Individual Residential Spray Irrigation Systems (IRSIS)

The Individual Residential Spray Irrigation System was developed and is designed to treat wastewater for sites with certain restrictive soil conditions.

ARTICLES | **UPDATED: AUGUST 15, 2008**

IRSIS systems can be permitted in soils with evidence of:

- A water table at greater than 10 inches from the soil surface, and
- Rock formations at greater than 16 inches from the soil surface.

Final disposal via IRSIS systems may not be on to floodplain soils or flood prone areas, or onto agricultural lands where food for human consumptions is grown.

The trade-off for being able to dispose of liquid household wastes on these marginal soils is that a considerably larger land area (at least 10,000 square feet) is needed for the disposal system. There are also limitations regarding the land slopes that may be used for spray fields. The maximum slope allowed for construction of a spray field is:

- 4% on non-food producing agricultural areas,
- 12% on open grassed areas, and
- 25% on closed-canopy forested areas.

Components and Overall Layout

The IRSIS system generally consists of six components;

1. a treatment tank
2. a dose tank
3. a secondary filtration unit
4. a chlorine contact unit
5. a storage tank, and

6. the spray field, see Figure 1.

The wastewater, leaving the home, flows to the treatment tank (most often a septic tank) where it is stored and treated. The effluent from the treatment tank flows to a secondary filtration tank (sometimes called pre-treatment) where the remaining solids are removed and the effluent receives additional treatment. If the filtration tank is up-grade from the treatment tank, a dose tank will be needed to pump the wastewater to the filtration unit. The effluent from the filtration unit flows to the chlorine unit, where chlorine is added to the wastewater. The chlorinated wastewater then enters a large tank with three functions:

1. provide storage where the wastewater effectively comes in contact with the chlorine and kills any remaining microorganisms
2. storage of the effluent until the appropriate time for disposal of the wastewater onto the spray field, and
3. a dose pump that pumps the effluent to the spray field.

Finally the treated effluent is distributed onto the land surface using irrigation sprinklers. The sprayed effluent finally contacts the soil and vegetation, which provide final treatment of the wastewater.

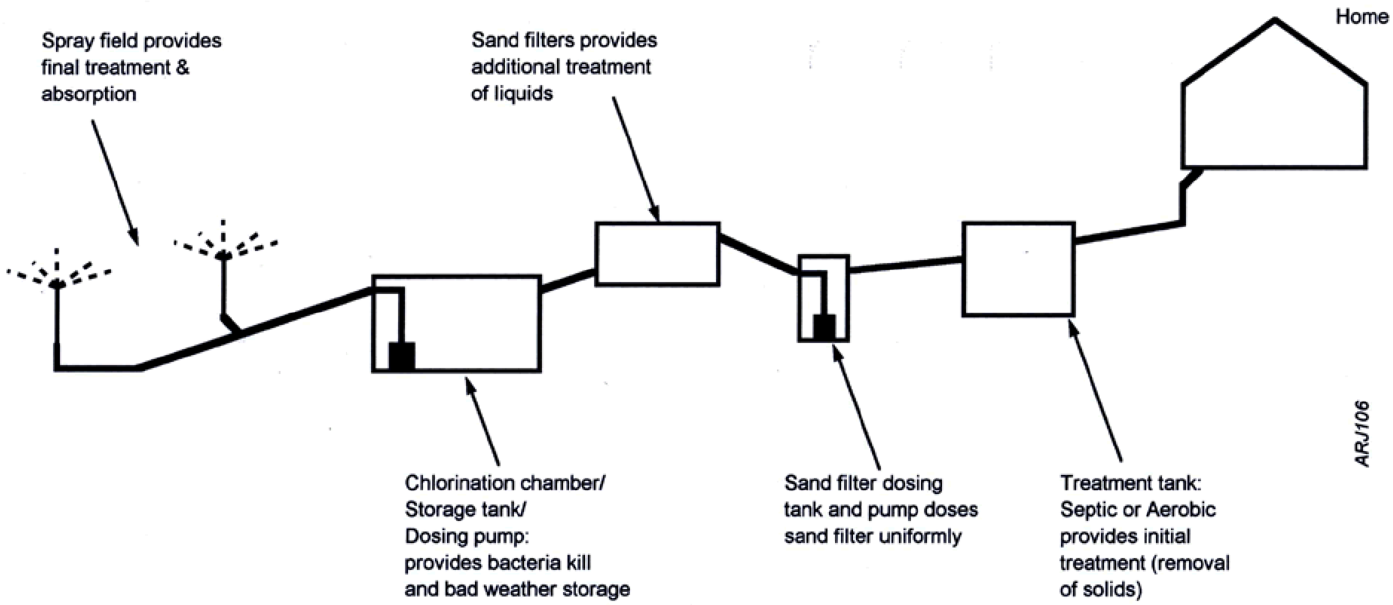

Figure 1. Components of an IRSIS on-lot sewage land application system.

Treatment Tank

A large majority of treatment tanks used in IRSIS systems are septic tanks. The wastewater leaving the home flows to the septic tank where it is stored for two or more days during which solids settle to the bottom of the tank as sludge and light particles float to the liquid surface to form a scum layer. Aerobic treatment tanks provide for treatment of sewage by aerobic bacteria, which reduce the BOD and suspended solids through mechanical aeration.

Dose Tank

The dose tank is an underground concrete or fiberglass tank placed between the treatment tank and the filtration unit. When sufficient slope is available, a dose tank may not be needed and the filtration unit can be fed by gravity. When a dose tank is needed, wastewater from the treatment tank accumulates in the dose tank until a prescribed depth is attained, when the wastewater is pumped to the filtration unit. The pumped wastewater is delivered to the top of the filtration unit in doses that enhance the function of the filtration unit and provide for a rest period between doses of wastewater.

A few helpful guidelines regarding the pump and dose tank can prevent malfunctions. Figure 2 illustrates a typical dose tank and pump. The dose tank should be a watertight, non-corrosive chamber with a working dose capacity of 25 to 50 percent the daily sewage volume from your house. The total tank capacity should be at least two day's sewage flow capacity. Finally, locate all electrical controls in the manhole extension above the dose tank or in a waterproof electrical box located outside of the tank. Install an alarm system that will both sound off and light up in case the water depth in the dose tank depth exceeds preset levels. Commercial alarm units are available.

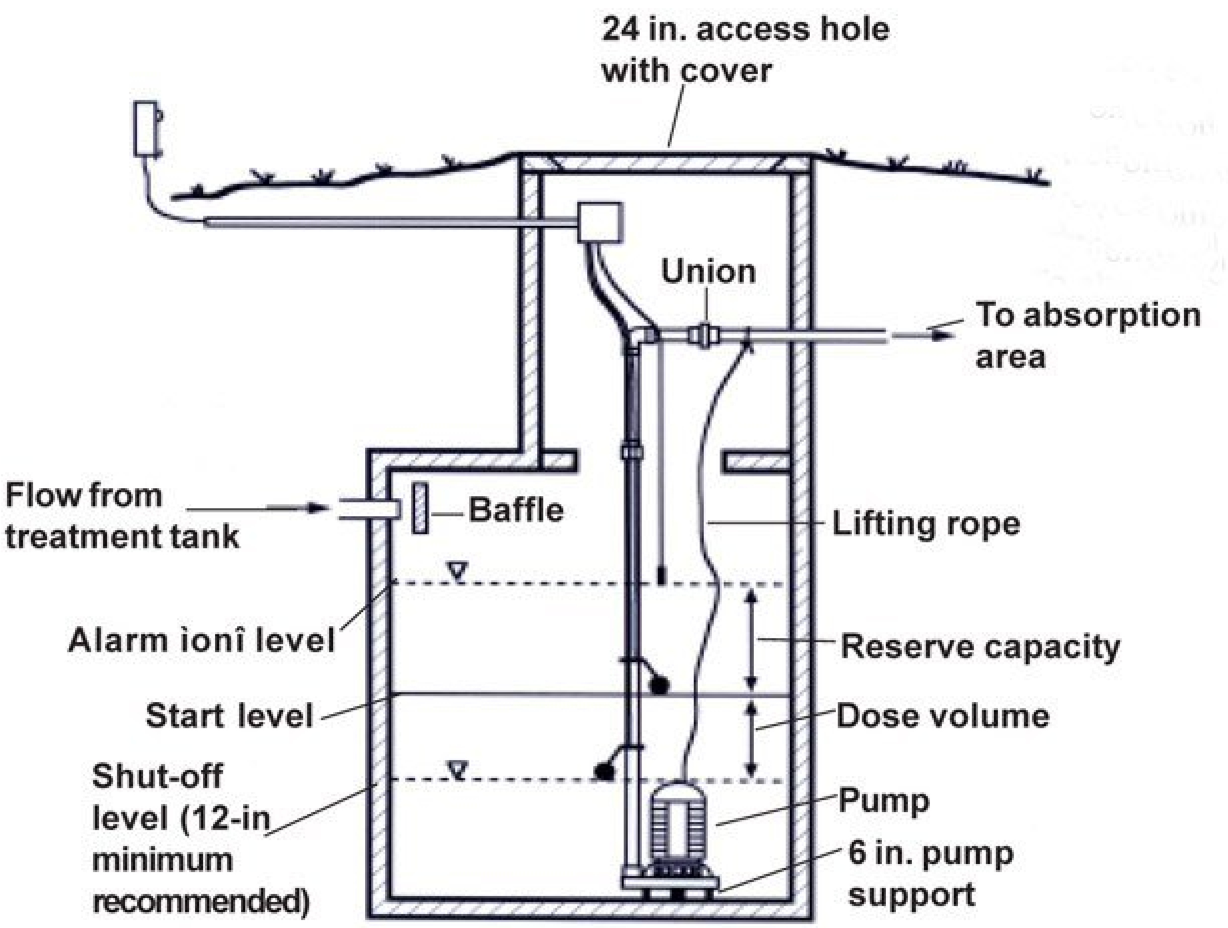

Figure 2. Typical dose tank and pump installation.

Filtration Unit

PA-DEP currently permits the use of several filtration or pre-treatment units. The two types of intermediate filtration units, prescribed in Chapter 73, are the free access sand filter, see Figure 3, and the buried sand filters, see Figure 4. The Alternate peat-filled Bio-filter is also available and maybe used in place of the sand filters, see Figure 5.

Free Access Sand Filter

The wastewater from the treatment tank is applied through the distribution pipe onto the splash plates that distribute the wastewater over the surface of the sand. Once in the sand, the wastewater percolates through to the collection system below the sand. Two free access sand filters must be used. The filter must be able to receive wastewater in a minimum of 100-gallon flood doses to the sand filter surface. High water visual and audible alarms must be installed to activate when more than 12 inches of influent is ponded on the sand surface. The free access sand filter is designed to allow periodic maintenance and filter accessibility, see figure 3.

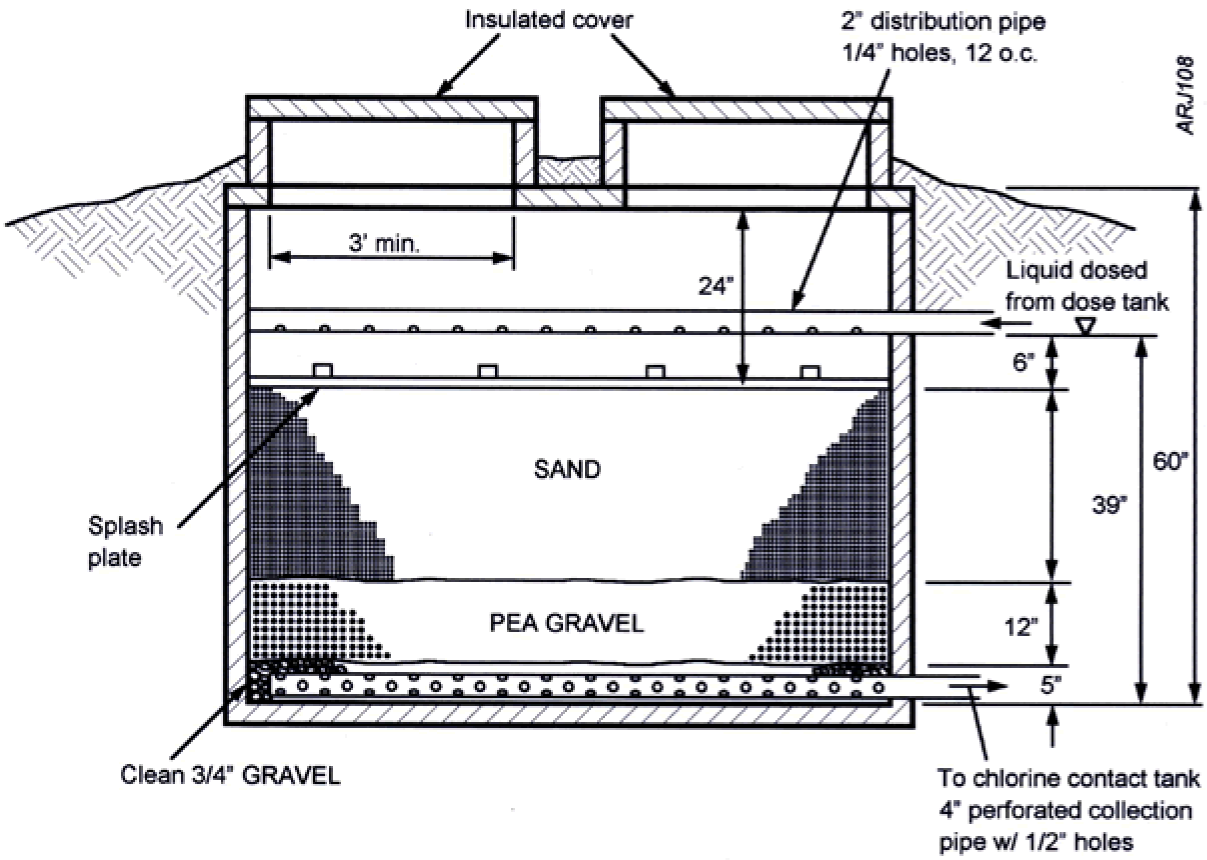

Figure 3. Free access sand filter.

Buried Sand Filter

The buried sand filter is a lined, confined volume of sand with an aggregate layer on the top, into which the treatment tank effluent is dosed via a pipe distribution system and an aggregate layer on the bottom, that collects the treated effluent via a piping system, see Figure 4. Buried sand filters are not usually installed where bedrock is encountered above the proposed depth of the sand filter. Where a seasonal high water table rises above the proposed depth of the sand filter, special design considerations must be used to protect the liner. Buried sand filters may not be installed in unstable fill.

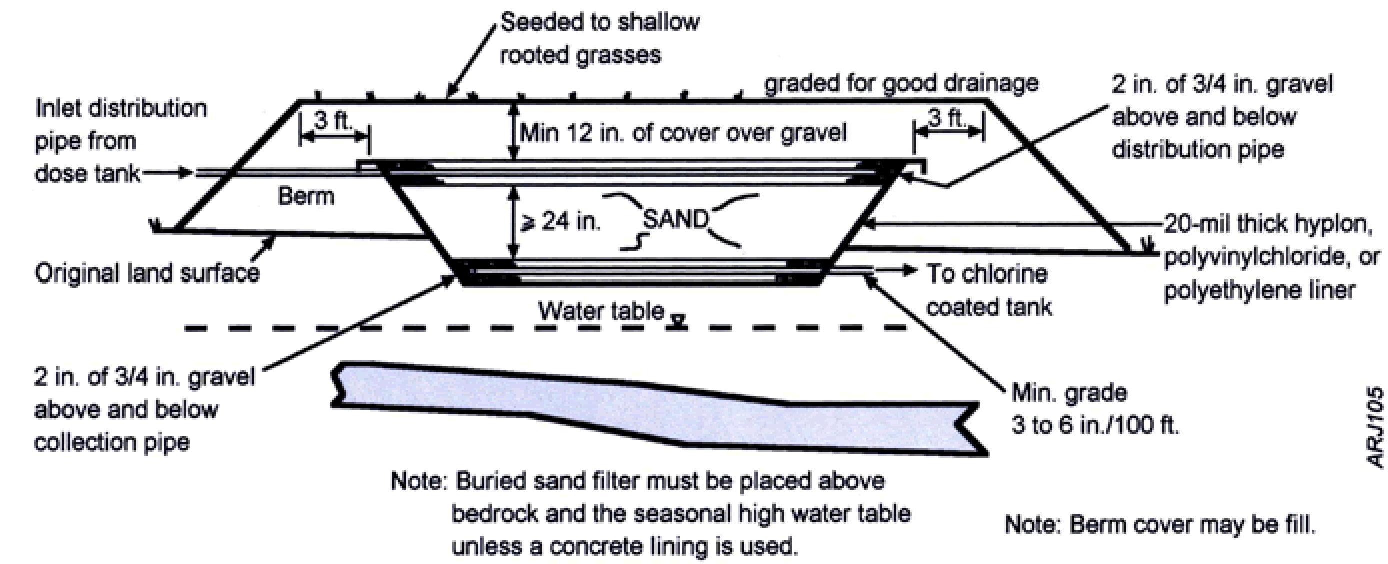

Figure 4. Buried sand filter.

Peat Bio-Filter

The peat bio-filter, see Figure 5 (below), has also been approved as a secondary treatment filter. The peat bio-filter is a large tub filled with peat. The treatment tank effluent is applied to the top of the peat. The effluent receives additional treatment as it percolates through the peat layer. The effluent is collected at the bottom of the peat and discharged to the chlorine unit.

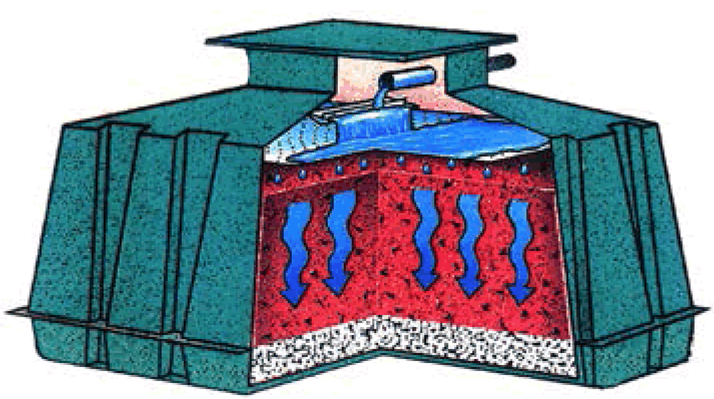

Figure 5. Peat Bio-filter.

Chlorine Contact and Storage Tank

All water leaving the filtration unit must be disinfected with chlorine. Chlorine disinfection is the introduction of chlorine to the effluent to kill harmful bacteria and protect water quality. Chlorine disinfection is required prior to spray irrigation and must be designed to reduce the fecal coliform concentration to less than 200/100 ml in any given single sample. Either of two types of chlorinators must be used (1) an erosion tablet unit, or (2) a hypochlorination unit. The erosion tablet units have no moving parts, are less expensive and have lower maintenance. They are often difficult to calibrate. The hypochlorination units are easy to calibrate, but have moving parts, are more expensive, and require more maintenance. The chlorinator must be able to maintain a chlorine residual of 0.2 to 2.0 ppm and provide for a 30-minute contact time. The time interval between chlorine introduction and spray irrigation must be at least 30 minutes.

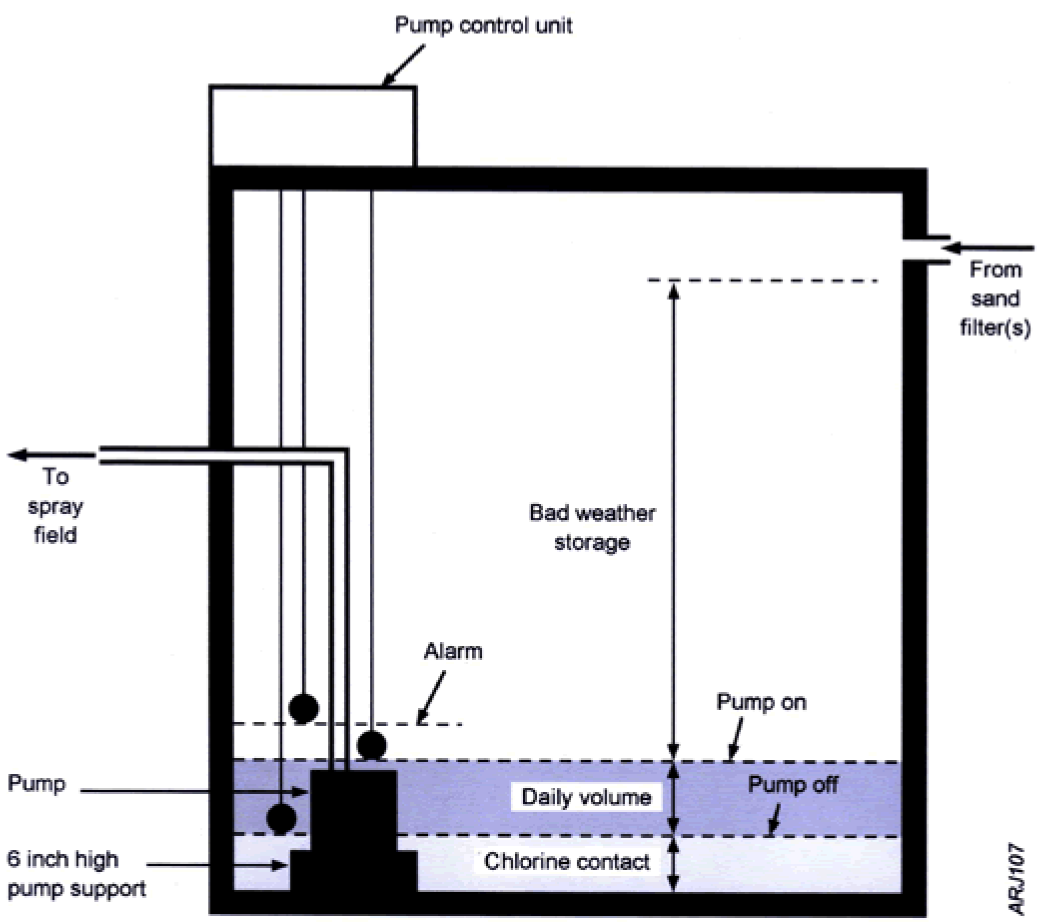

Figure 6. Chlorine contact and storage tank.

The chlorine application unit is usually at the entrance to the storage tank and serves to introduce the chlorine to the wastewater before (or as) it enters the

storage tank. The, so called "chlorine contact" time is the time required for the chlorine in the wastewater to kill the bacteria. As noted above this minimum contact time is 30 minutes and this contact period occurs as the wastewater waits in the storage tank. The storage tank also provides a place to store the wastewater before it is spray irrigated. Normally the wastewater is spray irrigated onto the site every night. Under poor weather conditions, such as snow or very wet conditions, the wastewater may be stored in this tank and irrigated on a succeeding day. The minimum liquid capacity of an IRSIS system storage tank shall be 2,000 gallons for homes with three bedrooms or less. The tank shall be made larger by 500 gallons for each bedroom over three.

Spray Irrigation Area and Distribution System

The spray field provides tertiary treatment for the chlorinated wastewater. The wastewater should be applied at low rates. The wastewater landing on the soil surface and vegetation plus the sunlight and evaporation of the wastewater enhance the system's ability to produce high quality water. The minimum spray field areas for an IRSIS system are shown in Table 1. Effluent should be applied to the spray area once each day after midnight. A manual override of the pump system allows interruption of the spray cycle when weather conditions are not conducive to spraying. Sprinkler heads must be spaced so the spray patterns from individual sprinklers do not overlap. Each sprinkler must be placed on a riser that extends 1.5 to 5 feet above the land surface. Vegetation must be cut or trimmed to keep it from interfering with the sprinklers' rotation and spray diameter. The minimum pump discharge shall be equal to the total discharge of all sprinklers at design operating conditions.

Table 1. Spray field area requirements.

Soil Characteristics	Soil Characteristics	Slope	Required Spray Field Area (Ft^2)	Required Spray Field Area (Ft^2)
Depth to bedrock	Depth to water table		Homes with 3 bedrooms or fewer	Additional area per bedroom
16 to 20 inches	10 to 40 inches	≤ 12	40,000	10,000

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Depth to bedrock	Depth to water table		Homes with 3 bedrooms or fewer	Additional area per bedroom
16 to 20 inches	10 to 40 inches	> 12	80,000	20,000
16 to 20 inches	> 40 inches	≤ 12	15,000	3,750
16 to 20 inches	> 40 inches	> 12	30,000	7,500
> 20 inches	10 to 20 inches	≤ 12	20,000	5,000
> 20 inches	10 to 20 inches	> 12	40,000	10,000
> 20 inches	> 20 inches	≤ 12	10,000	2,500
> 20 inches	> 20 inches	> 12	20,000	5,000

Summary

The Individual Residential Spray Irrigation System is an expensive alternative to on-lot sewage disposal. The filtration system, chlorinators and one to two dose tank/pumping stations all require periodic maintenance. During periods of poor weather, a decision must be made as to whether or not to apply the treated wastewater to the land that day. Each of these decisions means the homeowner will need to deal with their sewage disposal system daily. These decisions cannot be forgotten or ignored. On the other hand, the IRSIS system provides the opportunity for on-lot sewage disposal using soils that might otherwise not meet the requirements for any other on-lot system type. Before you decide on an IRSIS system, investigate all the possibilities and alternatives and weigh the cost of the system, installation and maintenance.

For additional assistance contact your local Sewage Enforcement Officer or County Extension Educator

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