Pipeline

Winter 1999
Vol. 10, No. 1

National Small Flows Clearinghouse

Small Community Wastewater Issues Explained to the Public

SPRAY AND DRIP IRRIGATION FOR WASTEWATER REUSE, DISPOSAL

Did you ever wonder how golf courses keep their large fairways looking so lush, healthy, and green all season long? The answer may surprise you.

In many communities in the U.S. and around the world, treated wastewater is reused to irrigate golf courses, lawns, landscaping, forests, and even crops. Because water is such a precious commodity, recycling wastewater can have both economic and environmental benefits for communities. Irrigation also can be the most practical and environmentally-friendly way communities can dispose of treated effluent from wastewater treatment plants and individual home systems.

Better for the Environment

Currently, the most common way community treatment plants dispose of wastewater after treatment is to discharge it to surface waters. However, as populations grow, the burden to local streams and rivers is increasing. Reusing wastewater to irrigate land can help protect precious surface water resources by preventing pollution and by conserving potable water for other uses.

Another benefit of applying wastewater to land is that the soil provides additional treatment through naturally occuring physical, biological, and chemical processes. Irrigating with wastewater also adds nutrients and minerals to soil that are good for plants, and it helps to recharge valuable groundwater resources.

A Solution for "Problem" Sites

Irrigation systems often can be used in place of soil absorption fields (drainfields) to provide final treatment and disposal of wastewater from individual onsite systems, such as septic systems and home aerobic treatment units. As the demand for land in rural areas is increasing, more sites are being developed in places previously considered unsuitable for onsite systems. Irrigation sometimes is permitted as an alternative wastewater disposal method for difficult sites, such as areas with slowly permeable soils, shallow soils, or complex topographies.

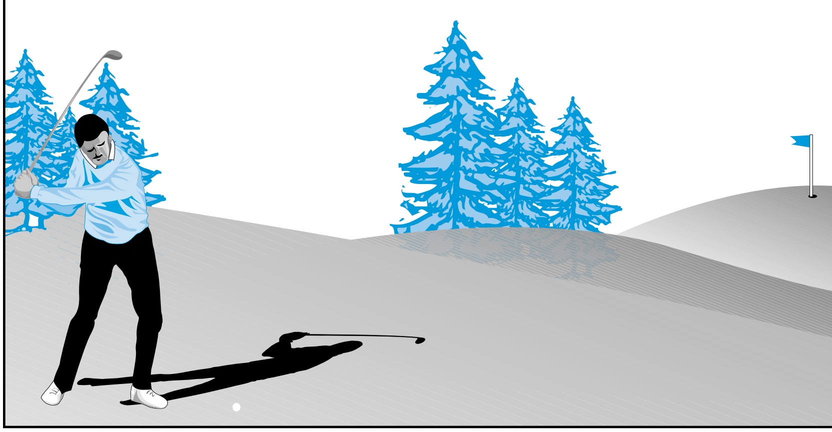
This *Pipeline* issue provides a brief overview of two types of wastewater irrigation systems—spray systems and subsurface drip systems—how they work, their advantages and disadvantages, and when they may be a good option for homes, businesses, and communities. Operation and maintenance issues also are discussed.

Readers are encouraged to reprint *Pipeline* articles in local newspapers or include them in flyers, newsletters, or educational presentations. Please include the name and phone number of the National Small Flows Clearinghouse (NSFC) on the reprinted information and send us a copy for our files.

If you have any questions about reprinting articles or about any of the topics discussed in this newsletter, please contact the NSFC at (800) 624-8301 or (304) 293-4191.

Treated wastewater can be reused to irrigate . . .

- lawns;
- parks;
- landscaped areas around offices and industrial developments;
- landscaped areas around residences;
- pasture grass;
- highway medians;
- golf courses;
- cemeteries;
- forests;
- trees, corn, alfalfa, and other feed, fodder, and fiber crops; and
- food crops.



Is irrigating with wastewater a good option for your home or community?

If you live in an area where water must be conserved or is expensive, or where other options for disposing of wastewater are restricted, then reusing wastewater for irrigation may be a good option for your home, farm, business, or community. It also can be a good choice simply because it is an efficient use of local resources.

In arid climates, such as in Arizona, New Mexico, and parts of California, for example, or where the demand for water threatens to exceed the supply, as it does in parts of Florida, many homes and businesses could not afford to maintain grass lawns or landscaped areas without reusing wastewater. In Hawaii, treated wastewater is used to irrigate pineapples and sugar cane to save money and conserve fresh water for other uses.

Irrigation also can serve as an alternative onsite disposal method for lots deemed unsuitable for conventional septic tank/soil absorption systems. Because irrigation systems are designed to deliver wastewater slowly at rates beneficial to vegetation, and because the wastewater is applied either to the ground surface or at shallow depths, irrigation may be permitted on certain sites with high bedrock, high groundwater, or slowly permeable soils. Irrigation systems also can be designed to accommodate sites with complex terrains.

Local governments sometimes choose to reuse wastewater from community treatment plants for irrigation, rather than discharging all of it to local surface waters. Irrigation can help communities to save money or avoid exceeding surface discharge permit limits, while preserving the quality of local water resources for drinking water, aquatic life, and recreation. Some communities even have two separate distribution systems—one for potable water and another for reclaimed water for watering lawns and other irrigation needs.

Is it safe?

Irrigating with wastewater is safe when all federal, state, and local regulations regarding its treatment and use are strictly followed. When regulatory requirements are met, the wastewater returned to the environment after irrigation usually is higher quality than the wastewater discharged from treatment plants due to the additional treatment provided in the soil.

Regulations protect public health and the environment by requiring that wastewater always be pretreated prior to irrigation and by restricting its quality, use, and the manner and location of its application. Cumulative levels of nutrients, salts, heavy metals, and disease-causing organisms also must be monitored in the soil at some sites.

Regulations Vary

Wastewater reuse is not permitted everywhere. Regulations vary from state to state and sometimes from community to community. State and local governments may have additional or more stringent requirements than the federal regulations.

Community residents can contact local health agency officials to find out about regulations in their area. The National Small Flows Clearinghouse (NSFC) also offers information about federal and state regulations. *(Refer to the contacts list on page 7 and the products information on page 8.)*

Pretreatment Is Required

After wastewater receives primary and sometimes secondary treatment in a community treatment plant or individual onsite treatment system, additional treatment steps often are required prior to irrigation to reduce the amount of suspended solids and organisms in the wastewater. Both can pose a threat to public health and clog systems. Microorganisms, such as bacteria, can collect or multiply and create slime that clogs systems. Pretreatment also minimizes odors in wastewater, so there is less potential for creating a public nuisance and attracting animals that can spread diseases.

Different degrees of pretreatment are required for the wastewater depending on how it will be used and the intended method of irrigation. For example, standards are more rigorous for surface irrigation methods, such as spray irrigation, and when irrigating food or feed crops or land intended for public use. Biological pretreatment to remove organic matter from the wastewater is followed by filtration, to remove small particles from the wastewater, and disinfection.

Subsurface drip irrigation systems also employ filters mainly to protect against system clogging. Additional treatment may be necessary to protect the receiving environment and may include secondary treatment plus disinfection. This adds to the cost of building, operating, and maintaining systems, which should be considered when determining whether irrigation is a practical wastewater disposal option.

Site Conditions Are Important

Not all sites are appropriate for wastewater application. Communities wishing to dispose of wastewater from treatment plants through irrigation sometimes must purchase or lease suitable land for disposal or enter into cooperative arrangements with local farmers or landowners. Sites near surface water or high groundwater often are restricted, especially when these are used as drinking water sources. Regulations typically require minimum separation distances or buffer zones from ground and surface water resources and public areas to minimize contact with wastewater.

Other important site selection criteria include the type of soil, soil wetness, slope, drainage patterns, and local climate, including rainfall amounts and evaporation rates. In areas that have cold or wet weather part of the year, wastewater often must be stored in lagoons or holding tanks until irrigation is needed. Some irrigation equipment also can freeze in very cold weather.

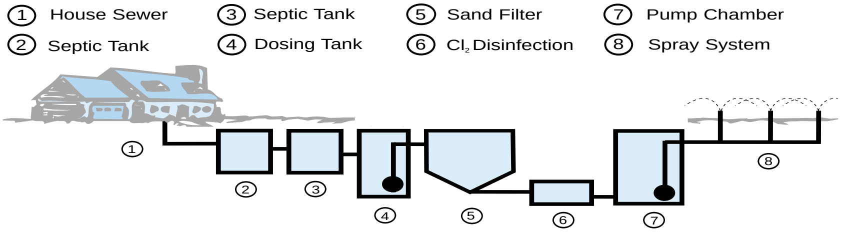
Maintenance Is Necessary

All systems, including irrigation systems, have operation and maintenance requirements. These include periodic checking and cleaning of filters, checking valves, pumps, and timers, and, in some cases, monitoring wastewater quality and its impact on soils. Large systems serving farms, businesses, or communities often have operators, but most systems are at least partially automated.

Although spray and subsurface drip irrigation systems serving individual homes may only need maintenance about once or twice per year, homeowners should consider that these systems will require more attention than conventional onsite systems.

Spray Systems Irrigate Lawns, Parks, Crops

Example residential spray system schematic



Spray irrigation is an efficient way to nourish plants and apply reclaimed wastewater to land. Some spray systems are very similar to potable-water sprinkler systems used to irrigate lawns. Others are specifically designed for agricultural applications.

While there are many possible spray system designs, they all work by distributing treated wastewater across the soil surface. Systems should be designed by qualified professionals who have specific experience working with irrigation systems.

System Design

Because spray systems apply effluent above-ground, the wastewater must be treated to a high enough level to protect public health and reduce odors. In general, regulations require that effluent used for surface irrigation at least meet secondary treatment standards plus disinfection.

With spray systems, therefore, after primary treatment in a septic tank or community treatment plant, the wastewater usually goes to a home aerobic treatment unit, sand filter, recirculating sand filter, or other filter, and then to a dosing tank or pump chamber. The wastewater is then disinfected with chlorine, ozone, or ultraviolet light before it is stored in a lagoon or holding tank for later use or just prior to its application to land. In some community systems, aerated or facultative lagoons provide treatment as well as additional storage area for the wastewater.

After treatment, filtration, and disinfection, a pump equipped with timers sends the wastewater under pressure through the mains and lines of the spray distribution system at preset times and rates as needed for irrigation. The area to be irrigated (the spray field) can be sloped up to 30 percent, depending on local regulatory requirements, but must be vegetated and landscaped to minimize runoff and erosion.

Chlorination is the most common disinfection method used with spray irrigation. One common chlorinator design accepts chlorine tablets or powder; another doses liquid chlorine into the wastewater. With chlorination, adequate contact time is necessary to allow the chlorine time to kill harmful bacteria and other pathogens.

A holding tank or lagoon is another necessary component in most spray systems, because storage space allows operators to adjust application rates, if needed. In some onsite systems that employ a recirculating sand filter, the recirculation tank serves as the storage tank. However, spray systems in cold or wet climates may need to store 130 days of design flow or more. Systems may be permitted to apply wastewater only certain months of the year, or they may be required to include subsurface drainage to help prevent runoff and erosion during wet weather.

Large community systems sometimes reduce the amount of storage area they need by obtaining controlled discharge permits, which allow them to release wastewater to surface water in winter or during times of high stream flows.

Spray Equipment

There is an impressive array of high-tech spray equipment available for irrigating crops. Some consist of series of sprinkler heads mounted to elevated distribution pipes, which move across fields either laterally, by means of drive units at both ends of the pipe (called linear move), or in a circular motion from one fixed end (called pivot move). The height and amount of pressure with which the spray nozzles emit wastewater can be adjusted. Systems even can be programmed to adjust application rates for different parts of the field and to shut off automatically during rain or high winds. And some can be operated remotely.

Another design used to irrigate row crops, called a portable irrigation reel, is a little less high-tech. It consists of a hard plastic hose wound to a drum reel. One end of the hose is attached to a portable sprinkler cart, which is pulled away from the reel during setup, and the other end of the hose is attached to a hydrant. A motor or turbine rewinds the reel and crops are irrigated as the sprinkler cart moves along the uncultivated irrigation paths, which must be kept clear for this purpose.

There also is a variety of sprinkler designs for irrigating smaller field crops, lawns, and landscaping, which are similar to potable-water lawn sprinkler systems. The sprinklers can be fixed (called solid-set) or moveable, buried or above-ground, and some designs are telescoping to adjust the height of application to fit the height of the plants. Other variations exist in the amount of pressure and manner in which the wastewater is released from the sprinklers—examples include full circle, partial circle, gun, and microspray. Different pressure amounts are appropriate for irrigating different plant types. Individual home systems use low trajectory sprinklers to minimize aerosol production.

Fixed, buried sprinkler systems usually are among the most expensive designs to purchase and install, but they have certain advantages. They are less likely to be vandalized or accidently damaged and they make maneuvering farm equipment and lawn mowers easier. However, some moveable system components can be stored indoors in the winter. Most spray system designs include valves and controls that allow operators or homeowners to adjust the flow to certain areas of the spray field. Some larger systems have both automated and manual controls.

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Some Advantages of Spray Systems Include . . .

- When properly designed, installed, and operated, most spray systems provide uniform distribution of wastewater to plants and eliminate discharge to streams.
- Above-ground irrigation is needed for some germinating plants.
- Spray irrigation increases levels of nitrogen, phosphorus, and minerals in the soil.
- Above-ground spray system components are easier to inspect, control, and service than subsurface drip irrigation components.
- When performed during the heat of the day it has a cooling effect on some crops and decorative landscape plants.
- Evaporation contributes to the rate of wastewater disposal.

Some Disadvantages of Spray Systems Include . . .

- Spray systems generate aerosols, which can pose a threat to public health. Therefore, regulations typically require large minimum setback distances, buffers, and other restrictions that make spray systems inappropriate for small lots.
- Wet soil surface promotes weed growth, making some crops and landscaping difficult to maintain.
- Wet soil surface makes weeding, harvesting, and operating lawn mowers and farm equipment more difficult.
- Applications of insecticides and fungicides to crops must be scheduled carefully between spray irrigation applications to allow maximum contact/ exposure times.
- Above-ground spray equipment is exposed to the elements and can be accidentally damaged or vandalized.
- Bacteria tends to survive better in wet, cool soil conditions.

Spray Systems Irrigate Lawns, Parks, Crops

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Setbacks and Buffer Zones

To guard against the possibility that drifting aerosols and runoff created by spray irrigation systems will reach and contaminate nearby public areas and water resources, regulations typically require considerable minimum setback distances or buffer zones to nearby residences, property lines, public areas, wells, streams, rivers, lakes, and wetlands. Minimum setbacks of as much as 150 to 500 feet from neighboring residences and water sources are not unusual, depending on local regulations. Buffers also may be required from water lines, embankments, drains, drainage ditches, and public rights of way. A minimum vertical separation distance to the water table also applies.

Because of these setback requirements, spray systems tend to be mainly practical for irrigating crops, fields, and larger land areas or home lots.

Operation and Scheduling

Unlike traditional irrigation systems whose sole purpose is to deliver water to plants, several additional factors must be considered when managing wastewater irrigation systems. The timing and rate of wastewater application must be designed so that plants benefit as much as possible from the nutrients and other constituents in the wastewater without being overwhelmed by them. In addition, there is the potential that certain wastewater constituents may accumulate in the soil and plants over time and become toxic to the plants, clog the soil, or alter the soil structure.

For example, too much nitrogen can result in nitrate accumulation in crops, but too little can result in reduced yields. If evaporation regularly exceeds precipitation, too much salt may remain in the soil, which can damage roots. The particular characteristics of the wastewater must be considered in relation to such factors as climate and the individual nutrient requirements of the crops, grass, or landscape plants selected.

In addition, the need to dispose of the wastewater has to be balanced with the needs of the plants during various stages of growth and the hydraulic capacity of the soil and its ability to effectively provide treatment.

Farmers must schedule irrigation times and rates carefully, always adjusting for different rainfall and evaporation amounts. Some use devices, such as tensiometers, to measure soil wetness, and rain gauges and pan evaporation tests to keep track of irrigation needs. Spray irrigation of crops also needs to be scheduled around applications of pesticides and fungicides to plants.

Scheduling the irrigation of other types of spray fields is usually less complicated. Unrestricted public access sites, such as the lawns of homes or businesses, landscaping, parks, highway medians, and golf courses, often are irrigated only at night or during off-hours to minimize the potential for public contact with the wastewater. Small systems and systems serving individual homes often are designed to apply a set amount of wastewater twice a week or so at predetermined rates and times. The system designer estimates the amount needed based on records showing average precipitation and evaporation rates in the area. Homeowners usually can adjust or override the pump settings if needed.

If a system is designed and sized primarily for wastewater disposal, the loading rates permitted for the wastewater may be below the irrigation needs of the plants. Therefore, additional water may be required for irrigation with some systems.

Monitoring and Maintenance

The pump, disinfection system, and spray heads in spray irrigation systems require regular maintenance. For example, the chlorine tablets in chlorinators need to be replenished regularly—approximately once per month for home systems. Open pipes and spray heads can become damaged, plugged, or frozen. Any changes in pressure in the system can alter the spray patterns in the field, so spray patterns should be tested to ensure that the system still complies with all setback requirements.

Other monitoring requirements vary depending on state and local regulations, public access to the site, and system size. In some systems, regular daily or weekly monitoring is needed to check influent and effluent quality, system storage capacity, wind speed and direction, signs of ponding or runoff in the spray field, and depth to water table. Cumulative levels of nutrients, heavy metals, fecal coliforms, and other wastewater constituents must be monitored in the soils (and groundwater) at some sites once or twice per year.

Subsurface Drip Irrigation Systems Have Many Advantages

Drip irrigation systems (also known as "trickle" systems) are another efficient and proven technology many small communities can chose to recycle and dispose of wastewater. Drip irrigation technology using treated wastewater is used in Israel and throughout the world as a way to conserve water resources. These systems require less water than spray systems to irrigate plants, and the technology has been used for more than 30 years for various agricultural and landscape applications.

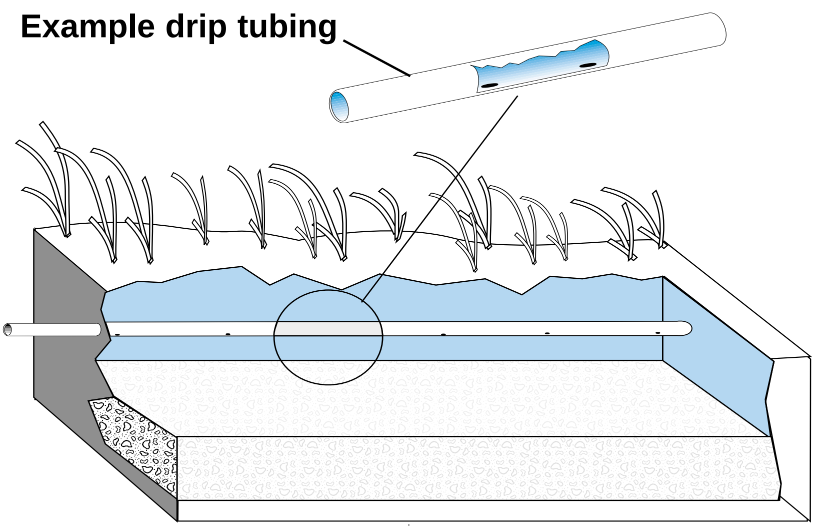
Subsurface Drip Systems Deliver Effluent to Plant Roots

With drip systems, treated wastewater is applied to soil slowly and uniformly from a network of narrow tubing (0.5- to 0.75-inch diameter), usually plastic or polyethylene, placed either on the ground surface or below ground at shallow depths of 6 to 12 inches in the plant root zone. The wastewater is pumped through the tubes under pressure, but drips out slowly from a series of evenly-spaced openings. The openings may be simple holes or, as is the case in most subsurface systems, they may be fitted with turbulent flow or pressure-compensating emitter devices. These emitter designs are proprietary and vary depending on the manufacturer of the system. *(The graphic below is meant to illustrate a generic subsurface drip tube design.)*

Drip system emitters are designed to ensure that the wastewater is always released at the same slow rate at atmospheric pressure, even though the water pressure inside the tubes can range from 5 to 70 pounds per square inch (psi) during a dosing cycle. However, most systems are engineered to maintain relatively consistent pressure inside the tubes, usually about 20 psi. The pressure-compensating feature of emitters allows drip irrigation lines to be installed at different elevations at a site while maintaining uniform flow.

Because subsurface drip systems release wastewater below-ground directly to plant roots, they irrigate more efficiently and have advantages different from those of surface irrigation systems. For example, the soil surface tends to stay dry, which means there is less water lost to evaporation and there is almost no opportunity for the wastewater to come in contact with plant foliage, humans, or animals. Also, percolation losses are reduced because the wastewater is applied to a wide area of soil at a slow rate directly to plant roots.

In addition, in drip systems the wastewater is delivered to the most biologically active part of the soil, which enhances treatment and minimizes the possibility of groundwater contamination. The constant moisture in the root zone also may increase the availability of nutrients to plants, reducing the delivery of nitrogen to groundwater. *(Refer to page 6 for a list of some advantages and disadvantages of subsurface drip systems.)*



Other System Design Elements

As with spray irrigation systems, wastewater must be pretreated prior to drip irrigation to protect public health and the environment and to prevent systems from clogging. Settleable and floatable solids are removed by primary treatment, which may take place in a community treatment plant or lagoon or on individual home lots in a septic tank or home aerobic treatment unit. Primary treatment always is followed by filtration in a particle-size filter to protect the tubing from clogging.

In most systems, effluent flows to a tank or pump chamber equipped with controls, where it is stored until a predetermined dosing volume is reached. All drip systems are equipped with a filtration system before the distribution system, such as a series of disc filters or mesh screen filter membranes, to remove small suspended solid materials from the wastewater that can clog tubes and emitters. Some systems also include a disinfection step to protect public health.

The U.S. Environmental Protection Agency approves the use of the chemical trifluralin to prevent root intrusion into emitters, although some states may not permit it. One manufacturer of drip system tubing incorporates a chemical barrier to root intrusion directly into the tubing material itself. However, the consistently wet conditions in the soil and the pressure compensating emitter design discourages root growth into the distribution lines.

The distribution system in subsurface drip systems usually includes a mainline, submain, and narrow drip laterals with emitters. The total length of drip tubing will depend on the restrictiveness of the site, the area needing irrigation, and the amount of storage space available. The laterals normally are installed in narrow trenches (approximately 10 centimeters wide) dug with a vibratory plow. Because of the flexibility of the laterals and their shallow placement, drip lines can be laid around trees and other topographic features with little disturbance to the site.

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Advantages of Subsurface Drip Systems Include . . .

- Water and nutrients are delivered directly to plant roots.
- Less water is required when irrigating with drip systems than with spray systems and other suface irrigation methods.
- Wastewater is distributed more evenly with drip systems than spray systems and open irrigation trenches.
- Evaporation losses and weed growth are reduced because the soil surface remains dry.
- Operating lawnmowers and farm equipment is easier because system components are buried and the soil surface stays dry.
- There is no aerosol generation and no wastewater contact with plant foliage.
- Crops irrigated with drip systems can be harvested sooner than when irrigated with spray systems.
- Fewer problems exist with odors, ponding, and runoff.
- There is less chance of wastewater carrying additional chemicals, such as pesticides and fungicides, from the ground surface to groundwater.
- Studies suggest nitrogen in wastewater may be better absorbed by plants and less likely to pollute groundwater when applied directly to plant roots.
- In some cases, fewer pretreatment steps are required for wastewater with drip systems.
- It is less likely that subsurface drip components can be accidently or intentionally damaged.
- Flexible tubing can accommodate sites with complex topographies.
- There are generally fewer operation and maintenance requirements than with spray systems.

Disadvantages of Subsurface Drip Systems Include . . .

- Emitters can potentially clog, affecting the uniformity of application.
- Temporary use of sprinklers or other surface irrigation may be necessary during plant germination period.
- It is difficult to monitor and correct potential emitter clogging.
- Effects of freezing temperatures on drip systems and applying wastewater to frozen ground is still the subject of study and debate.

Subsurface Drip Systems Have Many Advantages

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The submains supply the amount of water required by the individual laterals it feeds, and valves are located between the main and the submains to control the flow of water to different parts of the system.

Clogging

Drip system emitter clogging was more of a problem in the past than it is today. Root intrusion into the drip tubing and internal clogging from the buildup of sediment, suspended solids, algae, and bacterial slime have been diminished greatly by better pretreatment, filtration, disinfection, and new tubing and emitter designs. Most systems allow weekly or biweekly forward flushing of the tubes to scouring velocity to remove slime and sediment buildup.

The size of the emitter orifices also is important to prevent clogging and should range from four to six times the maximum size of the particles that can pass through the mesh of the filter screen preceding the distribution system. For example, a system using a filter screen size of 115 microns (140 mesh) should have emitters approximately 800 microns in diameter to achieve about a six-to-one ratio.

When even a few emitters do clog, it can affect the pressure inside the tubes and the uniformity of wastewater distribution in the field. It also may be difficult to identify and service buried emitters that clog. And like traditional soil absorption systems used with septic systems, saturation of the soil around the emitters of a drip system can eventually lead to the formation of a biological clogging mat, which can cause system failure. However, in general, subsurface drip systems are considered to be a manageable and reliable technology.

Filters on all drip systems need to be checked and periodically backflushed or cleaned. Backflushing reverses the water flow through the lines and the filters to release trapped sediments. Some systems can be set up to backwash automatically at preset intervals, or operators can do it manually as needed. The wastewater flow needs to checked periodically to determine if any emitters are plugging. If a scale buildup develops on emitters, an acid treatment may be necessary.

Setbacks and Buffer Zones

As with spray irrigation systems, regulations typically require that drip systems be installed at minimum distances from nearby residences, property lines, public areas, wells, surface water resources, and groundwater. However, because drip systems deliver wastewater below ground and do not produce aerosols, buffer zones of 25 to 50 feet are generally required to neighboring residences—considerably less than is required for spray systems, making drip disposal more practical for smaller home lots.

Operation, Maintenance, and Scheduling

As with spray systems, drip irrigation must be scheduled so that plants benefit from the nutrients and other constituents in the wastewater without being overwhelmed by them, and the needs of the plants must be balanced with the capacity of the soil to treat the most restrictive components in the wastewater. These concerns must be balanced in turn with climate and other site factors.

Less labor usually is required for operating and maintaining fixed subsurface drip system components as compared to spray systems and surface drip systems with moveable components. For small and individual home systems, the pattern of flow may be fixed or adjusted manually or automatically by the homeowner or operator, depending on the system design and sophistication. In general, the best care for subsurface drip systems is provided by following the individual manufacturer recommendations.

Some communities may require homeowners and small system owners to maintain a service contract with an authorized manufacturer's representative to ensure appropriate monitoring and maintenance. Larger systems often have full-time operators to maintain and service systems and to control the pattern of wastewater flow to irrigate different crops or fields. Some systems can be operated and monitored remotely through telemetry.

Refer to the list of NSFC documents on page 8 and the list of contacts on page 7 for more detailed information on subsurface drip systems.

Wisconsin Drip System Is an "Educational Opportunity"

If you were to pinpoint the center of Wisconsin on a map, you just might find Nasonville Elementary School. Located in the rural Marshfield School District, in the middle of dairy country, Nasonville has plans to consolidate with another local school adding 67 students to the 95 currently enrolled. But before health officials would approve the additional students, the school needed to upgrade its old wastewater system.

"In our part of Wood County, we have some of the densest clay soils ever seen," explained Paul Rodenbeck, the school district's building and grounds director. "For years, the school's wastewater system consisted of a septic tank that discharged across an open field. Because of the difficult local site conditions (heavy silt loam over massive clays), our options for upgrading were somewhat limited."

Holding tanks are the only new onsite wastewater systems being permitted in the area. But Rodenbeck, a former municipal wastewater treatment plant operator, was inspired to research possible onsite wastewater treatment alternatives for the school.

One option that may have been appropriate for Nasonville was a mound system, but the school was not keen on the way it might look on the school grounds, the earthwork involved, or the prospect of having to mow it. Repair costs were another concern. "Even if only one part of the system needs to be repaired, the mound has to be dug up," Rodenbeck said.

Rodenbeck's inquiries led him to work with Duane Grueul of the Wood County Planning and Zoning Department. Grueul suggested several area design firms that have experience with onsite systems. He also introduced Rodenbeck to Dr. James Converse of the University of Wisconsin's Small Scale Waste Management Project, one of the first research programs in the country to study onsite systems.

The firm the school chose for the project, Ayres and Associates of Madison, worked together with Dr. Converse, Grueul, and Rodenbeck to design a solution for the site—namely, a subsurface drip system. The system was installed in August 1998 and is part of the University of Wisconsin's research project.

"Because we are working with the university, we were able to get an experimental permit for a drip system," Rodenbeck said. "Graduate students from the university regularly monitor the system's performance, which is good for us and an educational opportunity for them."

Nasonville's new system is sized to handle 2,500 gallons of wastewater flows per day, which is enough to accommodate approximately 350 students. Rodenbeck estimated the system size needed by checking daily water use at other area schools. The system consists of a 3,000-gallon septic tank equiped with a Zabel™ filter at the outlet. From the septic tank the wastewater flows to a recirculation tank where the wastewater is pumped to a recirculating gravel filter. After treatment in the gravel filter, the wastewater returns to the recirculation tank and then flows to an intermediate settling tank equipped with another Zabel™ filter at the outlet. Next, the wastewater flows to a dosing tank where it is sent to the drip distribution system.

"The system is designed to dose over a 24-hour period," explained Rodenbeck. The drip system itself has four zones or cells and takes up about one acre of the 10-acre school lot.

Rodenbeck said that the system has been working well. "Due to mechanical problems, the gravel filter was taken out of service during the winter, and we had to bypass the filter all together," he said. "The university requested that we not fix this problem, but, instead, operate the system with just the septic tank effluent going through the drip system filters and then to the drip lines. The system has been working fine this way. None of the emitters have plugged and I haven't even had to clean the filters. The gravel filter will be modified and be online for the start of school."

The university students continually monitor the performance of the system and levels of bacteria in the soil as well as investigate the effect of temperature on the levels of bacteria in the soil.

To learn more about Nasonville's system and the University of Wisconsin study, contact Dr. Converse at (608) 262-1106.

CONTACTS

The National Small Flows Clearinghouse (NSFC)

The NSFC offers technical assistance and free and low-cost information about onsite and small community wastewater technologies and issues, including spray and drip irrigation, wastewater reuse, and state and federal regulations. Only a few of the NSFC's many resources and services are mentioned in this issue. Visit the NSFC's Web site at www.nsfc.wvu.edu, or call (800) 624-8301 or (304) 293-4191 for assistance or to request a free catalog.

Local and State Health Agencies

For more information about spray and drip irrigation, local regulations, or permit requirements, community residents should contact their local or county health department officials. Community leaders who wish to evaluate irrigation as an alternative to direct discharge should contact their state health agency. State and local agencies usually are listed in the government section or blue pages of local phone directories.

Extension Service Offices

Many universities have U.S. Department of Agriculture Extension Service offices on campus and in other locations, which provide a variety of services and assistance to individuals and small communities. For the number of the Extension Service office in your area, check the government pages of your local phone directory, call the NSFC, or call the U.S. Department of Agriculture directly at (202) 720-3377.

The Irrigation Association (IA)

The IA is the irrigation industry's trade organization and has members who can provide professional assistance in all aspects of irrigation. IA members include researchers, technicians, manufacturers, distributors, dealers, system designers, consultants, installers, and contractors. Visit its Web site at www.irrigation.org to conduct a search of IA's membership or for consumer information, including how to hire an irrigation contractor. Or, contact IA headquarters in Fairfax, Virginia, at (703) 573-3551 for assistance.

RESOURCES AVAILABLE FROM NSFC

To order any of the following products, call the National Small Flows Clearinghouse (NSFC) at (800) 624-8301 or (304) 293-4191, fax (304) 293-3161, e-mail nsfc_orders@estd.wvu.edu, or write NSFC, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Be sure to request each item by number and title. ***A shipping and handling charge will apply.***

Spray and Drip Irrigation Technology Package

A selection of useful articles about spray and drip irrigation with wastewater is presented in this publication. The articles are chosen from the NSFC's Bibliographic Database. Onsite irrigation systems and the application of wastewater to forest lands and parks are among the topics discussed. Case studies also are included. The price is $16.25. Request Item #WWBKGN53.

Guidelines for Water Reuse

This EPA manual presents federal guidelines for implementing a water reuse system and how to evaluate water reclamation and reuse opportunities. Chapters are devoted to each of the technical, financial, legal, institutional, and public involvement considerations that a reuse planner might examine.The price is $30.00. Request Item #WWBKDM72.

Computer Search: Drip Irrigation

This booklet is a compilation of article abstracts on drip irrigation compiled from a search of the NSFC's Bibliographic Database. Complete copies of the articles can be ordered from the NSFC. The price is $2.75. Request Item #WWBLCM18.

Computer Search: Spray Systems

Spray systems as an alternative to conventional methods of wastewater disposal is the topic of this NSFC Bibliographic Database search. Abstracts of spray system articles are included. The price is $6.75. Request Item #WWBLCM19.

Manufacturers and Consultants Database

Customized searches of the NSFC's Manufacturers and Consultants Database are available upon request. Contact the NSFC and ask to speak with a technical assistance specialist to request a search of irrigation system manufacturers, dealers, designers, consultants, and operators in your area. The price varies. Request Item #WWPCCM16.

Guide to State Level Onsite Regulations

This guide provides information about state regulations regarding onsite wastewater systems. Contacts, keywords, and definitions are included. The price is $12.50. Request Item #WWBKRG01.

Free Brochure: Water Reuse Via Dual Distribution Systems

This free brochure examines the benefits of a wastewater reuse system and includes information on system operation, design, cost, and public acceptance issues. Request Item #WWBRGN15.

PIPELINE

National Small Flows Clearinghouse

West Virginia University

an equal opportunity/affirmative action institution

Pipeline is published quarterly by the National Small Flows Clearinghouse at West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064

Pipeline is sponsored by:
U.S. Environmental Protection Agency
Washington D.C.
Steve Hogye—*Project Officer*
Municipal Support Division
Office of Wastewater Management

National Small Flows Clearinghouse
West Virginia University
Morgantown,WV
Peter Casey—*Program Coordinator*
Andrew Lake—*Special Technical Advisor*
Cathleen Falvey—*Writer/Editor*
Jill A. Ross—*Associate Editor*
Kairi Frame—*Graphic Designer*

ISSN 1060-0043

Pipeline is funded by the United States Environmental Protection Agency. The contents of this newsletter do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Printed on recycled paper

National Small Flows Clearinghouse
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Morgantown, WV 26506-6064
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Nonprofit Organization
U.S. Postage Paid
Permit No. 34
Morgantown, WV