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**Subsurface Drip Dispersal for Domestic
Septage Effluent Management
Document WMS 20-001**

This technical guidance document provides information to sanitarians, contractors, and owners on using subsurface drip dispersal for domestic septage effluent management.

Subsurface drip dispersal (SDD) is a method of applying effluent to the soil at very low rates which may be used in place of traditional soil absorption systems. Drip systems are well adapted to sites having a severely limited soil absorption capacity, shallow soil, or a very restricted area for soil absorption. Drip systems typically receive enhanced treatment effluent from an aerobic treatment unit (ATU) or other pretreatment component. Drip lines are placed quite shallow (no more than 8-10 inches) and can easily be installed around trees, shrubs, and other landscape features with minimal disturbance to them.

The concept of using subsurface drip to disperse effluent is adapted from the irrigation industry where fresh water sources are used for crops. Subsurface drip irrigation (SDI) systems became more feasible with the advent of plastic tubing after World War II. Initially (1960s) they were used for high revenue orchard or horticultural crops. The first U.S. field trials of SDI on field crops began in the 1970s. Around 1990, Texas A&M University started experimenting with distributing domestic wastewater effluent through drip lines. Since the mid 1990s, SDD for household type effluent following enhanced treatment has evolved into a widely accepted and effective option for dispersal of wastewater for final treatment in soil.

Drip Description

Drip systems disperse effluent 8-10 inches below the ground surface through small emitters in ½ inch diameter tubing. The shallow placement by SDD systems puts effluent into the active root zone, maximizing evapotranspiration and nutrient uptake. The system is designed using the grid concept with supply and return/flush manifolds at the ends, creating a closed loop system. The result of a proper grid design is a complete subsurface wetted area. Each emitter delivers less than a gallon of water per hour, usually with a spacing of 2 feet along the line and a 2 foot spacing between lines. The goal of drip is to apply the effluent at an approximately uniform rate, as safely as possible and distributed throughout a 24-hour period. Small, uniform effluent doses are applied throughout the day in the root zone where the moisture can be absorbed and taken up by plants or transmitted downward. The installation and use of SDD has important advantages shown in Table 1.

Because drip systems normally include an enhanced treatment component following the septic tank, they ensure water entering the system is high quality. An aerobic treatment unit

(ATU) is often used for enhanced pretreatment but this is not the only option.

Table 1. Some Advantages and Limitations of Subsurface Drip Dispersal (SDD)

Feature	Advantage or Possible Limitation
Small (½ in) diameter flexible pipe	Flexible pipe allows placement around obstacles. Because the footprint of a drip dispersal field can be formed to any configuration, it is a good option to use in tight areas, around existing buildings, trees, and small lots.
Shallow water placement	Because of shallow placement, as much as 75 percent of the water is taken up by plants and transpired by leaves. During the active growing season, plants use some nutrients (nitrogen and phosphorous) in the effluent.
Placement with insertion plow	Because the drip line is installed with an insertion plow, as is used to place telephone cable, or by a narrow trench machine, minimal soil disturbance occurs during placement.
Empty lines between doses	In the Kansas climate, drip systems are designed to provide complete drain back at the end of the dose cycle. Because water is not held in the drip lines, this prevents freezing of the water and also helps minimize root intrusion.
Herbicide impregnated lines	Two brands of drip system are currently available. One uses Treflan® herbicide impregnated in the plastic pipe and can be installed in areas with trees or vegetation without undue concern about root intrusion.
Maintenance needs	Regular service is required to insure the system functions properly and has good longevity. SDD systems are unforgiving regarding delayed maintenance; system failures may be unrecoverable.

Suitable Drip Applications

High Water Table. When the soil evaluation indicates that there is a shallow seasonal or perched water table a subsurface drip system helps provide the vertical separation since it can be installed as shallow as 8 inches, or even on the surface and then covered with 8 inches of topsoil.

Rocky Terrain. Shallow installation can keep the system out of shallow rock conditions.

Steep Slopes. Since the field is precisely dosed by time and area, steep slopes do not pose the problem they would in a conventional gravity system. The drip field can be lengthened along the contour or spacing between lines can be increased to limit “water stacking”, the accumulation of water moving laterally through shallow layers from each successive downslope lateral.

Tight Soils. When a site has tight soils with slow permeability, subsurface drip dispersal may be a good alternative. Usually, the soil layers near the surface where drip lines are installed can take more water. On sites with tight soil conditions the emitter application rate (dose per square foot) can be reduced and the field enlarged accordingly. Using uniform small doses in the area minimizes over-wetting of isolated areas in the field. Timed doses prevent the field from being hydraulically overloaded during peak usage in the mornings and evenings.

Drip System Components

Several manufacturers of drip line currently have products on the market. They are similar in size and incorporate both pressure compensating and turbulent flow emitters. One product has a process to reduce root interference, Rootguard[®], using the herbicide, Treflan[®], incorporated in the exterior of the pipe and a bactericide impregnated in the interior to inhibit bacterial slime growth in the drip line. This technology helps minimize plugging or clogging of the emitters.

A pump supplies effluent under pressure to the drip lines. The pump must be sized for the flow and pressure requirements. A high quality pump and controls that can be serviced by a local service provider is recommended. The pump control panel houses the dosing timer, the high water alarm, the electrical wiring to the pump, and is connected to power from the house main electrical breaker box.

The pipes from the enhanced treatment component to the pump tank, tank to the drip field, and manifolds supplying the field must be Schedule 40 PVC. The manifold lines are sized for the flow, and often are 1 ¼ inches in diameter. The drip lateral lines are connected at 2 foot intervals along the manifolds. The manifold line should be installed on a grade that allows total drain back of contents to the pump tank after each pump cycle to prevent possible freezing.

The supply manifold valve box is rectangular, large enough to easily accommodate the necessary components, and located on the supply manifold, just below the first drip line. This box houses the supply manifold shut-off valve, the pump pressure test gauge connection and valve, the injection port ball valve, and the filter system and flush line. Because of very small emitter orifices filtration of all water delivered to a drip system is essential. A self-flushing vortex filter with a stainless steel screen (150 mesh or 100 micron size) element is often used for final treatment before the effluent enters the field.

The return manifold on the opposite end of the drip field or on the same side, is the same diameter pipe. This carries the effluent that was not dosed out of the emitters back to the pump tank. The drip lines are connected to the return manifold on spacing the same as the supply manifold. This line must also be installed on a grade that allows total drain back to the pump tank after each pump cycle, to prevent freezing.

The return manifold pressure valve is a 13 inch PVC ball valve located in a valve box just a few feet past and below the last drip line in the return manifold. This important valve controls the operating pressure in the field, usually at 20 psi. The pressure is set using a glycerin filled gauge installed in the return manifold, just up-stream of the return manifold pressure valve and housed in the valve box. One manufacturer's manual recommends a factory pressure regulator pre-set at 20 psi located in the supply manifold control box. However, in freezing conditions, regulating the pressure on the return manifold with a partly closed valve has proven to be less troublesome than a regulator. The manufacturer has agreed that in specific situations, such as freezing conditions, this would be a recommended method of regulating pressure.

Vacuum breakers are installed at the high points of the field to prevent vacuum in the supply and return lines that would suck soil into emitters when flow stops. With subsurface drip it is an absolute necessity to have a vacuum breaker at the high points. Most systems will have only two high points; the tops of the supply and return manifolds.

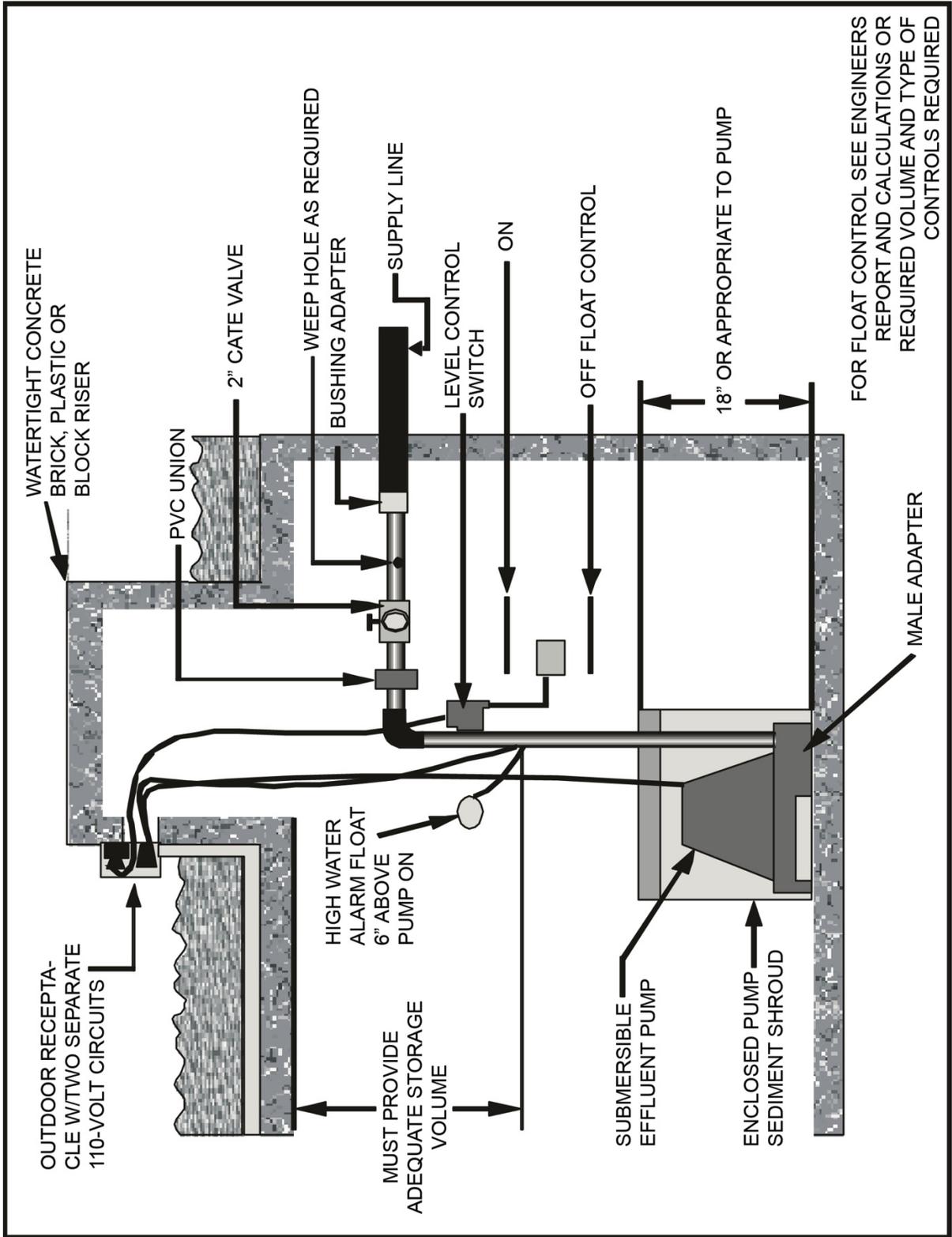


Figure 1. Dosing Pump Tank

Designing the Drip System

Select the area with careful consideration for the best soil available and suitable topography. The system can usually be installed on sites with steep slopes, small and irregular lots, or wooded areas by using careful planning for line locations. However, the topography must permit the manifolds to drain to the tank when the pump is off.

Note: The following paragraphs about design are taken from *Subsurface Trickle Irrigation System for Onsite Wastewater Disposal and Reuse* by B.L. Carlile and A. Sanjines.

Even though the drip system maximizes the soil absorption rate through the low rate of application, thus keeping the soil below saturation, there will be times when the soil is near saturation from rainfall events. The design must account for these periods and assume the worst condition of soil saturation.

Using a safety factor of 12, a suitable design criterion would be to load the system at the estimated hydraulic conductivity, but apply water for only a total of 2 hours per day out of the available 24 hours. The wastewater should be applied in pulses or short doses several times per day. Since the driplines are near the surface where the soil dries the quickest, the soil absorption rate is usually a higher value and the potential of water surfacing is minimized. This design criterion should avoid an overload except when the soil is near saturation from rainfall.

Table 2 shows the recommended loading rates in gallons per day per square foot (gpd/sq ft) for various soil types, hydraulic conductivity, and perc rate conditions. The loading rates shown are based on treated effluent with BOD and TSS values less than 20 mg/L. The size of the dispersal field can be calculated by dividing the total daily flow in gallons by the hydraulic loading rate. For example, a daily flow of 450 gallons in a soil with a loading rate of 0.2 gal/sq ft/day would require a field area totaling 2,250 square feet.

Soil Type should be based on the most restrictive layer within two feet of the bottom of the dripline. In many cases, a one-foot separation has proven successful; however, local regulations should be followed.

Drip System Installation

- During very dry conditions, the soil should be conditioned with water a few days before installing the drip system. It is much easier to install the system in moist soil. The best preparation is to apply a few inches of water to the soil at least 3 days before installing the dripline so the soil has time to drain. When the soil is very dry, 2-3 inches of water should wet the soil below the dripline depth. The soil surface should be moist but not wet so the tractor pulling in the drip line maintains traction.
- Many parts are needed, so be sure to have all supplies required before opening trenches. Before opening the trenches, pre-assemble in a comfortable place as many sets of components as will be needed.
- Handle the dripline and components with care. To help assure a long life, store the dripline in a shaded, cool place. Avoid hot temperatures, especially when handling and placing the tubing.
- Mark the four corners of the field with stakes. The top two corners should be at the same elevation and the bottom two corners should also be at the same elevation. On irregularly shaped areas, more markers may be required to maintain required grades. Be

sure to maintain a positive grade at the planned manifold locations.

- Locate the watertight pump dosing tank to receive pretreated effluent by gravity flow. To prevent freezing of lines, the tank must be positioned to allow the manifolds to drain back after each pump cycle, thus the tank must be at the lowest elevation of the system. Install a watertight riser from the dosing tank to the ground surface for easy access for service.

Table 2. Loading Rate Guide for Soil Types and Properties

Soil Type	Approximate Hydraulic Conductivity, in/hr	Perc Rate min/in	Loading Rate gpd/sq ft
Coarse Sand	>22.0	<5	Not Recommended
Fine Sand	1.5 -21.6	5 - 10	Not Recommended
Sandy Loam	1.0 - 1.5	10 - 20	1.3
Loam	0.75 - 1.0	20 - 30	0.9
Clay Loam	0.5 - 0.75	30 - 45	0.6
Silty Clay Loam	0.3 - 0.5	45 - 60	0.4
Clay Non-swelling	0.2 - 0.3	60 - 90	0.2
Clay Swelling	0.1 - 0.2	90 - 120	0.1
Very Tight Clay	<0.1	>120	0.075

- Based on the flow rate required for the SDD field, size the pipeline to assure minimum velocity for scouring and to achieve acceptable friction loss (this is often 13 inch pipe).
- On the supply side of the field, dig a trench at least 12 inch wide and 12-15 inch deep from the dosing tank to the bottom stake and then to the top stake on the same side. See Figure 2. Run the supply pipe from the tank to the field's lower corner of supply side.
- On the opposite end of the field, paint a line on the surface from the other bottom corner to the other top corner.
- Using the insertion plow, install the dripline at the design depth from the trench to the painted line on the other end. When the dripline reaches the painted line, raise the plow and cut the dripline, leaving about 1 foot above ground level. Continue this process on 2-foot centers until the required length of dripline has been installed.
- Place the supply manifold pipe in the trench and attach the dripline extending out of the trench wall to the pipe. Make this connection following the manufacturer's guidelines (see Figure 2).
- Attach the pump to the supply line manifold, and pressurize the system. The pump should be left on long enough to see water flow from each of the driplines sticking up from the ground on the other end. This will assure there are no obstructions in the dripline and flush any debris from the line.

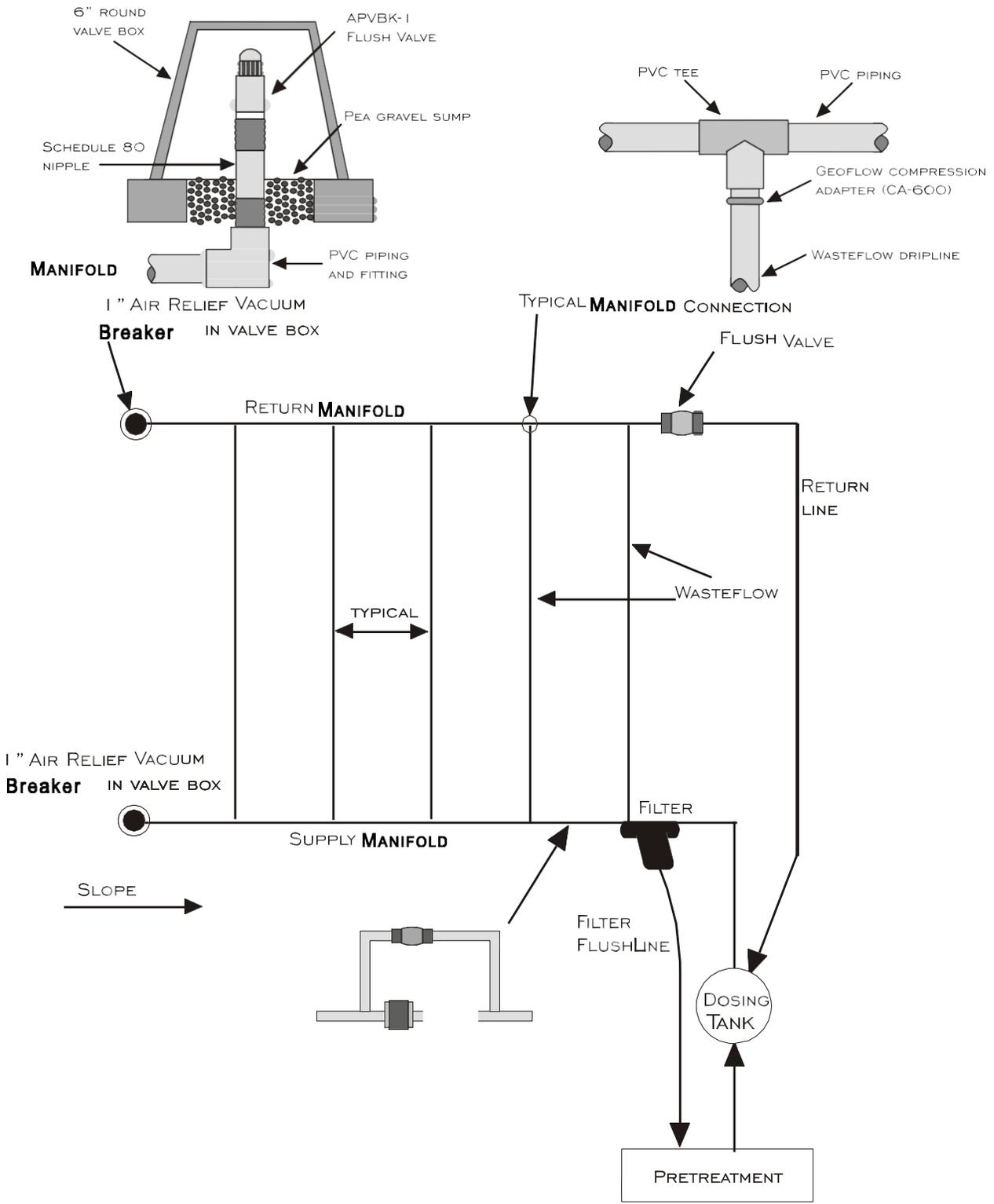


Figure 2. Typical Drip Field Layout

- Dig the trench for the return manifold pipe on the other end of the field, next to the exposed driplines and repeat the process for attaching the driplines to the return pipe.
- Install a vacuum breaker at the top of both the supply and return manifolds in accessible valve boxes with enough air space so debris could not be sucked into the line. See detail on Figure 2.
- Install a large valve box on the supply line just below the corner of the drip field. Install in it the filter, the flush line returning to the pretreatment tank, and a ball valve with pressure gauge port to check pump.
- Install a small valve box on the return manifold just below the last dripline and install the inline pressure adjustment valve (ball or gate type) for the field. To make it more convenient to adjust the pressure, install a T with a shut off valve and port to connect the pressure gage on the field side of this valve.

Follow manufacturer or distributor information about choosing and installing pump tank, pump, timer control panels, and floats. This information should be available from the local dealer.

Maintenance of Drip Systems

Maintenance is essential for drip systems. It is strongly recommended that the entire system be cleaned and checked by a licensed service company every 6 months. The filters in the system including the tank effluent filter must be checked regularly and cleaned as needed. The components of the pump tank that distribute the flow require periodic maintenance as expected from any mechanical equipment. The system should be installed with an alarm system to notify the homeowner if the system is not operating correctly.

REFERENCES AND READING MATERIAL

Subsurface Drip Irrigation (SDI) Publications

Design Considerations for Subsurface Drip Irrigation (SDI) Systems, MF-2578, July 2003

Drip Irrigation for Vegetables, MF-1090, October 1993 Note; gardens must not be grown in wastewater absorption fields.

Filtration and Maintenance Considerations for Subsurface Drip Irrigation (SDI) Systems, MF-2361, January 2002

Maintaining Drip Irrigation Systems, MF-2178, April 1996

Management Considerations for Operating a Subsurface Drip Irrigation (SDI) System, MF- 2590, November 2003

Subsurface Drip Irrigation (SDI) Components: Minimum Requirements, MF-2576, July 2003

Subsurface Drip Irrigation System (SDI) Water Quality Assessment Guidelines, MF-2575, July 2003

Subsurface Drip Irrigation (SDI) with Livestock Wastewater, MF-2727, May 2006