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An Investigation of the Feasibility
of Testing One or More
Alternative On-Site Sewage Treatment
Systems in the Richmond Region

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An Investigation of the Feasibility of Testing One or More Alternative On-Site Sewage Treatment Systems in the Richmond Region

According to a report issued by the Task Force on Septic Regulations, 650,000 year round housing units in Virginia use on-site sewage disposal systems. That represents slightly over one third of all housing in Virginia. In rural areas, more than 70% of all households and most businesses depend on on-site systems.[1]

By far, the vast majority of households served by on-site systems are served by conventional septic tank/drainfield systems. These systems represent a safe, cost effective way of treating and disposing of household and small business sewage. Properly sited, designed, installed and maintained, such systems can last for up to 50 years.[2]

Unfortunately the conditions necessary for such long term service are not always available. Some home owners have difficulty finding a site suitable for a septic system on their property. In addition, septic systems sometimes fail, that is, stop operating properly. In fact, it is reported that one half of all septic systems in the United States fail after only 15 to 20 years.[3]

The problems associated with the installation of new septic systems and the failure of exiting systems are found here in the Richmond region. Installation can be difficult due to poorly drained soils and high water tables, especially in the coastal plain. These same factors can also lead to septic system failure. As development continues to occur in the coastal plain, finding sites that meet the requirements of the property owner and the Virginia State Board of Health, the agency that regulates septic systems, may become more difficult.

The purpose of this report is to examine the issue of household wastewater and how traditional septic systems work. The report also examines factors that limit the location of septic tanks and what causes these systems to fail.

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[1] Report of the Task Force on Septic Regulations, Institute for Environmental Negotiations, University of Virginia, (Charlottesville, Virginia, July 1991), p. 4.

[2] Kathryn O. Sevebeck and Carolyn J. Kroehler, A Guide to Septic Systems and Alternatives, Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, (Blacksburg, Virginia, 1992), p. 1.

[3] Ibid.

The report then examines alternatives to traditional systems. Three alternative systems are discussed along with the strengths and weaknesses of each system.

The report then discusses the need for more information concerning alternative sewage treatment systems. It examines how such information could be gathered. Finally, the likelihood of conducting such an examination in this region is examined.

During the course of this investigation, RRPDC staff members talked with many individuals familiar with traditional septic systems and alternative sewage treatment systems. Individuals for the Virginia Department of Health and Virginia Polytechnic Institute and State University were interviewed. Also interviewed were individuals involved in the distribution of equipment used to construct alternative systems and persons involved in the installation of on-site waste water systems. A complete list of those that helped with the preparation of this report is included in the acknowledgement section.

WASTEWATER CONTAMINANTS

Wastewater treatment is necessary because of the many contaminants found in the water. While sewage entering the traditional septic tank is 99% water, it contains biological, physical and chemical contaminants. Following is a brief description of these contaminants taken from The Systematic Evaluation and Repair of Failing Drainfields in the Coastal Zone Area of Virginia, published by the Department of Health.[4]

Biological Contaminants

Domestic sewage contains bacteria and viruses. Some of these organisms can cause disease. The presence of these contaminants is measured indirectly by testing for fecal organisms such as fecal coliform and fecal streptococcus bacteria. These are used as indicators to determine the presence of sewage in water.

The septic tank itself provides little wastewater treatment. It is the conditions found in the drainfield that reduce the bacteria in the wastewater. Simply put, the purpose of the septic tank drainfield is to reduce or eliminate these bacteria as the water seeps through the soil beneath the drainfield. This happens as the bacteria competes with native soil bacteria and organisms in the drainfield trench, as the wastewater is filtered by the soil

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[4]Donald J. Alexander, M.S., Calvin Jones, and Paul Sandman, M.S., The Systematic Evaluation and Repair of Failing Drainfields in the Coastal Zone Area of Virginia, Virginia Department of Health, Division of Onsite Sewage and Water Services, (September 25, 1992).

and as the bacteria die off due to time and hostile environmental conditions.

Viruses in the wastewater are treated in a different manner. They are adsorbed by the soil due to the difference in electrical charges between the negative charge of the soil and the positive charge of viruses. As it turns out, clayey soils have a higher ability to adsorb viruses than sandy soils.

Physical and Chemical Contaminants

One element used to evaluate wastewater is biochemical oxygen demand (BOD). A five day biochemical oxygen demand test (BOD_5) measures how much oxygen must be consumed to biologically digest and chemically stabilize the organic components of wastewater. While BOD is not a contaminant, it does provide a way to determine the characteristics of wastewater.

Another contaminant is suspended solids. These are materials such as filamentous material, hair and biological wastes. These do not always settle in the septic tank. High suspended solids can clog pumps and other machinery in a treatment system as well as the soil pores in the absorption field.

A final contaminant is nitrogen, considered by some to be the most important chemical constituent in wastewater. Nitrates, forms of nitrogren which come from urin, are highly soluble in water and do not bind to soil. Nitrates can cause both public health and environmental problems.[5]

HOW A SEPTIC TANK/DRAINFIELD SYSTEM WORKS

The traditional septic system is rather simple in design. It works totally on gravity and has no moving parts. A septic system consists of the septic tank which collects the wastewater and solids, a distribution box which splits the wastewater (effluent) evenly among a series of drain pipes and an absorption field which allows the wastewater to percolate (seep) into the ground.[6]

Treatment of household sewage begins when it enters the septic tank. Here heavy solids sink to the bottom. These solids are acted on by bacteria through a process of known as anaerobic (without oxygen) decomposition. This process creates a material called sludge which sinks to the bottom of the tank and must periodically be pumped out of the tank. The liquid from the tank floats to the top. Grease and light particles remain in the tank

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[5]Alexander, Jones and Sandman, pp 3-6.

[6]Sevebeck and Kroehler, p. 3.

due to an outlet tee. Wastewater is transported to the distribution box and to a series of perforated pipe or open jointed drain tile buried in the ground. There the wastewater passes through a layer of coarse gravel and then enters the soil in the absorption field. Bacteria and oxygen in the soil help treat the liquid. Eventually the treated water reaches the groundwater.[7]

While the process of wastewater treatment in a septic system is biologically complicated, the system itself is relatively simple from an engineering point of view. In addition, it is relatively inexpensive to build and maintain. In 1991, it was estimated that the average cost of installing a septic tank was between $3,000 and $4,000, depending on location, size, engineering and other variables. Maintenance is usually limited to the periodic pumpout of the tank.[8]

A variety of factors are examined to determine if a particular site is appropriate for a septic tank system. These factors include topography, available area, soil type and depth, slope of the land, depth to water table, proximity to drinking water supplies, bodies of water and shellfish areas, and the ability of the soil to absorb moisture (percolation rate).[9]

The installation of a septic system, and all other types of on-site, non-discharging systems is governed by regulations issued by the Virginia State Board of Health. These regulations detail the requirements for the siting and installation of septic systems.[10]

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[7]Small Wastewater Systems: Alternative Systems for Small Communities and Rural Areas, U.S. Environmental Protection Agency, Office of Water Program Operations, (Washington, DC, January 1980), no page number.

[8]Peterson, Craig E. and Thomas W. Simpson, Alternative On-site Wastewater Treatment and Disposal Systems, Department of Crop and Soil Environmental Sciences and Virginia Cooperative Extension Service, College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University, (Blacksburg, Virginia, 1992), p. 9.

[9]Peterson and Simpson, p. 10.

[10]Regulations governing discharging wastewater treatment systems are governed by the Water Division of the Department of Environmental Quality. Those systems and regulations are not discussed in this paper.

LIMITATIONS TO THE USE OF TRADITIONAL SEPTIC TANK SYSTEMS

The low cost and ease of installation of a traditional septic system, plus the minimal maintenance requirements make this type of system very attractive. And for a great majority of homeowners and businesses, this type of system is the best and most economical way to deal with wastewater.

There are some areas, however, where the installation of a traditional septic system may present problems. This was discovered in work done by the Richmond Regional Planning District Commission. The Commission assisted both New Kent County and Charles City County with the preparation of their land use plans. In each case, the RRPDC worked with representatives of the U.S. Soil Conservation Service, the Virginia Department of Health, Virginia Polytechnic Institute and State University and each county to determine the suitability of soil types for on-site sewage treatment. Conditions such as soil permeability, depth to water table, slope and existing Department of Health regulations were examined to determine the potential for installing conventional septic systems. In both counties, it was determined that over 60% of the generalized soil types in each county had severe limitations for the installation of on-site wastewater treatment systems, especially septic systems. The predominant reason for this determination was the presence of wet soils that could not adequately absorb wastewater from a septic system.

This does not mean that development is at a stand still in these two counties. Houses are being built and septic systems are being installed on a regular basis. It does mean, however, that siting septic tanks is difficult at best. It also means that some land that is desirable for development is not being developed.

SEPTIC TANK FAILURES

Septic system failure can be an inconvenience. They can also be a potential threat to the homeowner and the general public. Liquid waste can back up into the residence or business. Liquid waste can also pond on the property creating a health hazard due to viruses and bacteria and providing breeding places for mosquitoes and other insects.

Equally important, a failed system can contaminate ground and surface water. Improperly treated wastewater can allow bacteria, viruses, detergents and a variety of potentially toxic chemicals found in household cleaners to enter ground and surface water. This type of problem may be more difficult to detect since contamination can occur to groundwater without any outward signs.[11] According to the U.S. Environmental Protection Agency, septic

[11] Sevebeck and Kroehler, p. 15.

systems are the most frequently reported sources of groundwater contamination in the nation.[12]

There are four primary reasons for the failure of a septic system. These are hydraulic overloading, failure of a physical component due to stress or deterioration, landscape problems and unsuitable soil conditions. The following discussion is taken from the aforementioned Systematic Evaluation and Repair of Failing Drainfields in the Coastal Plain Area of Virginia.

Hydraulic Overload

Hydraulic overload occurs when more effluent (wastewater) is applied to the drainfield than can be absorbed by the drainfield. This can occur periodically or, in some instances, can occur all the time. According to some sources, excessive overload of the drainfield may be the leading cause of drainfield failure. Overloads can be caused by several factors.

One possible cause is water usage in excess of the designed capacity of the septic system. A growing problem is increased water usage. This can come from such varied sources as the addition of a hot tub, a home occupation such as a beauty shop or a hobby such as photography. Any of these factors can add extra flow which may exceed the capacity of the drainfield to absorb the wastewater.

Another problem is leaking fixtures. A small leak can add the equivalent of an additional bedroom to the daily wastewater flow. A severe leak or leaks can double the estimated wastewater flow.

Another problem stems from the design of the traditional septic tank system. As discussed above, the system contains a distribution box to equalize the flow to the drainfield. Equal distribution among the drain lines is difficult to achieve. The uneven flow may not cause a problem in flat terrains. However, in sloping terrains, problems can develop, especially if downhill lines receive added flow. This problem can be increased if the distribution box was not properly installed.

Physical Failures

One problem associated with a conventional drainfield is tree roots. Water loving trees such as maples can send roots out to drainfields, even when located 100 feet or more away. These roots can enter the drainfield, grow back to the distribution box and septic tank and block the flow of wastewater.

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[12]Sevebeck and Kroehler, p. 1.

Some failures are caused as materials used in the system wear out. Some older materials such as piping and some concrete products have a history of early failure. Some modern materials, such as plastic pipe, tend to not deteriorate, but are subject to stress. Some failures of materials are caused by operating heavy machinery over the drainfield.

Another cause of failure associated with older systems or ones that are not well maintained is clogging or organic mats. A mat forms at the interface between drainfield lines and the soil. This is normal. However, there are activities that cause this mat to clog the system. The use of garbage disposals increases the organic loading placed on the system. Compounds such as cellulose, which are difficult to breakdown in the septic tank, can also cause problems. A third problem is related to the excessive water flow caused by hot tubs which increase the loading on the system.

Soil Related Failures

One soil related problem can be a high seasonal water table. These high water tables usually occur due to site or soil conditions that do not allow the adequate disposal of precipitation falling or flowing onto the site. Wastewater disposal adds to the problem. Treatment efficiency is reduced due to an increased need for time and distance to adequately treat wastewater.

Another problem is slow infiltration rates for soils. That is, the soil is very slow to allow water to pass through it. In these types of soils, treatment and disposal is directly related to rainfall. When rainfall is high, normally spring and fall, treatment will be lessened. The ability of soils to transport rainwater and wastewater is important due to the heavy load a septic systems places on the soil. While rainfall in Virginia is typically 40 inches per year, adding a drainfield adds the equivalent of 120 additional inches of rain per year.

High shrink-swell soils, soils which contain active clays, generally have difficulty providing treatment for wastewater. These soils expand when they are wet and shrink when they are dry. The addition of wastewater to these types of soils causes the soil to swell shut, leading to system failure.

A final problem area is soils that have what is called restrictive horizons, or barriers in the soil which slows the downward flow of water. These soils may also contribute to what is called "perched" water tables which, due to soil conditions, limit the downward flow of water. The closer this restrictive layer is to the drainfield and the less the permeability (ability to pass water) of the soil, the greater the problem.[13]

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[13]Alexander, Jones and Sandman, pp. 7-12.

ALTERNATIVE ON-SITE SEWAGE TREATMENT SYSTEMS

Alternative wastewater treatment systems were developed to address the limitations of conventional septic systems. That is, these alternative systems were designed to work where traditional septic systems cannot work. Furthermore, they are designed to address conditions which may lead to the failure of a traditional septic system.

There are a variety of these types of alternative systems. Many of them incorporate the traditional septic tank, but use a variety of means to dispose of the wastewater. Each system was designed to overcome one or more conditions that limit the installation of a traditional system. Each system has its pros and cons as well as its proponents and detractors.

After conversations with many people, RRPDC staff selected three systems which appear to address some or all of the constraints that limit the installation of a traditional septic tank system. These systems are low pressure distribution systems, elevated sand mounds and constructed wetlands. Following is a brief description of each of these systems.

Low Pressure Distribution Systems

A low pressure distribution system is designed to overcome some of the constraints which limit the use of traditional septic system. Specifically, low pressure distribution systems can work in rapidly permeable coastal sands, inland soils with high water tables and in situations where the area available for wastewater disposal is small relative to the space needed for a conventional absorption field.[14]

These systems are designed to maintain an even distribution of wastewater in the entire absorption field, optimize dosing and resting cycles and provide for maximum separation of the distribution lines above the water table and any restrictive soil layers. These systems can effectively utilize the treatment characteristics of the soil, reducing the travel distance of pollutants.[15]

A low pressure distribution system begins with a traditional septic tank. To this is added a dosing tank and pump. The pump evenly distributes wastewater through a series of perforated plastic pipes that replace the traditional absorption field. This allows for a more efficient distribution of the wastewater through the entire drainfield. This system also allows the drainfield to

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[14]Peterson and Simpson, p. 61.

[15]Peterson and Simpson, p. 60.

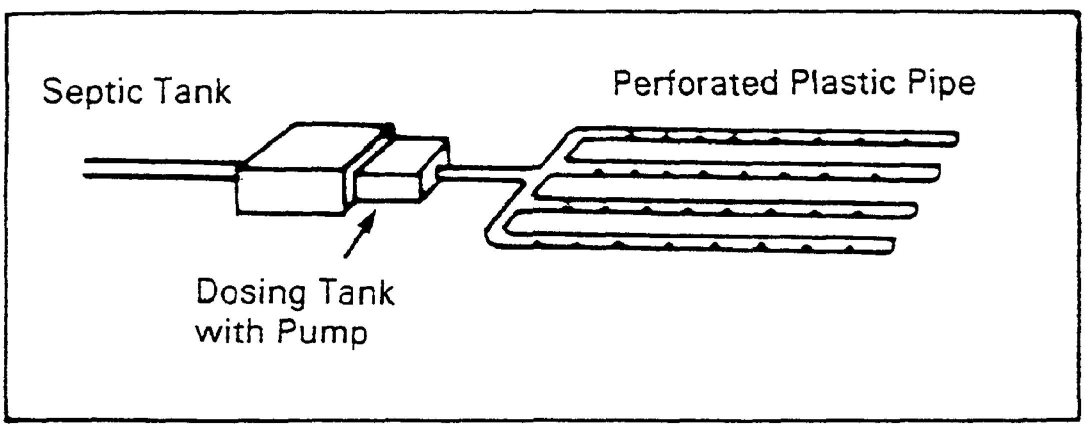
dry between dosings. In some applications a second septic tank is used to provide more settling room for solids. The drainfield may be the same size as that of the conventional septic tank/absorption field system, but regulations may permit a reduction of the drainfield size by up to 50 percent.[16]

These systems can cost twice as much as a traditional septic tank system to install. Furthermore, there are periodic maintenance costs and energy costs which need to be paid on a regular basis.[17]

Evidence indicates that low pressure distribution systems are suitable for use in areas of rapidly permeable coastal sands, some inland soils with high water tables and some soils with restrictive horizons. However, it must be remembered that while these systems are effective in environmentally sensitive areas, they do have constraints that limit their application. One report indicated that these systems do not always operate properly in areas with high water tables. This was due to ground water infiltrating the pump chamber. Simply stated, low pressure distribution systems are not a cure all for site problems, but can perform better than typical septic systems when properly designed.[18]

FIGURE 1

LOW-PRESSURE DISTRIBUTION SYSTEM



Source: A Guide to Septic Systems and Alternatives, Virginia Water Resources Research Center.

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[16]Sevebeck and Kroehler, p. 27.

[17]Ibid.

[18]Peterson and Simpson, pp. 61-62.

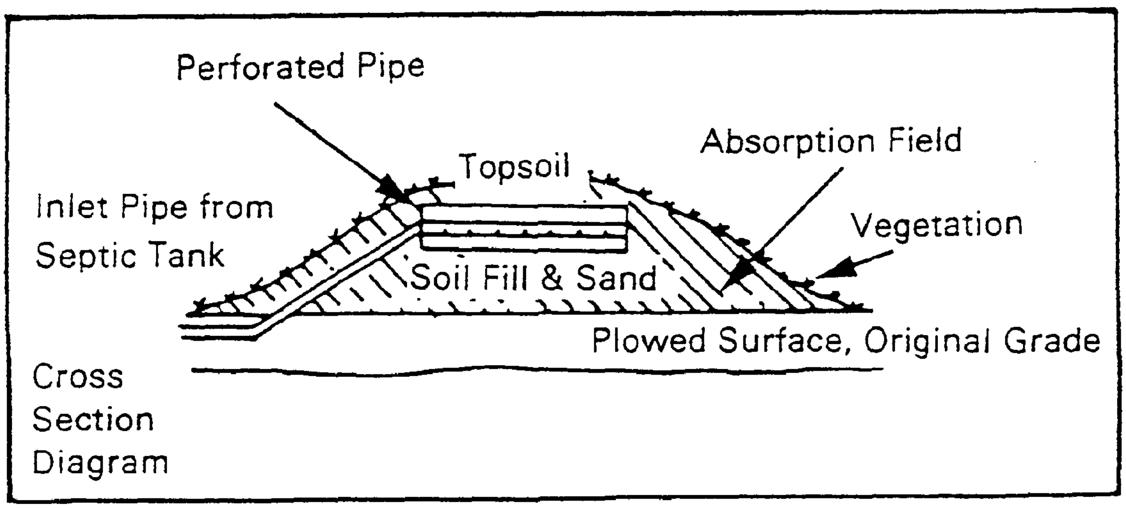
Elevated Sand Mounds

Another alternative is the elevated sand mound system. The elevated sand mound was developed to overcome several problems. These include high seasonal water tables, slow permeability of soils and shallow soil to bedrock.[19]

The sand mound system includes a traditional septic tank, but a mound of sand is used to raise the level at which the wastewater is disposed into the ground. In addition, there is a pumping chamber, an effluent pump, high-water alarm, supply line, perforated distribution lines and a mound made of sand covered with soil. The perforated pipe is placed in the sand mound. The purpose of this mound is to increase the amount of soil available to treat the wastewater. A two chamber septic tank or two tanks placed in series are sometimes recommended to reduce solids that may clog the distribution pipes.[20]

FIGURE 2

MOUND SYSTEM



Source: A Guide to Septic Systems and Alternatives, Virginia Water Resources Research Center.

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[19]Peterson and Simpson, p. 101.

[20]Sevebeck and Kroehler pp. 28-29.

The operating mechanism of a mound system requires periodic maintenance. In addition, the mound itself must be keep free of traffic and free of deep-rooted plants. Costwise, the mound system can cost two to five times more than a conventional septic system. Plus there are annual maintenance costs to pay.[21]

Mound systems have had problems. One evaluation in Pennsylvania found 51% of the mounds malfunctioning. The causes were related to poor site selection, system design and construction techniques, including improper, but cheaper, sand. Improper site evaluation often leads to insufficient separation between seasonal high water tables and impervious soils. Failure to pump out the septic tank also contributed to failures. A later study indicates that systems that are adequately sited, designed, constructed and maintained have fewer problems.[22]

Constructed Wetlands

Constructed wetlands are yet another alternative sewage treatment system. Constructed wetlands have been used in clay soils where percolation rates are very slow. In conjunction with sand mounds, constructed wetlands have been used in very wet soils. They have also been used where nitrogen contamination of ground and surface water was a concern due to their ability to denitrify wastewater.[23]

A constructed wetlands system begins with a typical septic tank. The septic tank removes coarse and heavy solids. To this is added one or more wetland "cells". Two cells are normally used in residential applications. These cells are basically constructed areas that contain wetlands plants growing in a medium.

Wastewater enters the first cell where it is distributed evenly across the width of the cell by a series of pipes and valves. This cell contains a plastic sheet liner on the sides and bottom which keeps the water from escaping. Wetland plants placed in gravel fill the cell. As the wastewater passes through the cell, suspended solids are filtered. Trace metals are absorbed by plants and organic material. Organisms in the wetlands, along with the roots of the plants, use these organic materials and nutrients as food. The plants provide the oxygen needed by the organism. Plant roots keep the rocks and soil loose so that water flows through them easily.

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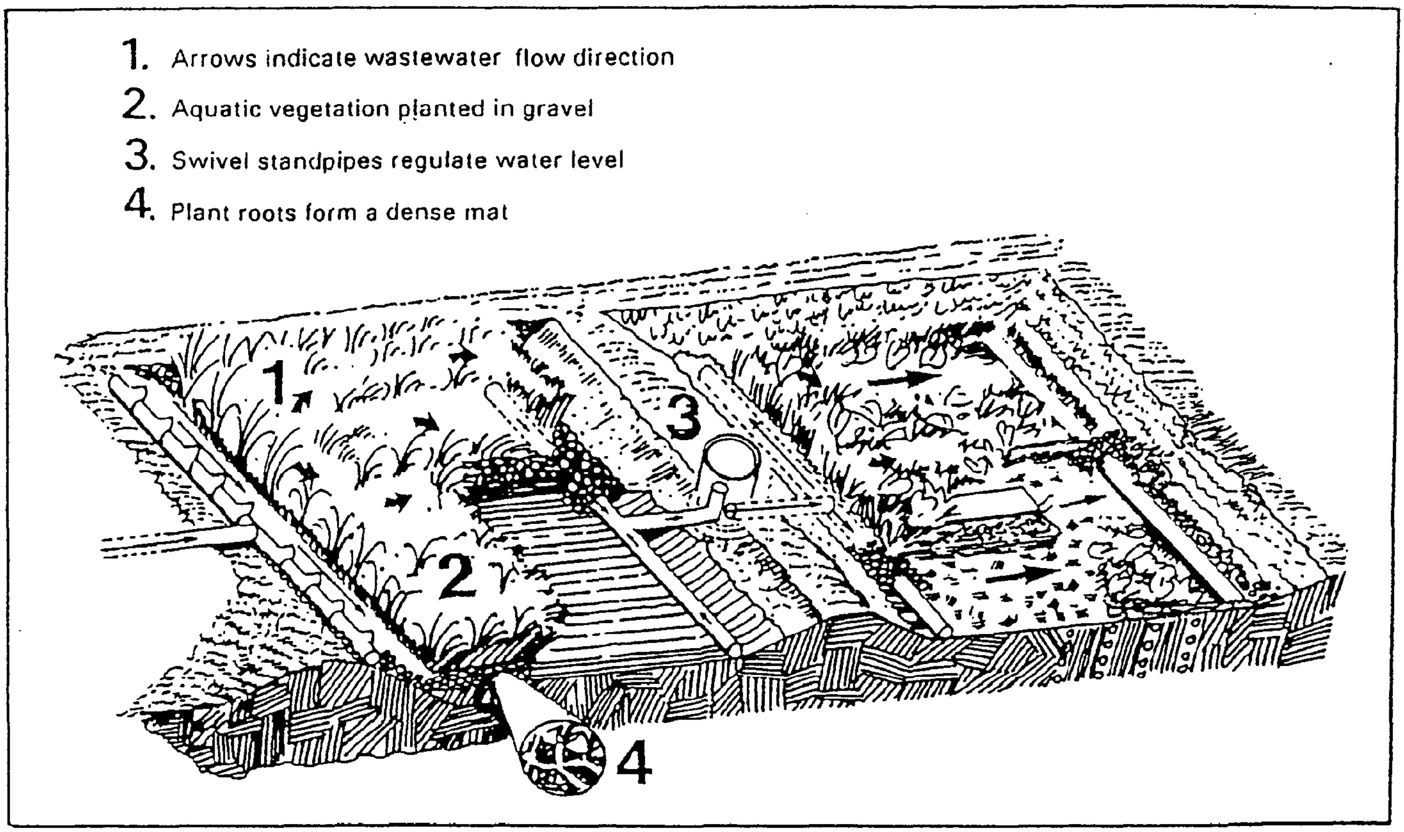
[21]Ibid.

[22]Peterson and Simpson, pp. 101 and 102.

[23]Peterson and Simpson, p. 190.

FIGURE 3

CONSTRUCTED WETLAND



Source: A Guide to Septic Systems and Alternatives, Virginia Water Resources Research Center. (Revised)

The wastewater then passes into the second cell which also contains wetlands plants in a layer of sand. Sand is used in the second cell to retain moisture and to aid the plants during dry periods. Again the water is distributed through a series of pipes. This cell is unlined, allowing the water to flow into the ground below. (Note: Constructed wetlands can be built as described or with a point source discharge or as a combination point source and non-point source discharge system. Where the wetland is designed to be a point source system, the second cell is lined.) They can be inexpensive to build and when compared to other alternative systems, are relatively maintenance free.[24]

There are limitations to the use of constructed wetlands. They should be constructed away from major streams and springs to avoid potential flooding and to avoid high water tables and saturated soils. The sites should also be flat or gently sloping.[25]

NEED FOR ADDITIONAL TESTING OF ALTERNATIVE SYSTEMS

The above discussion examined three types of alternative sewage treatment systems. While each has been used in Virginia and in other states, discussions with a variety of individuals indicates a general agreement that additional information is needed about these systems. Specifically, more information is needed about how these systems function in the various soil and water table conditions found in the coastal region of Virginia.

In order to find out additional information about the operation of these systems in the coastal plain, it has been suggested that one or more of these systems be tested in this region. These tests would involve actually installing one or more of these systems in the ground and operating the system for a prescribed length of time while testing the quality of the water in or around the drainfield. The purpose of the remainder of this paper is to discuss how such a test would be run and to examine the feasibility of funding such a test.

TESTING THE SYSTEMS

Testing an alternative sewage treatment system would involve several steps. These include the selection of the problem or limitation that needs to be overcome, the selection of a system to address this limitation, the selection of a site or sites to conduct this test and the design of the procedure to test the effectiveness of the system in dealing with the problem. Prior to doing any work, however, it would be imperative to meet with representatives of the Department of Health. Their assistance would be necessary to obtain the necessary permits. More

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[24]General Design, Construction, and Operation Guidelines: Constructed Wetlands Wastewater Treatment Systems for Small Users Including Residences, TVA/WR/WQ-91/2, March 1991, Water Resources River Basin Operations Resource Development, Tennessee Valley Authority, (Chattanooga, Tennessee), pp. 1-17.

Constructed Wetlands, Tennessee Valley Authority, Chattanooga, Tennessee. No date, no page number.

[25]Peterson and Simpson, p. 191.

importantly, their guidance and assistance during the process would ensure that the results of the test would be useful to the Commonwealth.

During the preparation of this report, the Department of Health showed much interest in the testing of one or more alternative systems. This interest is found both in the central office and from local environmental health managers. Unfortunately a lack of funding and staff has kept the Department from carrying out this research on its own.

Condition to be Examined

The first step in the test would be to determine what limitation or condition the test would attempt to address. Discussions with Health Department officials indicate that there are two problems that are normally encountered in attempting to install an on-site sewage treatment system in the coastal plain region. By far the most often encountered problem is a high seasonal water table. Another problem is clay soils. These soils can experience problems due to shrinking and swelling during dry and wet periods. In addition, clay soils can have low perculation rates. It would seem appropriate that sites with these limitations be found and that systems to overcome these limitations be tested.

Site Selection

Once the specific limitations to be examined are selected, a site would have to be chosen. Two options are available. A test could be conducted at an actual residence or at a site selected strictly for testing purposes. It appears that an experimental site is preferable over an actual residence. First, this gives the testing agency more latitude to control input. Second, there is the possibility that the alternative system may not function properly. This would mean additional expense to provide a properly functioning system for the homeowner, not to mention the inconvenience to the homeowner.

It has been suggested that a campus at one of the area's community colleges may be an appropriate site. Such a location would have a source of wastewater input as well as provide an opportunity for around the clock surveillance and access. The issue would be finding a site at one of these colleges that has the desired limiting factors.

Another alternative would be a site owned by a local government. This could be done in conjunction with a governmental facility or on a vacant piece of property. A vacant site would be preferable for the reasons stated above.

Yet another possibility is a parcel owned by a land developer that has not yet been developed. This would demonstrate the potential for the use of a system in close proximity to actual or potential home sites. This would also allow the developer to become involved in the test and may increase interest in one or more alternative systems in the development community. This is important if these alternative systems are ever to be used in more than limited applications.

System Selection

Once a site is selected, the specific type of system must be determined to meet the needs of the site and of the issues to be tested. As stated previously, each system has its strengths and weaknesses when dealing with the various factors that warrant the use of alternative systems.

System selection will be influenced by the funds available to test the alternative systems. The costs of these systems vary.

Finally, the type of system selected may be impacted by the amount of interest shown in the system. This report has discussed three types of systems, but there are several other types of alternatives available. As stated before, each has its supporters and detractors. It may be a particular system is selected first for funding or other reasons. In that case, a site would need to be selected that provides the appropriate type of conditions for the selected system to attempt to overcome.

Test Design

The next step would be the actual design of the test. This includes decisions about the length of the test, the number and depth of the monitoring wells, how to provide influent to the system and the number and timing of the test samples that will be collected. Following are some broad guidelines that can be used to begin to think about this phase of the process.

Ideally, there would be three phases to the test. The first step would be to examine ground water quality at the site before installation of a system. While this is not always done, due to funding limitations, obtaining information about pre-test conditions is strongly recommended. The second phase would be the actual installation of the system. The final step is the actual operation and testing of the output of the system under simulated residential usage.

In developing a testing procedure, it is important to remember that the State does not have specific standards for wastewater effluent with regard to its impact on ground water. Therefore, any testing should attempt to test the relative effectiveness of a system to treat wastewater. In other words, the test should compare the quality of water coming into the system (the influent) with the quality of water leaving the absorption field (the effluent). From this, conclusions can be drawn about the ability of a system to treat wastewater.

Testing is usually done by taking water samples from a series of monitoring wells. While the exact number of wells varies based on the type of test being run, the topography of the site and funding, it is recommended that at least two to four wells be dug. Many times these are very shallow wells, with a depth of approximately six feet. On occasion, wells eight to ten feet are professionally dug.

The influent and effluent of the system is sampled for a variety of contaminants. These are fecal coliform, ammonia, nitrates, nitrites, BOD (bio-chemical oxygen demand), suspended solids, orthophosphate, pH and TKN (total kjeldahl nitrogen). Again, it is important to determine exactly what you are trying to evaluate in order to determine what tests need to be run.

Decisions also need to be made about the length of the testing period and the frequency of testing. While recommendations vary, it is important to take sufficient samples to properly test the performance of the system. Ideally tests of pre-installation conditions should be run for a period of 3 to 6 months to establish base data. Water samples should be taken at least every 2 weeks at the beginning of the testing period. It may be possible to reduce testing time to once per month if there is no variability in results.

During the actual testing of effluent, it is necessary to test water samples every one or two weeks. Again, if there is no variability in samples, it may be possible to reduce testing to once per month. If there is a considerable amount of variability during first the 18 months, additional sampling may be necessary.

The actual period of testing should be a minimum of 18 months. Preferably, the test should be run for a longer period, with 36 months being a preferred length.

The important point to remember before developing any testing scheme is to be sure what the test is attempting to accomplish. Clear goals are needed regarding the purpose of the test. The main reason for testing any sewage treatment system is to determine the performance of the system. The principal issues that need to be examined are how effective is the system in treating the wastewater and/or how effective is the system in disposing of the wastewater.

PROJECT COSTS

The total cost of the project will be based upon three factors--the goals of the monitoring program, the type of system being tested and the number and frequency of water samples that are taken for testing. As stated previously, alternative treatment systems can cost between $7,500 and $15,000. Testing can cost $1,000 per month and more. Therefore, a test of alternative systems could cost $50,000. This is a substantial amount of money. However, the results of this test would add greatly to the body of knowledge available about alternative systems.

FUNDING THE PROJECT

Funds for testing alternative sewage treatment systems in Virginia are almost non-existent. While the Department of Health wants and needs additional information about such systems, their resources are stretched to the limit. Anyone contemplating any funding from that Department will find much enthusiasm, but little or no money.

Virginia Polytechnic Institute and State University does conduct tests similar to what is being proposed. It may be possible to work with Virginia Tech to arrange full or partial funding for such a test.

Funding from a non-profit organization such as an environmentally and/or water quality focused organization may be possible. During the course of the investigation, one such agency was approached about funding such an activity. Unfortunately funds were not available. However, there are agencies that have a high level of interest in protecting water quality that may be of assistance. The Virginia Environmental Endowment may be one such agency.

Another possible source of funding is the private sector. While there may be funds available, preliminary inquiries again turned up much enthusiasm for such a project, but limited funding possibilities.

One area investigated was manufacturers of the equipment used to construct alternative systems. It was discovered that these systems are essentially a collection of pumps, piping and other materials that are put together by the installer. There is no real alternative system "industry". The large, well funded corporations that fund experiments for other types of wastewater testing do not exist. Since most of these parts are made by small manufacturers and/or by companies that sell the parts for a variety of applications, there appears to be little interest or capital available from this sector.

Another possibility is the home building industry. Developers are looking at ways to construct homes in a variety of locations. Some of these are without public sewer and are marginal when it comes to the installation of traditional septic tanks. Funding from this source may be possible.

PROJECT PARTICIPATION

While finding financial support for testing these alternative systems is very important, and will be difficult, there is another type of support that must be garnered. That is the support of the various agencies and groups that will contribute to public acceptance of alternative sewage treatment systems. The needs and concerns of these groups have to be addressed before and during the testing period.

The Department of Health must be involved from the beginning. The Department continues to show great interest in testing alternative systems and, as the preparation of this report has shown, the Department is willing to help with efforts to expand the information available concerning these alternative systems. Their involvement in any testing is vital.

Another group that will need to be included in the testing process is the development community. This includes developers, builders and realtors. These individuals must be given a chance to see how these alternative systems are installed and how they function. It is important that this segment of the community understand and have confidence in alternative systems. If they do, they will be more likely to support the use of these systems and recommend these systems to potential home owners.

Local officials must also be involved in this process. As with the development community, local elected and appointed officials must become comfortable with these alternative systems. If they are not, local governments are less likely to approve new developments that depend on these alternatives systems for sewage disposal.

Finally, the individuals in the community that will be installing these systems in the years to come must see and understand these alternative systems. These individuals must understand these systems and support them. If they do not, the likelihood of local acceptance is reduced.

Therefore, any testing program must be widely publicized. Efforts must be made to involve the parties mentioned above. They should be involved from the beginning. Furthermore, the installation process must include time for these groups to see how these system are actually constructed, from ground breaking to final completion. These groups should also be involved in the testing phase. They need to understand why the testing is being conducted, what the results are and what these results mean.

It may be appropriate to form a technical advisory committee with representatives from these various interest groups as part of the test procedure. This advisory committee could be involved in decision making regarding the test. It could also help publicize the results of the test. The more local people are involved and understand the strengths and limitations of these alternative systems, the more they are likely to support to use of these systems in they future.

CONCLUSION

This paper has examined the issue of alternative on-site sewage treatment systems. It has also examined the feasibility of testing one or more systems to find determine their suitability in the coastal plain region. Several conclusions can be drawn based on the information presented.

1. Septic tank/drainfield systems are, and will continue to be, the system of choice for most people. This is due to the low installation costs, low maintenance costs and relative ease of operation.

2. Septic tanks are highly effective, but will not work in every situation.

3. Alternative sewage treatment systems expand the options available to land owners by permitting development on sites where traditional septic systems cannot be located or have failed.

4. Of the variety of alternative systems exist, the types of systems most commonly mentioned during the preparation of this paper were low pressure distribution systems, elevated sand mound and created wetlands.

5. While alternative systems have been tested before, there is substantial interest in testing these systems further to determine their effectiveness under varying conditions in Virginia, especially in the coastal plain region.

6. Any testing of such systems should involve both the Department of Health, local officials, land developers and installers.

7. Public money for additional testing is in very short supply and may not be availalbe. Private funds may be available, but this is not certain.

8. Any effort to fund additional testing will require a concerted effort to involve public regulators, local governments, private installers, land developers and realtors in the testing process.

Hopefully this paper will stimulate interest in this activity. It is especially hoped that funding from one or more agencies or individuals can be arranged to carry on this vital research.

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