater Treatment: A National Small Flows Clearinghouse Summary of Onsite Systems in the United States, 1993	$0.00
WWBKGN90	Seminar Publication: National Conference on Sanitary Sewer Overflows	$0.00
WWBLGN91	Sewage Sludge (Biosolids) Use or Disposal Documents	$0.60
WWBKGN92	Commitment to Watershed Protection: A Review of the Clean Lakes Program	$0.00
WWBKGN93	Response to Congress on Use of Decentralized Wastewater Treatment Systems	$13.10
WWBLGN94	Waste Water Justice? Its Complexion in Small Places	$0.00
WWBKGN96	Compendium of Tools for Watershed Assessment and TMDL Development	$0.00
WWBKGN97	1996 Clean Water Needs Survey Report to Congress	$0.00
WWBRGN113	Composting Biosolids	$0.00
WWBRGN114	Land Application of Biosolids	$0.00
WWBRGN115	Sewage Sludge Incineration	$0.00
WWBRGN116	Sludge or Biosolids	$0.00
WWBLGN126	Outreach and Technical Assistance Programs	$0.00
WWBKGN127	Clean Water Tribal Resource Directory For Wastewater Treatment Assistance	$0.00
WWBKGN128	Wastewater Disposal Options for Small Communities in Mississippi	$3.65
WWBKGN129	Wastewater Disposal Options for Small Communities in Alabama	$3.65
WWBKGN130	Wastewater Disposal Options for Small Communities in Louisiana	$3.65
WWBKGN142	Clean Water Action Plan: Restoring and Protecting America's Waters	$0.00
WWBLGN143	Response to Congress on the AEES "Living Machine" Wastewater Treatment Technology	$6.05
WWBLGN144	Response to Congress On Privatization of Wastewater Facilities	$5.65
GNBKIN05	Designing a Water Conservation Program: An Annotated Bibliography of Source Materials	$0.00

NSFC Newsletter

GNBKIN01	Publications Index 1999	$0.00
GNNLBI49	Small Flows, Fall 1999	$0.00
GNNLBI50	Small Flows Quarterly, Winter 2000	$0.00
SFPLNL01	CSO Pipeline	$0.20
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SFPLNL06	Wastewater Treatment Protects Small Community Life, Health Pipeline	$0.20
SFPLNL07	Alternative Sewers Pipeline	$0.20
SFPLNL08	Choose the Right Consultant for Your Wastewater Project Pipeline	$0.20
SFPLNL09	Lagoon Systems Pipeline	$0.20
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SFPLNL18	Mounds: A Septic System Alternative	$0.00
SFPLNL19	Funding Sources for Wastewater Projects	$0.00
SFPLNL20	Evapotranspiration	$0.00

Operation and Maintenance

WWBLOM01	Reducing the Cost of Operating Municipal Wastewater Facilities	$0.00
WWBKOM02	Cost Reduction and Self-Help Handbook	$12.65*
WWBLOM04	Contract Operation and Maintenance: The Answer for Your Town?	$1.90
WWBLOM05	Analysis of Performance Limiting Factors (PLFs) at Small Sewage Treatment Plants	$3.05
WWBLOM06	The Onsite Operator Training Program: Success in Every Region!	$3.75
WWBLOM07	Alternative Sewers Operation and Maintenance Special Evaluation Project	$2.60
WWBKOM08	Combined Sewer Overflows: Guidance for Nine Minimum Controls	$0.00
WWBKOM09	POTW Sludge Sampling and Analysis Guidance Document	$0.00
WWBKOM16	Detection, Control, and Correction of Hydrogen Sulfide Corrosion in Existing Wastewater Systems	$0.00*
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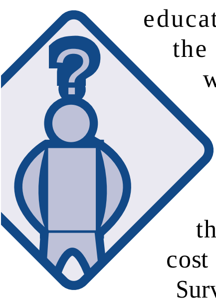
From the available data, it did not appear that alternative technologies were any less successful than conventional systems. Rather, a strong correlation could be drawn between the age of the system, whether conventional or alternative, and the failure rate.

Although anecdotal, local health administrators indicated that they are of the opinion that the failure of alternative systems is generally caused by improper maintenance and improper installation and/or faulty components rather than by any inherent weakness in the technology.

Lack of Information and Education

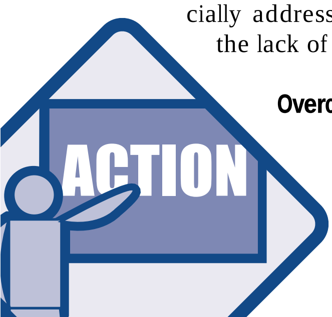


A broad range of stakeholders indicated that lack of information and education were significant barriers to the acceptance of alternative onsite wastewater technologies. While the quality and selection of classes provided by the Northwest On-Site Wastewater Training Center were deemed excellent, there were complaints about the cost and accessibility of this training.

Survey responses suggested a need for more informal education opportunities as well as further education directed at elected officials, realtors, lenders, homeowners, and members of the building industry—groups not usually targeted for such training. The rationale for this special target group was that they are often in the position to be decision makers and should be as educated as possible about the potential of alternative systems.

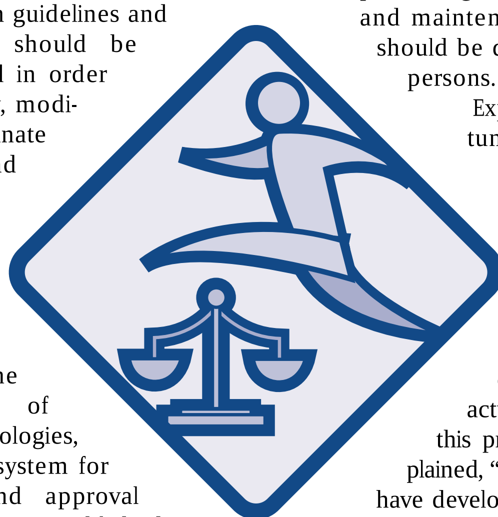
Action Plan

The goal of the Action Plan was to translate the results of the Barriers Assessment Study into clear objectives and strategies for overcoming the identified barriers. The study noted that the quantity and quality of data kept by state and local jurisdictions was low, and offered suggestions on ways to improve and encourage this valuable practice. The Action Plan included suggestions especially addressing complaints about the lack of public education.



Overcoming Legal Barriers

The report concluded that it would be beneficial to modify and streamline design standards and suggested the following:



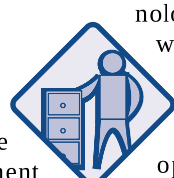
A detailed analysis of Washington Department of Health alternative system guidelines and standards should be conducted in order to identify, modify, or eliminate costly and nonessential practices and design features.

To encourage the approval of new technologies, a clearer system for review and approval should be established. Clearly defined approval processes would assure the public of adequate performance testing and reliability.

Establish statewide standards for the operation and maintenance of conventional and alternative onsite sewage systems. These standards should precisely define the appropriate operation and maintenance requirements for each type of system. To help ensure participation of system owners in operation and maintenance programs and to enforce perpetual maintenance agreements, special enforcing mechanisms must be identified.

Develop disinfection methodology guidelines. Alternatives to chlorine disinfection should be stressed due to the operational difficulties associated with simple chlorine delivery systems and the potential adverse environmental impacts.

Encourage Record Keeping



Establish a program for collecting and sharing quantitative data relating to the performance of alternative wastewater treatment technologies in the field.

A system for diagnosis and reporting of onsite system failures and their causes should be developed and implemented. This should include uniform definitions of failure and a standard method for diagnosing and reporting failures. State and local officials will be able to make decisions with confidence once they know adequate quantitative data are available on these systems.

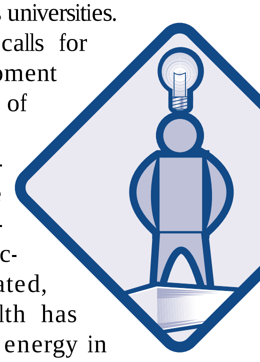
Expand Educational Opportunities

Develop a comprehensive education strategy targeting nontechnical persons (e.g., homeowners, realtors, and lenders) that deals with the application, performance, cost, and operation of alternative onsite wastewater treatment systems.

A catalog describing the users' costs, permitting requirements, and operation and maintenance of approved systems should be developed, especially for lay persons.

Expand informal training opportunities. Technology transfer sessions should be kept current as data-gathering progresses.

Soltman admitted that due to the interplay of some of the major barriers, it can be a bit daunting trying to develop clear solutions. As to actual changes brought about by this project's findings, Soltman explained, "Some local health jurisdictions have developed databases for managing, and monitoring systems as suggested by the report. The greatest efforts have been expended toward the education of lay persons at the local health jurisdiction levels, through programs funded by the state's universities. Our current biennial plan calls for increased activity in development and electronic distribution of information materials."



In response to the comments received about the confusing and complex standards of design currently recommended, Soltman stated, "The Department of Health has spent extensive effort and energy in this area. We currently have ten alternative guidance documents, with five or more new ones in development. Our process now includes annual review of all design documents, revising as the technology demands." He added that work was being done to expedite and standardize approval of new technologies, improve the consistencies throughout the guidelines regarding operation and maintenance, and complete development of an interim document for disinfection elements of onsite sewage systems as suggested by the study.

Soltman observed that there is wide variability nationally regarding alternative system use, and the need, or perceived need, to use them. " But I suspect that if a comparable study was done elsewhere, the results would be very similar," he concluded.

For further information, contact Soltman at (360) 236-3040 or e-mail *mark.soltman@doh.wa.gov*. And the Washington State Department of Health has a Web site at *http://www.doh.wa.gov*. SF

Photo courtesy of Carol Wildman

Above, Starbuck volunteers at a town meetings and at work installing nearly three miles of collection line. The bottom photo shows two senior volunteers, both over 70, cutting slots in pipe to be used in the upflow filters. Starbuck saved thousands of dollars by not buying preslotted pipes.

Starbuck

CONTINUED FROM PAGE 25

a last-minute cancellation by a construction force from a local Marine Corps unit planning to use the project as a training exercise left her in a bind. Wildman called the governor's office for help, and before long, ten inmates were installing subsurface drip lines.

"The inmates were great to work with," said Wildman. "They called again and may come back to help with some spring cleaning!"

Construction was underway, and the job at hand called for dedication and hard work. Some citizens had construction experience from building dams along the Snake River in the 1960's. One community member contributed his farming equipment—a backhoe and excavator—to save on expenses.

"The volunteers put in a three-mile-long collection system," said Thornton. "We really uprooted the town."

Diane Lusk, the project's labor coordinator, made sure that there were enough volunteers on the job each day and gave everyone daily updates on the project.

"Communication is one of the most important things in a project like this. You have to keep everyone informed and talking every day," she said. "I loved working side-by-side with neighbors and friends, and I got a chance to know some people better."

Wildman was surprised to find that some of the hardest workers were citizens who had never been very involved in the community before. On the other hand, she was also disappointed to learn that some other people she had expected to be very active took little, if any, interest in the project.

"For each septic tank, you put in at least 80 hours of work," said active volunteer Ray Thornton. "You can just get to work or wait for regulators to tell you that you have to upgrade. Then you'll pay dearly."

The consensus was that the volunteers all worked well together and even had some fun along the way. Lusk recalled some little water fights that helped to break the monotony.

Nevertheless, long hours, stress, and unfamiliar work made its impact, especially throughout the construction phase. Wildman and many of the volunteers had to set aside their regular lives in order to focus on the task at hand. Wildman was unable to tend to her fiber arts business and had to shut down her studio for a year. Personal relationships were also at risk.

"If I hadn't married the kind of man I did, I could have never done this," Wildman explains. "We like to do building projects together and have been trying to remodel our house, but everything has been put on hold."

"Some things have just got to give way when you are working on a time limit like this," said Lusk. We had to do whatever it took to get things done before winter."

Although nothing can be done about time constraints, Wildman thought an improvement could be made to the self-help process Starbuck followed.

"I think some training is necessary," she explained. "You go into the project blind, especially as to the technical aspects. If someone explained some of the different types of systems beforehand, instead of letting you try to interpret what the engineers tell you, it would make things much easier."

Wildman spoke with other community sparkplugs before the project got underway, but admitted that nothing can really prepare you for what your particular project will be like, considering that no self-help project is the same as another.

"Working on a project like this is more than a full-time job," said Wildman. "I'm not a plumber, engineer, or accountant, but I have learned."

Wildman had to stay strong in the face of negative gossip and individuals attempting to undermine the project. She also felt she played the role of a counselor, helping everyone involved understand each other and talk openly in order to effectively work together.

"You're walking a fine line between expecting productivity and giving the volunteers space," she said. "You have to motivate, not reprimand. It's not like a regular job where you can fire people."

Roderick, who identified exhaustion as a problem to be avoided, tried to make sure the busy sparkplug's spirits were always high, and that she got whatever help she needed.

Through self-help, the community was not only able to cut their costs, but actually did not spend a dime more than what they received in grants. The engineering firm was amazed at how quickly the project was finished.

"We simply stuck to the plan all the way through to the end," Wildman said. "Working together like this really does bring out the strengths in the community."

The construction was completed in mid-December, and Starbuck's citizens will be hooking up to their new, self-installed centralized waste system this spring.

Wildman said that wastewater treatment technicians employed by the town will conduct all onsite maintenance. Residents' user fees will pay for inspection and cleaning of septic tank effluent filters and for the pumping of the tanks.

For more information about Starbuck's project, contact Wildman at (509) 399-2373. For more information about self-help programs in Washington, contact Roderick at (360) 407-6541. For information about the Rensselaerville Institute's STEP program, call Vice President and Program Director Jane Schautz at (518) 797-3783 or visit the Institute's Web site at *http://www.tricampus.org/*. SF

Jolene Lawton is a freelance journalist living in Montclair, New Jersey.

Removal Efficiency of Standard Septic Tank and Leach Trench Septic Systems for MS2 Coliphage

CONTINUED FROM PAGE 27

pathogens. Many manufacturers desire to gain "credits" that will allow a decreased vertical separation to groundwater when their system is used. For instance, if a particular unit is shown to consistently remove 99 percent of human pathogens, in our example this might compensate for 2 ft of soil passage (assuming similar soil type and hydraulic loading rate). This might, in some instances, obviate the need for a more costly or obtrusive mounded system at some locations.

Very preliminary results of MS2 phage removal rates of different technologies are presented in table 1. The results suggest the eventual promise that some range of vertical separation credits, where pathogens are a main concern, can be determined. These authors believe, however, that the approach of using this research to establish credits should proceed cautiously. A number of factors that control the persistence and entrainment of viral pathogens require further research. Yates (1987) has summarized compelling research indicating that virus removal in soils is inversely related to the hydraulic loading rate. Thus, any distance-to-groundwater credits awarded an alternative technology should not be coupled with concurrent allowances for reduced leachfield size, since reduced size translates to a higher hydraulic loading rate.

In addition, since the effluent from many alternative technologies has lower biological strength, a slower formation of a biomat in the leaching facility might be expected. Research is needed to show whether this impeded formation of the biomat, resulting from pretreatment, appreciably affects the leaching facility's ability to remove viruses. As a conservative measure, alternative septic systems installed in remedial situations in Massachusetts may receive either vertical-separation-to groundwater relief or a reduction in leachfield size must use pressure distribution for effluent disposal in order to ensure that even hydraulic loading rate occurs across the infiltrative surface. This measure likely maximizes the treatment for pathogenic viruses.

Table 1

Preliminary results of virus reduction rates from septic tank effluent to system effluent

Alternative Septic System	Percent Reduction of MS2 Virus
Open-Cell Foam Trickling Filter	32–62
Layered Sand Filter	78
Activated Sludge Treatment System	95
Recirculating Sand Filter (Immature Biomat)	98
Recirculating Sand Filter (Mature Biomat)	99

Summary

The data presented indicate that the standard 5,678-L (1,500-gal) septic tank receiving 330 gal/day removes approximately 74 percent of the viruses. Presumably, this reduction in viruses is due to their association with organic particles that settle out in the septic tank. The leach trench receiving effluent at 3 cm/day (0.74 gal/sq ft/day) and placed in medium sand fill removes an additional 99.9 percent of the surrogate virus in a passage of 152.5 cm (5 ft). Of the alternative septic systems tested, a recirculating sand filter with a mature biological surface appears to offer the best treatment for viruses and compensates for approximately 61 cm (2 ft) of soil passage. Further studies to be conducted at the Massachusetts ASSTC hold considerable promise that state regulators will have a science-based rationale for establishing separation-to-groundwater and leachfield reduction "credits" that can be assigned to alternative septic systems being tested at the facility. SF

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John J. Higgins[1] is presently the Director of Municipal Assistance for the Massachusetts Department of Environmental Protection.

George Heufelder[2] is an environmental specialist with the Barnstable County Department of Health and the Environment on Cape Cod Massachusetts. He also is a principal investigator and one of the initiators of the Massachusetts Alternative Septic System Test Center in Falmouth.

Sean Foss[2] also is an environmental specialist with the Barnstable County Department of Health and the Environment on Cape Cod Massachusetts. His present focus for the Massachusetts Alternatie Septic System Test Center is to assist in determining the virus-removal efficiency of various alternative onsite septic systems.

1 Massachusetts Department of Environmental Protection Training Center, 50 Route 20, Millbury, Massachusetts 01527

2 Barnstable County Department of Health and the Environment, Superior Courthouse, Route 6A, Barnstable, Massachusetts 02630

EPA Develops Voluntary National Standards for Managing Onsite/Decentralized Wastewater Systems

CONTRIBUTING WRITER
Joyce Hudson

Did you know that septic tank systems constitute the third most common source of groundwater contamination? Approximately 25 percent of the estimated 100 million occupied homes and 37 percent of new homes in the U.S. are served by onsite wastewater treatment systems. More than half of the homes with onsite systems are more than 30 years old, and a significant number of them report problems.

When onsite/decentralized wastewater systems are properly managed, they can be the most practical and least expensive way to treat household wastewater. State agencies, however, report that onsite/decentralized wastewater systems often fail because of inappropriate siting, design, or inadequate long-term maintenance. High failure rates indicate a need for better management of these systems in order to protect water quality and public health.

The U.S. Environmental Protection Agency (EPA) has developed a draft *Voluntary National Standards for Management of Onsite/Decentralized Wastewater Systems* to assist communities in establishing comprehensive management programs for onsite/decentralized wastewater systems. In addition, EPA has prepared an outline of a guidance manual that communities may use to implement the standards. The voluntary standards can directly benefit other related programs, such as source water protection, watershed management, and restoring and preserving recreational and other water resources.

These standards have been developed for several reasons. In 1997, EPA's *Response to Congress on the Use of Decentralized Wastewater Treatment* Systems recognized lack of management as a major barrier to implementing decentralized systems. The report concluded that "adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas." In 1998, EPA and other federal agencies jointly issued the Clean Water Action Plan to address the remaining threats to our nation's waters. The plan clearly states a commitment to promote adoption and management of appropriate onsite/decentralized systems and to produce a set of voluntary national management standards.

Five separate standards are presented as a progressive series. Management requirements of the system become more rigorous as the technology becomes more complex and the sensitivity of the environment increases. Each standard includes a set of management program objectives and an accompanying set of activities needed to achieve the objectives. The standards and the accompanying guidance are to be used as a benchmark by state, tribal, and local units of government and by communities to 1) identify a management program objective, 2) evaluate whether the current onsite/decentralized management program is adequate to meet its objectives, and 3) determine both an appropriate management standard and the necessary program enhancements to achieve its objectives and public health and environmental goals.

Adoption of these standards is voluntary, and EPA recognizes that states, tribes, and local governments need a flexible program framework and guidance to tailor their programs to the needs of the community and to the abilities of the regulatory authority. EPA obtained initial input from various stakeholders, including representatives of many national organizations, as well as state and local regulatory agencies. EPA continues to actively seek input on how to ensure the standards are useful and will foster change in management practices.

EPA is also undertaking other initiatives to improve onsite/decentralized wastewater treatment systems, such as

- funding research and demonstration projects,
- providing technical guidance with updated information on treatment and disposal technologies,
- developing case studies and sharing lessons learned from others, and
- developing materials for homeowners and others on proper management practices.

For more information on the Voluntary Management Standards or other initiatives relating to onsite/decentralized wastewater systems, visit EPA's web site at *http://www.epa.gov/owm/decent.* To receive updated information about decentralized wastewater activities, call EPA's contractor, Lisa Knerr at (703) 385-6000. SF

Joyce Hudson is a senior environmental engineer with the EPA Headquarters' Office of Wastewater Management 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 EPA's effort to promote onsite/decentralized wastewater systems.

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Vacuum Sewers as Collection Systems

Flood Preparation and Recovery Plans for Small Treatment Plants

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Difficult Sites Require Advanced Technology

The Hydrologic Cycle

Pressure Sewers—Grinder Pump and Septic Tank and Effluent Pump (STEP) Systems

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Who wants your opinion? The editor of the *SF Quarterly* does, and not just as a "letter to the editor," either. Our "Forum" column is a place where readers can share informed, well-thought-out ideas that they feel will be of value to people involved in the treatment of wastewater, both onsite and small centralized systems.

We are open to all aspects of small-flow wastewater treatment, such as technology, management, regulation, operation, and maintenance. Please send your opinions (for the Forum column, 750 to 1000 words) to the *SF Quarterly* editor at the address on the staff box on page 2

NATIONAL SMALL FLOWS CLEARINGHOUSE

America's
Information Source on Small Community and Onsite Sewage Systems

Looking for information about wastewater collection, treatment, and disposal? The National Small Flows Clearinghouse (NSFC) can help.

Funded by the U.S. Environmental Protection Agency, the NSFC is a nonprofit organization that assists small communities (those serving populations with fewer than 10,000) with their wastewater-related needs. We offer a wide variety of resources about such topics as:

- septic systems and alternative onsite and community wastewater treatment technologies,
- regulations,
- operation and maintenance,
- design and monitoring,
- strategies for managing small wastewater systems, and
- public education.

The NSFC helps homeowners, local and state government officials, renters, bankers, citizens' groups, regulators, research scientists, educators, consultants, manufacturers, operators, contractors, and other professionals. We produce two quarterly publications, *Small Flows Quarterly* and *Pipeline*, which are free by request to U.S. residents. Our Web site hosts discussion groups on wastewater issues and provides information about conferences and events across the country.

In addition, the NSFC operates a toll-free technical assistance hotline available Monday through Friday from 8:00 a.m. - 5:00 p.m., Eastern Time. The NSFC provides outreach services through workshops, seminars, and conference participation. We have an inventory of more than 300 free and low-cost educational wastewater products. Contact us today for a free information packet!

National Small Flows Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064

(800) 624-8301/(304) 293-4191
www.nsfc.wvu.edu

National Small Flows Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064

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