Wastewater Management

- Surfaces as an Important Issue in the New Millennium

The idea of wastewater management is as old as man himself.

Simply put, man has struggled through the ages with the problem of what to do with his waste. The painstaking efforts of plumbers past is evidenced by the ancient drains, grandiose palaces, and bath houses of the Minoan civilization some 4,000 years ago.

Man knew instinctively, even in his earliest existence, the importance of allowing animal and human waste to go downstream, yielding to the natural flow of things. He may not have known all of the consequences, but he surely found the prospect of harvesting drinking water from the same area of the stream used for waste distasteful.
Now, in the dawning of a new century, wastewater management is still an issue in the forefront. As our ancestors sought to answer that eternal question, we, in a more sophisticated manner today, are still trying to figure out the best way to manage our waste.

What Is Wastewater Management?
Imagine that you are opening a new business. It is a considerable investment. You have put a lot of time and hard-earned money into it. Would you open your new store without a long-term plan, having no control over future sales or purchasing?
Although this question may seem rudimentary, in many parts of the country the onsite wastewater treatment industry has been functioning just this way, without a long-term plan or management program.
The dictionary defines management as "the act, manner, or practice of managing, supervising, or controlling." Whether you spend millions or thousands of dollars, or whether the system is part of a public works project or an individual septic tank, there should be some entity responsible for the overall consequences and direction.
Most communities already manage their onsite systems to some extent through regulation. But the term "management" as it is used today implies a broader definition.
In other words, wastewater systems, particularly onsite systems, need to be managed or controlled, not just technologically, but with a broad concept connecting individuals, communities, local officials, and regulatory agencies if failures and malfunctions are to be avoided.

Why Is Management Important?
Trends and numbers speak volumes about the need for onsite wastewater management today.
As we enter the new millennium, population growth is moving more and more homeowners into suburban areas, many relying on onsite wastewater treatment and disposal. The majority of homes in rural America already rely solely on onsite systems.
Approximately one fourth of the estimated 109 million housing units in the United States are served with septic tanks or cesspools, according to a 1995 American Housing Survey

(AHS). During that year alone, more than 2.5 million septic tanks in America were reported as malfunctioning (or as having a total breakdown of the system).
Graham Knowles of the National Small Flows Clearinghouse's (NSFC) National Onsite Demonstration Project (NODP) authored a report titled "Septic Stats, An Overview," based on the AHS data (1). In the report, he combines U.S. Department of Commerce Bureau of Census statistics with the AHS data to establish septic tank trends.
Knowles' report projects that by the year 2025 there will be 40 million housing units with septic tanks. If the current trend continues, that could mean as many as 4 million septic systems could be malfunctioning by 2025.
If this projection becomes a reality, the necessity for greater control through management programs should be self-evident.

As In Olden Times turning the clock back to study how wastewater systems evolved and how management programs have fared throughout the years can be a useful tool. Close to 4,000 years ago, approximately 1700 B.C., the Minoan Palace of Knossos on the isle of Crete featured four separate drainage systems that emptied into great sewers constructed of stone. The palace latrine was the world's first flushing toilet with a wooden seat and a small reservoir of water (2).
From 3000 to 1500 B.C., early plumbers laid sewage and drainage systems. Archaeologists have discovered underground channels that remained virtually unchanged for centuries (3).
Ancient gravity sewers were developed in response to the density of populations living in close proximity or in cities, according to Peter Casey, program coordinator for the NSFC. These large central systems were actually analagous to sewers developed in the 1800s in London and other large cities.
During these times, there were many outbreaks of various diseases, such as dysentery, cholera, infectious hepatitis, typhoid and paratyphoid, and various other types of diarrhea.
"The biggest health benefit of the 20th century was brought about by the purification of drinking water and treatment of wastewater," Casey added. "It increased life expectancies and had a tremendous impact on man's health and survival."
Casey said in 1870, the average person could expect to live to be 40 years old. By 1900, that age climbed to 47 with steady increases throughout the decades since. Today, the average person in a developed country can expect to live into his or her 70s or beyond.
According to a 1997 U.S. Environmental Protection Agency (EPA) document, onsite wastewater systems have been around since the mid-1800s (4).
"In rural areas during the mid-1800s to the early 1900s, sanitation was not a problem because the water supply was hand carried or pumped. No water was required for the privy," Casey said. "If it became full, they would simply cover it and dig a new privy."
Many people are familiar with the early 1900 image of a splintered, wooden shed, usually with one door and a hole in the floor, as the rural family's outhouse. Chamber pots were dumped outside or in the privy.
After the 1930s when electricity and gas became available in rural areas, the need for onsite treatment arose because of the increased volume of liquids in the wastewater, Casey said.

“Once farmhouses got electricity and indoor plumbing and the conveniences of the large cities, the flows became too great and caused problems,” Casey added. “Suddenly, there was running water in the house, making way for baths, showers, and flush toilets.

Cesspools were the earliest form of onsite system in response to increased water use. They were usually just a large, covered hole dug in an inaccessible area.

“With the move to the suburbs in the 1940s, we saw dense housing units trying to use all this water on half-acre lots. There was no place for all of the water to go,” Casey said.

Septic tank systems, specifically, have been used for wastewater treatment since the turn of the century, according to a report from a 1994 University of Waterloo, Ontario, conference (5).

The report, by Richard J. Otis and Damann L. Anderson, adds that the use of septic tanks did not become widespread until after World War II when the suburban housing boom outgrew the rate of sewer construction.

Regulation Begins

The Otis and Anderson report notes that in the 1950s, states began to adopt regulations to provide a universal basis for the design and installation of septic tank systems. These early codes did not, however, provide much in the way of broad management or prevention of system failure. The programs regulating the installation and use of onsite systems could not keep up with the increasing demand (5).

The report adds, “Today, it is generally recognized that past approaches to managing onsite wastewater treatment systems use are no longer adequate . . . . The failure of these systems to gain acceptance as effective and permanent facilities is due primarily to shortcomings in management programs.”

The report notes that the biggest assumption at that time was that onsite systems would ultimately be replaced by central sewerage.

Despite this, some early management programs did arise. In 1954, Fairfax County, Virginia, established an onsite wastewater management program when the board of supervisors there directed the health department to develop a program that would prevent future septic system failures (6).

The management plan focused on the planning, design, and construction review of septic tank systems through an extensive permit program.

Under this early management plan, the county was in charge of site evaluation, design review, installation supervision, monitoring, and public education while the homeowners were responsible for the operation, maintenance, and repair of the systems (6).

With the establishment of the wastewater treatment construction grant program under the Federal Water Pollution Control Act Amendments in 1956, the focus continued on construction of centralized sewers. Throughout the 1960s, the concept of septic tank systems being a temporary solution continued.

Onsite Systems Are Recognized

In the 1970s, millions of dollars were still being spent on constructing sewers and centralized wastewater treatment facilities, while at the same time, many federal and state agencies started to consider regulating and managing onsite systems as part of environmental pollution control issues. Throughout the 1970s, management programs sprang up across the country.

By 1974, many states had identified the need for better managed individual onsite systems through studies conducted under the Federal Water Pollution Control Act, Section 208. More importantly for the onsite system industry, EPA regulations required the inclusion of a cost-effectiveness analysis of alternatives by all applications initiated after April 30, 1974, under the Federal Construction Grants Program.

In fact, the 1977 Clean Water Act (CWA) Amendments required communities to examine alternatives to conventional systems. In addition, the NSFC was established by Congress as part of the amendments to provide technical information and assistance to small communities across the country.

In the 1978 "Report to the Congress," the Comptroller General of the U.S. stated that septic systems can function as effectively and permanently as central facilities and are a cost-effective alternative to sewage treatment plants, adding that "EPA and other federal agencies should increase the acceptance of septic systems by requiring established public management entities to control their design, installation, and operation (7)."

If the 1970s could be remembered as the decade septic systems became recognized as permanent wastewater treatment options, then the 1980s might be remembered as the decade of onsite exploration. During the 1980s, the field progressed significantly, and many onsite management system models were developed.

In the 1990s, the issue of management has been tweaked further, focusing on the development of adequate monitoring and comprehensive management systems.

In the 1997 "Response to Congress on Use of Decentralized Wastewater Treatment Systems," EPA stated 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."

Since then, septic tank systems and other alternative systems generally have been recognized not only as environmentally and technologically sound treatment methods, but have been viewed as viable, permanent methods of treatment.

In the 1997 report, EPA noted that one of the barriers to implementing decentralized systems is a lack of management programs. To overcome this, EPA recommended development of management programs "on state, regional, or local levels, as appropriate, to ensure that decentralized wastewater systems are sited, designed, installed, operated, and maintained properly and that they continue to meet health and water quality performance standards."

As one of the responses to these 1997 recommendations, EPA launched Phase IV of the NODP in 1998.

Enter Phase IV

Phase IV of the NODP is a three-year program, focusing on establishing the necessary processes to help small communities develop a broad concept of management for onsite systems.

Knowles, program coordinator of Phase IV, has been studying management issues. He commented, "Management programs are imperative today because they will enable communities to control the effectiveness of wastewater treatment and can help ensure public health, improve water quality, and sustain the environment."

Knowles said Phase IV's mission has three components:

1. To gather data, information, knowledge and insights concerning all aspects of onsite management systems nationwide.

Under this component, Knowles said objectives will be to establish a repository of information and expertise on the topic of onsite management, forming a national database of management systems complete with case studies addressing issues of management approaches, compliance, improvement, and prevention perspectives.

2. To create a framework, with tools and educational products for national dissemination to communities through a network of partners.

Knowles explained that this component seeks to "develop a framework of guiding ideas to assist communities through the process of moving from their current reality toward increasingly effective onsite wastewater management." He added, "The aim is to establish strategies for change, creating "a network of interested publics to partner with, for disseminating the onsite management idea and delivering products, tools, and services."

3. To analyze, evaluate, review, and refine onsite management models, methods, and materials at strategically selected sites.

Knowles said this component of the project is designed to select suitable sites to pilot onsite management systems. It also will "provide NODP expertise, materials, mentors, management insights, tools, and techniques to communities interested in adopting an onsite management systems approach." This component will document and track management strategies, products, tools, and services to meet differing community needs.

Once these components have been met, Knowles said Phase IV ultimately will provide interested communities with practical, hands-on technological and management expertise facilitating community onsite system management programs tailor-made to meet a particular local community's needs.

To help the project succeed, NODP IV has enlisted an expert panel, made up of talented individuals in the wastewater field who have made and are continuing to make significant contributions to the evolution and development of onsite management plans.

Cranberry Lake's Success

One panel member, Jane Schautz, vice president and director of the Small Towns Environment Program at The Rensselaerville Institute in New York, is working with several communities, studying their onsite management programs. Schautz's role is that of an observer, documenting the progress and noting the plan's assets and possible defects.

She defines onsite management as "the systematic monitoring and maintenance of onsite systems to anticipate and/or correct malfunction in order to preserve the life of the system and prevent environmental degradation."

The challenging task, she said, is to make a management program work in existing communities that have onsite systems and do not automatically see the benefit of adopting a management system with all of its associated costs that the residents have not paid previously.

She cited Cranberry Lake, New Jersey, as an excellent case study of this scenario. One important lesson she has learned is that residents have to be shown there are innumerable benefits to whatever costs might be incurred.

The Cranberry Lake Septic Management System was established in 1990. It is a relatively affluent area. Most of the houses around the lake were built in the 1950s and intended for seasonal use. Because of this, some of the lots are small, approximately 50 by 50 feet.

"Year-round occupancy was not expected, but with retirement increasing, more and more people are living there year-round," she said. "With retirees you have to be sensitive to their limited incomes. One fear was that they would be thrown out of their houses if a malfunction were discovered. That made the problem more intense."

Prior to the establishment of the management system, Cranberry Lake had a nitrate problem from failing septic systems and was overgrown by weeds. Schautz said that as a bonus, having the management system for wastewater in place helped the township to successfully secure funding for treating unwanted plants.

Schautz believes Cranberry Lake's success should be credited largely to Margaret McGarrity, the "spark plug," or local person who took the initiative to get things moving there. She added that Township Manager Ronald Gatti also played a major role in their success.

"Trying to establish a management district is going to be controversial, and people have to be willing to deal with controversy without being damaged," said Schautz. "You have to have savvy people who have the guts to stick with it. A plan is inert until somebody believes in it. You have to have a champion to give any plan a life."

McGarrity, a member of the environmental township commission, was that person for Cranberry Lake.

Schautz said McGarrity felt that sewers were inappropriate for the area. "Sewers just take wastewater from one area and move it to someplace else," said Schautz. "McGarrity felt they couldn't afford that for the wells or lake. She looked at all of the components and decided it made no sense to spend money installing septic systems and allowing them to malfunction."

Under the management plan, residents pay a flat $15 fee that covers a three-year period, that extends from one date of pumping to another. By paying the fee, they update their permit by showing proof of pumping. Municipal officers oversee the process.

The township board of health is responsible
for enforcement. "They have astonishing compliance," said Schautz.

Schautz added that the township residents' drinking water is provided by privately owned wells. "People understand that this is all related to maintaining the purity of their lake, as well as preserving their drinking wells.

"It took awhile to convince people that this was in their best interest, but they now see that this is an improvement of their relationship with the township government," said Schautz.

In fact, Cranberry Lake's management plan has been the model for other communities in the area. She said, "To me one of the most persuasive evidences of the plan's success is that others in the area have seen the results and are taking steps to follow that model.

"In the beginning, people were saying, 'why us?' and now after the evidence, not only are they seeing many upgrades to systems made voluntarily, but people are saying, 'why not us?' and have petitioned the township board to include other areas," she added.

Schautz cautioned that management plans cannot be established overnight. She quipped, "Starting a wastewater management district is like planting asparagus—the first rule is

the ground should have been prepared three years ago. Cranberry Lake did it faster, but very intensively."

Cranberry Lake's first step was education, including presentations at local meetings, seminars, articles in the local newspaper, information booths at community meetings, and insert fliers. Schautz said this process took approximately one year.

"McGarrity and Gatti said their success depended on persistence—getting the word out and allowing it to take hold, giving people time to come to their own conclusions," Schautz added. "In this case, their commitment and belief eventually became infectious."

Another helpful aspect of gaining acceptance was that the ordinance was relatively mild. "That way, there was less opposition," she said. "There's no reason to make this harder than it has to be. In fact, they went out of their way to accommodate people."

The management plan gives the township the authority to fine residents $1,000 per day or order them to do 90 days of community service for noncompliance, but Schautz said there has rarely been a need to impose those punishments.

In addition to having a spark plug, educating the public, and persistence, Schautz believes humor is an imperative component to the key to success. "McGarrity and Gatti livened up their material with graphics and energy," she said. "It really worked for the community."

In the end, Schautz said a management plan must be based on the local culture and philosophy. "Some of the purists say it isn't a management system unless you have inspectors there all the time, tearing up the soil. I'm not saying that doesn't work; but for an older established community, it seems that moving in areas of environmental sensitivity makes sense when people come to the understanding that they are at risk."

Getting Utilities Into the Plan

Another expert panel member, Bridget Chard, is a Small Communities Project coordinator and a township supervisor from Pillager, Minnesota. She works as a consultant for many townships in Minnesota, helping them implement a management model, called an "Environmental" Subordinate Service District, that can be tailored to meet differing needs.

In essence, the model allows local township boards, usually lacking the expertise, time, and experience needed, to develop and maintain a management plan by partnering with the local rural utilities. "The rural utilities are already in place and providing electric power to the rural residents. These residents are already part of the rural electric co-op. Therefore, these utilities are usually more than willing to provide this management service," she explained.

"They have the needed assets to oversee the systems. They do the billing, administrative work, and actually manage the wastewater system and therefore relieve the work that the town board would have to do. Essentially this becomes a public-private management system. It's a good set of checks and balances. The townships have the authority to levy onto the residents property taxes for any unpaid service charges."

In this model, enforcement issues are taken care of through a partnership with the township or county. "This is a choice situation," said Chard. "We continually are building new partnerships and better ways to do things. As homeowners and township board people become introduced to this new model, it's always an education process. We do a great deal of informational work up front before we create the districts."

The model allows for different methods of funding, including service charges and/or a property charge. She added, however, that a township and its residents sometimes find other alternative and equitable methods for financing their projects.

Chard, who is an independent contractor and chairman of her township board, said this model works well for old and new systems. “This model is usually used to retrofit and replace old groups of non-conforming wastewater systems as well as being used for new conservation-based designed subdivisions. It’s a fluid, dynamic model that can change and adapt to the local homeowner’s needs. You can come up with different ways of handling old systems versus new systems. We want everybody’s environment to be protected,” she added. “It also stabilizes the local economy and protects the landowners real estate investment.”

Like Cranberry Lake, the area has water sources to protect. As a result, Chard said lake associations are very active in Minnesota with education programs as well as performing lake monitoring. They have been very supportive of projects that protect their lake quality and well supplies. Most of the areas where Chard works as a consultant are served by individual well systems.

Also like Cranberry Lake, many of the lots were platted years ago and originally may have been set up for seasonal homes and have very small lot sizes. These lots are now seeing a need to replace a failing system with nowhere to place it on the property.

Chard has helped township projects, ranging from as small as eight to 200 homeowners, set up management districts. “We continually learn from the evolution of these and older districts,” she said. “You should always be improving on the models.”

Chard was involved with the establishment of Cass County’s first management district model, which was included in EPA’s 1997 “Response to Congress on Use of Decentralized Wastewater Treatment Systems.”

The statute used in Minnesota for the framework of this management model is Minnesota Statute 365A for townships. This statute is used to provide many services that residents need within a township including road paving, animal control, and many other services. The statute was used to develop “Environmental” Subordinate Service Districts, which manage a water or wastewater projects or both at the same time.

Under that plan, the Rural Utilities Services, formerly the Rural Electrification Association, was a major player. Cass County sought out the local utility, Crow Wing Power and Light of Brainerd, Minnesota, and asked them to help with the management program, including monitoring, monthly inspections, pumping, record keeping, and billing administration. Chard said this type of plan is typical of the model.

She added that there are currently four known wastewater management districts operating in Cass County today with many others being implemented around the state by townships and counties. The county usually partners with the townships to do all of the enforcement, permitting, and siting of treatment sites as well as implementation of a Geographic Information System (GIS) database for the districts. “They don’t want to micromanage small groupings of wastewater systems, but would rather partner with townships. This method keeps them informed about the smaller wastewater management systems. Now they have started doing planning and zoning, road work, and many other ideas have evolved from this original partnership and dialogue,” she added.

“The county attends yearly audit meetings with the township boards, residents, and rural utility representatives. They physically review the system and look at the management logs to see how the wastewater system could be improved.”

The keys to success, in Chard’s view, are education and the ability to keep an open mind. “It all goes back to working with your neighbor, building a trust base. From there, you are challenged to find answers,” she said.

“You sit down with the property owners in a meeting and say here is the problem, now what can we do. I have yet to come up against a group that can’t find their own solutions.”

Like Schautz, Chard recommends keeping education material and any documents homeowner friendly and humorous. “Try to make it fun. Homeowners always think of the government as being very imposing, but there is a lot of flexibility in this model that can be used to help the homeowners and town board work together and find solutions they need. When it’s done, all feel that they have ownership in their project,” she added.

Chard believes the definition for onsite management depends on a person’s perspective. “Onsite management from the homeowner’s perspective is new,” she said. “It means taking care of their system, which is something they have never done before. By taking responsibility of your system, you are also protecting your neighbor. Further, we are managing and protecting a considerable investment and not wasting anyone’s money to replace it sooner than is necessary.”

Chard added that onsite systems will always need some type of management tool, from the simplest “tank management” tools to the more sophisticated technologies that homeowners would not understand.

“To me, it is doing it right from cradle to grave. It has gone beyond knowing that there are problems, that central piping is no longer a necessary evil because it’s so costly,” she added.

“The NODP IV theory is truly fourth-generation thinking regarding the evolution of wastewater management for the new millennium,” Chard said. “Now we know we not only have the technology, but the tools to manage and maintain any onsite- and cluster-designed wastewater system.”

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