Subsurface Drip Systems RS&G

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Recommended Standards and Guidance (RS&G) for Subsurface Drip Systems

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Preface

This Recommended Standard and Guidance (RS&G) is applicable for statewide application. Regional differences may require variations in the application of the technology. The differences may also create a need for greater or more restrictive allowances than those described here. In either case, the local health officer has full authority in the application of this technology, consistent with Chapter 246-272A Washington Administrative Code (WAC) and local code. If any provision of these recommended standards is inconsistent with local codes, regulations, ordinances, policies, procedures, or practices, the local standards take precedence.

Local application of these recommended standards may be:

1) **Adopted as part of local rules, regulations, or ordinances.** When the recommended standards, either as they are written or modified to reflect local conditions more accurately, are adopted as part of the local rules, their application is governed by local rule authority.

2) **Referred to as technical guidance in the application of the technology**. The recommended standards, either as they are written or modified to reflect local conditions more accurately, may be used locally as technical guidance.

Application of these recommended standards may combine the two approaches above. The local health officer and board of health dictate the application of these recommended standards without deviating from Chapter 246-272A WAC.

The typical rule language provided here assists local health jurisdictions wanting to adopt these recommended standards in local rules. Additional information and guidance are presented in text boxes to distinguish it from the recommended standards.

Glossary of Terms: The Washington State Department of Health (the department) website provides a glossary of common terms for all RS&Gs at http://www.doh.wa.gov/Portals/1/Documents/Pubs/337-028.pdf.

The recommended standards found here support the design of on-site sewage systems (OSS) with design flows less than 3,500 gallons per day (GPD) but may also be applied to large on-site sewage systems (LOSS). However, some provisions for LOSS are not appropriate or allowed with the 2011 adoption of the revised LOSS rule, Chapter 246-272B WAC. The LOSS requirements from the RS&G have already been included in the rule. Design engineers and others interested in LOSS should consult the rule and LOSS program staff.

Typical RS&G Organization:

Standards Section	Explanation
Performance	Describes performance expectations, including treatment levels and function.
Application	Details how to apply the technology and includes conditions required prior to proceeding with design (includes “approved” status of the technology, component listing requirements, permitting, installation, testing and inspection requirements, etc.).
Design	Outlines design and construction requirements for the technology, including minimum standards that must be met to obtain a permit.
Operation and Maintenance	Explains operation and maintenance requirements for the technology, including responsibilities of various parties, recommended maintenance tasks and frequency, assurance measures, etc.
Appendices	Provides design examples, figures and tables, specific applications, and design and installation issues.

Introduction

Agriculture has used drip irrigation for many years. Using it as a technology to distribute wastewater only started in the late 1980's in the Southeastern United States. More recently, subsurface drip systems (SDS) have garnered national interest in the wastewater field, with many states conducting research, developing standards and/or actively permitting these systems.

SDS are efficient pressurized wastewater distribution systems delivering small, precise doses of effluent to shallow subsurface dispersal/reuse fields. SDS distribution piping is small-diameter, flexible polyethylene tubing, called dripline, with small in-line emitters. Emitters can discharge effluent at slow, controlled rates, usually specified in gallons per hour (GPH). Figure 1 shows dripline can be trenched into narrow, shallow trenches either by hand or with a trenching machine. It can also be plowed directly into the soil with a vibratory plow or other insertion tool and backfilled without gravel or geotextile.

Typical dripline installations in other states feature emitters spaced 2 feet apart with the dripline installed on 2-foot centers, sometimes with increased separations on sloped sites. Distribution networks are often laid out in grid patterns, but flexible dripline can easily be installed to accommodate irregularly shaped sites and to run parallel to contours on sloped sites. The 2-foot spacing is convenient for design and installation and has been used in many areas as a basis of drip distribution system sizing. This practice assumes each emitter will wet an area of four-square feet. This assumption is not valid in all soil types. Research conducted for agricultural applications has shown that wetting patterns around emitters are impacted by soil/site characteristics, emitter discharge rate, emitter spacing, and dosing regimen. Site characteristics and installation methods also affect distribution patterns, particularly in fine textured soils.

Soil wetting can be managed to maximize unsaturated subsurface movement, providing better distribution and treatment. The computer-generated model in Figure 2a shows the idealized effluent distribution pattern around an emitter with timed dosing. With frequent, equally spaced doses, effluent spreads out over time in a pattern roughly approximating a sphere in finer textured soils, with the largest volumes obtained in the middle soil texture range. Wetted volume is smaller with coarse and fine textured soils, as seen in Figure 2b. Design standards in this document are intended to maximize use of available soil volume and increase treatment efficiency by assuring unsaturated flow of effluent into the soil.

To avoid effluent surfacing during dosing, take care to apply effluent at a rate no greater than what the soil can accept, particularly in fine textured soils. Emitter discharge rates offered by the dripline manufacturer should be matched with soil type, with slower discharge rates applied in finer textured soils, as seen in Table 4.

Dripline is manufactured with either pressure compensating or non-pressure compensating emitters. It is commonly available with emitter spacing of 12, 18, and 24 inches. Pressure compensating emitters for wastewater applications are currently available with discharge rates of 0.4, 0.6, and 0.9 GPH (Netafim®) and 0.5 and 1.0 GPH (Geoflow®). Dripline using non-pressure compensating emitters are manufactured by Geoflow and, when used with a standard 20 pounds per square inch (psi) pressure regulator, has a rated emitter flow rate of 1.33 GPH.

SDS can be used to distribute primary, secondary, or tertiary effluent. The level of pretreatment provided affects allowable spacing, minimum dripfield area, minimum vertical separation and other design, maintenance, and monitoring requirements.

Drip systems offer some advantages over conventional pressure systems:

Advantages of Subsurface Drip Systems

- Installation of dripline is less site-intrusive and simpler than installation of conventional gravel-filled trenches. A backhoe is not needed, nor is gravel or geotextile.
- Dripline is flexible and can be installed in grid or irregular patterns as needed to accommodate contours on sloped sites, irregularly shaped areas, difficult site conditions, or landscape irrigation applications.
- Low flow rates allow for longer lateral runs than can be obtained with conventional piping.
- Shallow placement of dripline can enhance treatment by maximizing soil depth and delivering effluent to a point in the soil profile where there is typically more oxygen and organic material.
- A vegetative cover over the dripfield (usually turf) provides additional treatment and reuse through plant evapotranspiration.
- Slow, controlled emitter discharge combined with multiple daily dosing enhances aerobic conditions in the soil and results in frequent drainfield resting periods.

Engineering Concerns and Technical Solutions

Significant design, installation and management issues must be addressed in order for drip technology to be successful. Some of the key issues and technical solutions are noted below:

Engineering Concerns	Technical Solutions
Small diameter drip piping installed in shallow, narrow trenches and backfilled without drain rock provides insignificant emergency storage to handle occasional flow surges.	Pump chambers must be sized to provide peak flow storage capacity and installed in a manner that maximizes storage capability. Minimum tank volume is 1,000 gallons for residential application.
Dripline and emitters are vulnerable to clogging from suspended solids.	Primary settling and filtration in accordance with dripline manufacturer's specification is required for all drip systems. Additional treatment is recommended.
Low emitter discharge rates result in low pipe flow rates. Insufficient scouring velocity is provided during dosing to prevent sludge	Distribution piping must be installed in closed-loop networks with control valves, supply and return manifolds to allow for

build-up in dripline and other distribution piping.	periodic line flushing (see dripline manufacturer for recommended scouring velocities). Pumps should be sized for the expected discharge rate and for periodic flushing at manufacturer recommended velocity. Non-pressure compensating emitters discharge at a higher rate than pressure compensating emitters and may provide a better scouring effect.
Small diameter dripline and emitters are vulnerable to plugging from a buildup of bacterial slime and/or scale.	To reduce bacterial slime buildup in dripline: • Periodic line flushing is required for all drip systems. • Geoflow coats the interior wall of their dripline with a bactericide; • Netafim applies an antibacterial coating to its emitters and stresses adequate flushing velocity in their design manual and literature. If necessary, a mild chlorine bleach solution (5%) may be injected periodically.
Emitters of dripline that is subject to frequent changes in system pressure and is installed directly into the soil without geotextile can become plugged due to the suction of soil particles.	Air/vacuum release valves are essential to help prevent soil particles from being sucked into emitters and are required on all drip systems.
Shallow placement of dripline where plant roots are common and nutrient-rich discharge encourages root intrusion, which can plug emitters, potentially resulting in uneven distribution.	Geoflow implants a chemical root growth-inhibitor directly into their emitters. Netafim emitters feature a physical barrier built into their emitters to discourage root intrusion and offers a root-growth inhibitor in filter disks. All drip systems must include components deemed to be resistant to root intrusion by the manufacturer.
Shallow dripline installations may be susceptible to freezing during winters and in cold-weather climates.	Air/vacuum relief valves allow piping to drain between doses. Frequent dosing and continuous use of the system helps maintain soil moisture levels, which can create a barrier to frost penetration. Where frost is a concern, the recommended minimum dripline installation depth is 8-10 inches. Dripline may be installed deeper than 10 inches, but not more than 36 inches. All

	components at or near grade (valve boxes, etc.) should be insulated. In very cold climates, supply and return manifolds and transport piping should be insulated or buried below the frost line and/or designed to drain flush return water to the primary treatment unit or pump chamber. Designers are urged to consider owner lifestyle, water-use patterns, and local climate data before recommending a drip system to clients. (See Frost Protection in Appendix A.)
Shallow installations of dripline are more susceptible to damage from surface activities than conventional drainfields.	Owners should avoid activities that might damage the drip tubing or compact the soil, such as driving or using heavy equipment over the dripfield, digging, driving stakes into the ground, etc. Designers are advised to state this on plans or in Operation and Maintenance (O&M) manuals prepared for the owner.
Rodents are common in some areas and can damage dripline or burrow into valve boxes. Protected enclosures provided for headworks and valve boxes can be convenient places for rodents to store spoils from burrowing, which makes maintenance difficult or impossible and may interfere with system operation.	Rodents reportedly avoid wet soils. Frequent timed dosing maintains soil moisture and is required for all systems. Ideally, drip systems should be used soon after installation and remain in continuous service thereafter. A 2-parts per million (ppm) solution of butyric acid (smells like vomit and has a rancid oil smell) injected into the dripline occasionally during dosing reportedly discourages rodents. Head works and valve boxes may be underlined with hardware cloth (wire mesh) or with bricks, gravel, or other hard materials to discourage burrowing. Some practitioners insert mothballs or sprinkle boric acid at the bottom of the enclosure to repel rodents. (Avoid sprinkling anything corrosive on wires or other sensitive SDS components.) (See Rodent Protection in Appendix A.)
Emitter discharge rates can exceed soil capacity to absorb effluent during dosing, which can result in surfacing effluent in fine textured soils.	Emitter discharge rate must be matched to soil type (see Table 4) with lowest available discharge rates required in Type 6 soils. Avoid installations in compacted soils. Pump run times should be limited in accordance with manufacturer recommendations. (See

	Drainback and the Chimney Effect in Appendix A.)
In fine textured soils, effluent can accumulate during dosing in the trench or channel where dripline or conveyance piping are installed. This can cause effluent to drain to low points in the system and possibly surface.	Follow dripline manufacturers' installation instructions. Install manifolds and connect transport piping up gradient from dripline when possible or construct earthen dams at connection points to dripline. (See Drainback and the Chimney Effect in Appendix A.)

The preceding discussion underscores the importance of having a good working knowledge and understanding of drip technology; of proper product/component selection; and of following accepted standards of practice in design, installation, maintenance, and monitoring of drip systems.

1. Performance Standards

1.1. Performance Criteria

1.1.1. Treatment performance: A subsurface drip system (SDS), when properly sited, designed, installed, operated, and maintained consistent with these recommended standards and guidance, is expected to provide treatment performance equal to or better than conventional pressure distribution systems, and as such, SDS may be used anywhere pressure distribution is required.

1.1.2. Operational Performance: SDS must be designed, installed, and managed to provide even distribution and unsaturated subsurface flow to the greatest extent possible. (Note: Systems that are designed and operated consistent with these standards are expected to provide even distribution and unsaturated subsurface flow.)

1.1.3. Maximum length of each dripline run (lateral) must be in accordance with manufacturer's recommendations to ensure equal distribution.

1.1.4. Nitrogen reduction:

1.1.4.1. If approved by the local health officer, a nitrogen reduction credit of residential strength effluent may be assigned if all requirements of the RS&G Pressure Distribution (PD) and SDS are met, as well as the following criteria:

- Installed no deeper than 12 inches
- Has stable vegetative cover

1.1.4.2. If all the installation requirements are met, then maximum credits may be assigned when approved by the local health officer. Depending on the soil type, maximum nitrogen reduction credits for SDS and shallow PD networks are shown in Table 1.

1.1.4.3. Treatment of nitrates is often done through a series of system components starting with pretreatment in a septic tank all the way through the distribution component. A nitrogen reduction credit for a treatment component assigned a 50% nitrogen reduction credit may be combined with nitrogen reduction credit for PD and SDS dispersal components in specific soils. The maximum-design nitrogen reduction credit of the distribution methodology when combined with an upstream component is outlined in Table 2. Examples of treatment components with a 50% denitrifying credit are a Recirculating Gravel Filter, a Recirculating Gravel Filter with a Woodchip Bed, or a registered proprietary treatment product with a denitrifying credit of 50%, as determined through National Sanitation Foundation (NSF) Standard 245 testing.

Maximum credit for a combination of treatment components is assigned a 50% denitrification credit. Shallow PD or SDS in specific soils is assigned an additional denitrification credit as described in Section 1.1.5.

1.1.4.4. Combination of credits: The combination of credits is based on the findings of the Chesapeake Bay Partnership, Final Report, Recommendations of the On-Site Wastewater Treatment Systems Nitrogen Reduction Technology Expert Review Panel, prepared by Tetra Tech, Inc. February 2014, which states:

"The OWTS Expert Panel recommends that the baseline load applied to the soil treatment system from a conventional septic tank be 5 kg TN/person/year, which is the loading associated with a 60 mg/L total nitrogen (TN) concentration at an assumed flow of 60 GPD" Tetra Tech OWTS.

In-situ (receiving soils) are processes after the ex-situ (system components) treatment.

Example of combined credits:

- Recirculating Gravel Filter (50% nitrogen reduction credit) combined with drip or pressure distribution in type 6 soil (50%

nitrogen reduction credit)

Ex-situ (Recirculating Gravel Filter) (50%) x 5kg/person/year = 2.5 kg/person/year

In-situ PD or SDS drainfield with type 6 soil with a maximum 50% denitrification credit. (50%) (2.5 kg/person/year) = 1.25 kg/person/year in situ at the edge of a drainfield. Total % nitrogen reduction: 1.25 kg/person/year / 4 kg/person/year = 31% nitrogen left, leaving 69% total nitrogen reduction.

- Recirculating Gravel Filter (50% nitrogen reduction credit) combined with drip or pressure distribution in type 5 soil (40% nitrogen reduction credit).

  Ex-situ (i.e., Recirculating Gravel Filter) (50%) (5kg/person/year) = 2.5 kg/person/year

  In-situ PD or SDS Drainfield – Type 5 soil with a 40% denitrification credit. (40%) (2.5 kg/person/year) = 1 kg/person/year in situ at the edge of the drainfield 2.5-1=1.5 kg/p/year

  Total % TN reduction: 1.5 kg/person/year ÷ 4 kg/person/year = 37.5% total nitrogen left = 63% total nitrogen reduction

1.1.5. Recirculating Gravel Filter (50% nitrogen reduction credit) combined with drip of pressure distribution in type 4 soil (30% nitrogen reduction credit)

Ex-situ (i.e., Recirculating Gravel Filter) (50% nitrogen reduction credit) combined with drip or pressure distribution in type 4 soil (30% nitrogen reduction credit)

In-situ PD or SDS drainfield – type 4 soil with a 30% denitrification credit. (30%) (2.5 kg/person/year) = 0.75 kg/person/year in situ at the edge of the drainfield.

Maximum credit for combinations of specific treatment components assigned a 50% denitrification credit and shallow PD or SDS in specific soils assigned a denitrification credit:

With a 50% soil treatment and dispersal reduction 69% - Type 6 soils

With a 40% soil treatment and dispersal reduction 63% - Type 5 soils

With a 30% soil treatment and dispersal reduction 57% - Type 4 soils

SDS, in general, provide even distribution, but there is no known practical field test to verify exact discharge from each emitter. Field tests with dripline installed at the surface show little to no discharge until a lateral is fully charged, then all emitters discharge nearly simultaneously. Both registered dripline manufacturers publish tables showing maximum lateral runs (generally runs increase as operating pressure increases). Designers should verify with the manufacturer whether table values account for flushing cycles and if not, reduce lateral runs accordingly.

2. Application Standards

The standards apply to on-site sewage systems (OSS) with design flows less than 3,500 GPD. For systems with design flows from 3,500 to 100,000 GPD, standards in the LOSS rule (Chapter 246-272B WAC) apply.

2.1. Listing

2.1.1. The department reviews applications for proprietary subsurface dripline products. Products are approved and listed when the manufacturer or designated representative provide data showing it meets or exceeds the performance criteria in Chapter 246-272A WAC.

2.1.2. Before a local health jurisdiction (LHJ) may issue a permit for an on-site system incorporating SDS, the specific brand and model dripline must be included on the current List of Registered On-site Treatment and Distribution Products. While listing is not required for all other SDS components (filters, control valves, air-vacuum relief valves, and controllers), they must meet specifications of the dripline manufacturer.

2.2. Permitting

2.2.1. Permitting and installation of subsurface dripline products are subject to state and local code.

2.2.2. Only proprietary subsurface dripline products registered with the department and listed in the current List of Registered On-site Treatment and Distribution Products may be permitted by LHJs (Chapter 246-272A WAC). Only the specific models listed in the document are approved. If other models in a manufacturer’s product-lines do not appear on the list, they are not approved for use in Washington State. If in doubt, contact the department for current listing information.

2.2.3. SDS can be used as the distribution component in Sand Lined Trench Systems, Mound Systems, and Intermittent Sand Filter Systems. This RS&G (including Table 2 requirements) applies to SDS installation in these public domain technologies. SDS may also be used with Recirculating Gravel Filter Systems, but the RS&G for this technology contains unique media, filter sizing, loading, and dosing requirements, which supersedes Table 2 in this document. The construction of Sand Lined Trenches, Mounds, Intermittent Sand Filter, or Recirculating Gravel Filter systems must also be consistent with the requirements of their respective RS&Gs.

2.2.4. An installation permit and, where required, an operational permit, must be obtained from the LHJs prior to installation and use.

2.2.5. To obtain an installation permit, designers must apply to the LHJ and provide, at a minimum, items outlined in Chapter 246-272A WAC.

2.2.6. To obtain a permit for new construction, the designer must demonstrate that sufficient suitable area exists to construct 100% of the primary and reserve dripfield. Regardless of pretreatment and minimum (constructed) area requirements, a reserve area must be set aside equal to the area requirements listed under "Minimum Pretreatment."

2.3. Influent Characteristics

2.3.1. SDS may be used to distribute either greywater or combined wastewater (greywater and blackwater).

2.3.2. SDS designed and installed according to the manufacturer's recommendations and consistent with these standards are suitable for distributing residential strength sewage or lower wastewater strengths to the soil for final treatment and dispersal.

2.3.3. Design Flow (Daily Wastewater Flow Estimates)

2.3.3.1. Residential – For all residential applications, a minimum wastewater design flow of at least 120 GPD per bedroom must be used.

2.3.3.2. Non-residential – Design flows from recognized standards (i.e., the most current version of the Environmental Protection Agency February 2002 Onsite Wastewater Treatment Systems Manual) must be used and must incorporate an appropriate peaking factor. Where no peaking factor is specified, a minimum design flow equal to 150% of the average daily or "typical" flow should be used.

2.4. Treatment

2.4.1. Dripline manufacturers' recommendations vary on treatment but, in Washington State, waste characteristics, vertical separation, and soil type determine the minimum level of treatment required. To determine the appropriate level of treatment, designers should follow Chapter 246-272A WAC in conjunction with these standards as well as the dripline manufacturers' recommendations.

2.4.2. Any treatment technology used must be listed on the most current version of the department's List of Registered On-site Treatment and Distribution Products. Septic tanks must be listed on the current List of Registered Septic Tanks.

2.4.3. In soil types 3-6, the minimum treatment required for SDS is residential strength sewage treated by a properly sized septic tank with standard effluent filter. When influent waste strength is higher than normal residential sewage values, there must be treatment to Treatment Level E or better.

2.4.4. Installations of SDS where only minimum treatment is provided must include an effluent filter, which is an1/8 inch or finer mesh covering installed at the outlet of the septic tank. They must also have an access riser to grade with locking or secured lid must be installed over the filter to facilitate inspection and cleaning.

2.4.5. Filtration in accordance with the manufacturer's recommendations must also be provided.

2.5. Location Requirements

2.5.1. SDS may be located wherever pressure distribution is allowed or required.

2.5.2. The minimum horizontal separations (setbacks) from SDS components are identical to separations from conventional on-site system components identified in Chapter 246-272A WAC.

The SDS edge of dispersal component means the location of the dripline nearest to the item requiring the setback.

2.5.3. SDS may only be located in soil types 1-5 and only on slopes of less than 30 percent for OSS serving developments with daily design flows greater than 1,000 GPD. This is consistent with provisions of Chapter 246-272A WAC.

2.6. Installation

2.6.1. Only OSS installers approved by the LHJ may install SDS. LHJs may establish their own eligibility requirements specific to SDS.

2.6.2. Installers must obtain training in SDS installation prior to bidding SDS projects. They are solely responsible for obtaining any needed training.

> Installation guidance and instruction vary with dripline manufacturer and required knowledge and skills may be product specific. Guidance and training in SDS installation may be obtained from dripline or component manufacturers, distributors, experienced practitioners, and professional organizations such as National Onsite Wastewater Recycling Association (NOWRA), the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT), and Washington State Onsite Sewage System Association (WOSSA).

2.6.3. Installation method: the SDS designer must specify the installation method based on site and soil characteristics and dripline manufacture's recommendations. Installation techniques that pull or stretch dripline or smear the trench's sidewall are prohibited. Table 6 lists common dripline installation methods.

2.6.4. The installer must install SDS in accordance with the designer's specifications and must notify the designer when conditions are not suitable for installation as specified in the designer's installation method.

> In soil types 4, 5, and 6, dripline installation should only occur when the soils are dry to prevent compaction and smearing. Compaction and smearing significantly reduces the infiltrative capacity of the soil. If the soil is wet enough to form a wire when rolled between the hands, then it is too wet for dripline installation.
>
> The installer should verify moisture content at the depth specified for dripline installation during construction. If the site is too wet, the installation should not proceed until conditions are deemed suitable by the designer.
>
> A designer-specified ground cover (turf or other appropriate landscaping) should be planted over the dripfield to prevent erosion. Soil placed over the dripfield should promote aeration and support a vegetative cover.
>
> See also the discussion on Drainback and Chimney Effect in Appendix A.

2.7. Testing/Inspection

2.7.1. All SDS must be inspected, tested, and deemed to be functioning according to the design after installation. It must comply with state and local rules before it is placed into service. Inspections are conducted by the designer or professional engineer with the installer present, and a final inspection is completed by the local health officer.

2.7.2. SDS inspectors, design professionals, and installers must be familiar with these standards and receive training in the design and operational concepts of SDS prior to inspecting SDS. LHJs are responsible for assuring that inspectors receive proper training.

2.7.3. In lieu of a conventional squirt test, the licensed designer or professional engineer must perform or witness the installer performing initial hydraulic and pressure tests of the distribution system with clean water. They must verify the system is watertight and record baseline flowrate and pressure data. This data must be included in the Operations and Maintenance (O&M) manual. LHJs may require the tests be performed in their presence and/or may require baseline performance information at the time of the inspection. Installers are advised to follow the manufacturer's recommendations for specific start-up and testing procedures.

Field experience shows the system should be allowed to run for at least 3 minutes for an accurate hydraulic test.

2.7.4. The system must be re-inspected after 30 days of use. This is done to verify it is still operating as designed or if any repairs or adjustments are required.

Gopher damage to dripline has been reported in some areas. In areas with gophers, it is best to start up and test the system just prior to placing it into continuous service when possible. This is because gophers reportedly avoid areas where soil is continually moist but may be attracted when the system is not in service and/or has been allowed to dry. If it is not possible to test the system close to when it will be continuously used, it should be retested later just before use. See Rodent Protection in Appendix A.

3. Design Standards

Design standards not found in this section are located either in the department's RS&G for Pressure Distribution Systems or in Chapter 246-272A WAC.

Only qualified, licensed on-site sewage system designers or professional engineers registered in Washington State may design SDS.

3.1. Designer Roles and Responsibilities

3.1.1. SDS designers must obtain necessary training in SDS design, installation, and O&M prior to accepting jobs to design SDS. They must also have a working knowledge of Chapter 246-272A WAC, the standards, dripline manufacturer guidance, and applicable portions of the Pressure Distribution RS&G.

Design criteria and guidance varies with each dropline manufacturer and is often product specific. Useful drip design, installation and construction guidance for wastewater applications is published on the web by both registered dripline manufacturers, (Geoflow and Netafim).

3.1.2. SDS designers are responsible for designing SDS in accordance with these standards, providing oversight of construction and component testing, and developing post-construction documentation (i.e., O&M manual). A record drawing must be provided to the health officer and the OSS owner per Chapter 246-272A WAC. Designers must include the approved construction drawings and specifications for materials, installation, component testing, inspections, and final grading/landscaping in permit applications and to installers who bid projects.

3.1.3. Designers are responsible for scheduling a preconstruction meeting with the installer to go over important topics. Topics include soil conditions, vertical separation, installation method, and responsibilities for permitting, location utilities, protection of dripfield area, component testing, inspection, and providing information for record drawings, O&M manual, etc.

3.2. Submittal

Owners or designers of SDS must submit the following to the local health officer:

3.2.1. A design package for approval consistent with Chapter 246-272A-0200 WAC, local code, these standards, and applicable standards in the Pressure Distribution RS&G.

3.2.2. A management plan that identifies the service provider and includes a copy of a signed service contract and outlining management responsibilities, including compliance with any LHJ O&M program requirement.

3.2.3. An O&M Manual with a record drawing consistent with the Pressure Distribution RS&G.

3.3. Wastewater Characterization

3.3.1. Designers of SDS must characterize expected waste strength and flows. They must include this information in the permit application in accordance with Chapter 246-272A WAC. SDS are suitable for residential applications or equivalent. They are not allowed for industrial waste.

3.3.2. When waste strength is characterized as higher than residential sewage, the designer must propose a suitable treatment component. They must demonstrate the level of treatment is equal to or better than what is required for sewage from a residential source (i.e., equal to or better than Treatment

Level E). Higher levels of treatment may also be required based on local management plans, setbacks, vertical separation, and soil type.

3.3.3. For non-residential applications, LHJs may require any or all of the following:

3.3.3.1. Type of facility to be served by the OSS (i.e., school, restaurant, commercial store ,etc.)

3.3.3.2. Peak and average daily design flows

3.3.3.3. Use patterns (daily, weekly, monthly, and/or seasonal)

3.3.3.4. Waste strength (using accepted reference values or sampling for BOD[5], TSS, O&G, etc.)

3.3.3.5. Modification proposed (any options to reduce design requirements by modifying the waste stream to reduce flows, strengths, etc.)

3.4. Site Characterization

3.4.1. A soil/site evaluation is required in accordance with Chapter 246-272A WAC to determine site suitability for SDS.

3.4.2. Soil and site characteristics that impact design, location, or installation of SDS must be identified. At a minimum, the site characterization must include descriptions of the following:

3.4.2.1. Soil (textural class, structure, depth, confining layers, etc.)

3.4.2.2. Topography (landscape position, drainage, slope, etc.)

3.4.2.3. Landscape (vegetative cover, impermeable surfaces, etc.)

3.4.2.4. Location (where SDS components are to be located in relation to property lines, structures, utilities, easements, surface water, wells, etc.)

3.4.2.5. Control (demonstrate that the owner has permanent control of property, that the dripfield area will be protected from development and other damaging activities and how service providers can access the system for maintenance, etc.)

3.5. Minimum Vertical Separation

3.5.1. SDS must meet the requirements for pressure distribution with timed dosing. A minimum of 2 feet of vertical separation is required in soil types 3-6 where Treatment Level E is provided. The installed dripline depth should be assumed to be the infiltrative surface of the SDS to be compliant with vertical separation requirements.

3.6. Materials

3.6.1. All SDS materials must be warranted by the manufacturer for use with sewage. The warranty must cover the dripline for resistance to plugging from solids, bacterial slime, and root intrusion.

3.6.2. All transport piping, supply and return manifolds, and fittings must be Schedule 40 PVC or thicker.

3.6.3. Fittings used to join dripline to the distribution and flush manifolds must adhere to the manufacturer's recommendations. Both compression and barb fittings may be specified. This depends on the manufacturer's recommendations and the system's operating pressure.

3.6.4. All driplines must be color coded purple to identify that the pipe contains non-potable water from a sewage source.

SDS piping has historically been used in irrigation applications using potable water. When used for wastewater applications, irrigation SDS piping could be misidentified in the supply yard or drainfield, risking direct human contact with effluent. Purple (Pantone 512 or 522) coloring is a nationally recognized convention for identifying reclaimed and recycled water distribution pipe for non-potable applications. It may also be used for distribution of effluent in a drip drainfield. Both manufacturers of registered dripline in Washington State offer acceptable color schemes on their dripline for this purpose.

3.6.5. All driplines must include emitters with a maximum discharge of 1.3 gallons per hour. Emitter discharge may be controlled by use of pressure-compensating emitters or with a pressure regulator.

It is advised to only use or specify components that are made, distributed, or endorsed by the chosen dripline manufacturer (i.e., fittings, valves, filters, controls, etc.). Substituted components, such as filters, must meet the dripline manufacturer's specifications. Professionals involved in the design, installation, and maintenance of SDS are advised to check with the dripline manufacturer or distributor prior to making any substitutions to verify changes do not affect the dripline manufacturer's warranty.

3.7. Components/Sizing

The following components are required on all SDS:

3.7.1. Dripline must be on the department's List of Registered On-site Treatment and Distribution Products with maximum rated discharge as shown in Table 4.

3.7.2. Headworks: Components may be placed inside a tank riser with a secured lid. Components must be protected from corrosive gasses. Serviceable components must be housed in an accessible, protective enclosure, such as a large valve box. Headworks enclosures must be insulated in cold climates and installed below grade with an access riser. There must be a minimum of 3 inches of pea gravel beneath the headworks for disposal of vacuum relief valve discharge and condensation. A greater depth of gravel may be needed at some sites. When the headworks enclosure has an open bottom, wire/hardware cloth may be placed below the gravel to prevent rodent intrusion.

Headworks typically come preassembled and are sold by dripline and component manufacturers and distributers.

3.7.3. Filters are required on all SDS. They can be disk or fine-mesh screen type. They must align with the dripline manufacturer's specifications (i.e., must filter minimum particle size specified by the dripline manufacturer). Designers must specify the type in their design based on the manufacturer's specifications. Installers may only install filters specified by the designer and that meet dripline manufacturer's specifications.

3.7.3.1. Filters must be corrosion resistant and warrantied by the manufacturer for use with wastewater.

3.7.3.2. All filters must be sized and rated to operate at the maximum design discharge rate of the system (during the flush cycle). Filter backwash, where required or specified, must be included in calculating the maximum discharge rate.

3.7.3.3. All SDS filters must be installed so they are readily accessible for inspection and servicing.

3.7.3.4. Filters must be rated to operate at the design's highest pressure and the flow rate of the system (typically occurs during the flush cycle).

3.7.3.5. Means to regularly flush filters must be provided and is required for all SDS. Filters may be forward flushed (typically screen filters) or require backwashing (typically disk filters) according to the manufacturer's recommendations. They may also be the continuously self-cleaning type.

Flushing typically requires specialized plumbing and flush valves. See Section 3.9 for discussion on flushing filters. An oversized disc filter and hand cleaning by the service provider may reduce the frequency of cleaning.

3.7.3.6. An effluent pre-filter is required at the septic tank outlet on all systems that provide only minimum (primary) treatment. An effluent pre-filter is recommended on all systems regardless of the treatment level.

3.7.4. Pressure gauge(s) or means to connect them (such as Schrader valves – see Figure 4), are required for all SDS at appropriate locations to measure component plugging and/or to trigger automated flush cycles. For SDS with automated flushing, a pressure gauge or connection points must be installed on either side of the filter. For dripfields, one pressure gauge or means to connect it is required per distribution sector. Pressure gauges must be oil-filled type, rated for wastewater applications and operate within the design range of the system.

To ensure consistent pressure readings, it is recommended that the same pressure gauge be used for all pressure measurements of a given system. An increase in pressure (compared to the value observed during last inspection) typically occurs with a decrease in system flow rate and may indicate a clogged filter or dripline. A decrease in pressure/no pressure may indicate a leak within the system due to damage or disconnected dripline or broken/inoperable values.

3.7.5. A flow meter, or means to connect one, is required for all SDS to measure the pump's instantaneous flow rate. Flow meters must be rated for use with wastewater applications and must operate within design conditions of the SDS.

3.7.6. Flow meters and pressure gauges, or means to connect them, must be installed in an accessible location within the headworks to allow for reading and servicing. Flow meters and pressure gauges must be warranted by the manufacturer for use with wastewater. They must also be accurate within the expected operating ranges of the system.

Decreasing flow rate may indicate emitter/dripline plugging, plugging in the transport piping to the field, and/or plugging of the filter. Increasing flow rate may indicate malfunctioning check valves, vacuum release valves, broken drip tubing, and/or breaks in other piping. A flow meter may be installed permanently and dedicated for use with a particular drip system. It may also be provided by the O&M provider who installs it during each service visit and removes it once the service is complete. The local health officer may accept either option or establish local rules or policy to address it. Many modern control panels include standard inputs to measure pump-elapsed run time and dose event counters. Together, these provide useful long-term performance information for pressurized system and are recommended for drip applications. However, a key performance measure that the SDS O&M provider needs is instantaneous pump rate, which a flow meter more easily provides. The flow meter and pressure gauge together allow for the service provider to assess current performance of an SDS.

3.7.7. Air/Vacuum Relief Valve(s) must be installed at the highest elevation in each distribution zone. Some manufacturers recommend air/vacuum relief valves be installed at the highest end of the return manifold and any other high points in the system. Their purpose is to let air out when the pump turns on and to let air in when the pump shuts off. This prevents suction of soil particles into the dripline. All valves must be installed in a valve box with access to grade and include a gravel sump to collect and dispose of ejected effluent during doses (see Figure 7).

3.7.8. Supply and return manifolds are used to distribute effluent to dripline during dosing, as well as collect flush-water and return it to either the pump chamber or septic tank – typically the septic tank.

3.7.9. A chemical injector port is required to allow future connection of a chemical injection pump. Chemical injection may be occasionally needed to treat dripline for slime or scale buildup. The port must be located in an accessible location upstream of the dripline. Injected chemicals may include mild household bleach (for slime), mild acids such as vinegar (for scale) and rodent repellents such as butyric acid.

Chemical flush volume should be routed to the septic tank. This may require double plumbing for systems that normally return flush volume to a pump chamber. Because flushing normally occurs during a routine dose cycle, mild chemical injection should only be performed when necessary to protect beneficial microorganisms and other biota in the dripfield absorption area.

3.7.10. A control panel with audible and visible alarms and timed dosing is required for all systems. The panel must have inputs as needed for meter readouts and control of actuated valves and/or where there are multiple distribution zones.

3.7.11. The pump chamber for all SDS must have a minimum volume of 1,000 gallons for single family residential applications. For all other applications, the minimum pump chamber size depends on design flow (see Pressure Distribution Systems RS&G). Pump chambers must be installed in a manner that maximizes available storage. The pump chamber design volume must account for flush volumes as well as the design flow.

Flow equalization (additional tankage) is prudent in certain situations to eliminate and reduce the impact of hydraulic surges and excessive organic loading. When it is needed, flow equalization typically requires a larger pump chamber size.

3.7.12. Where flow equalization is proposed, the designer must provide calculations in the permit application to demonstrate there is adequate pump chamber volume for the proposed use.

3.8. Valves

3.8.1. Must be rated for wastewater applications. Irrigation values are not allowed. Valves must be readily accessible for inspection and servicing (e.g., in a valve box with access to grade).

3.8.2. Control valves used for system flushing and zone distribution must operate automatically where only minimum treatment is provided (see Section 3.10.10.continuous flushing for exception).

3.9. Layout/Configuration

3.9.1. Minimum area requirements for the constructed primary drainfield (single family residential applications) depend on pretreatment (see Table 2).

3.9.2. For new construction, regardless of treatment provided, the designer must demonstrate that sufficient suitable area exists to construct the 100% primary and 100% reserve dripfields. For residential applications, requirements for primary and reserve areas are determined using the design criteria in Table 2.

3.9.2.1. Where allowed by the LHJ, the reserve area may be placed in between active driplines if the spacing in Table 2 is doubled.

3.9.3. Where soils are compacted or cemented, the local health officer may require a bulk density test. If results show soil density approaches the values in Table 3 (within 95%), the health officer may require additional emitters or greater emitter/dripline spacing than values shown in Table 2.

3.9.4. If separate distribution zones are used, dosing must be automatically alternated between each zone.

Alternating doses between zones may be accomplished with a distributing valve or actuated valve and a controller. The control panel may require modifications to accommodate additional functions (additional logic unit, breakers, transformers, larger enclosure, etc.).

Designing multiple zones may be desirable to reduce pump size to provide additional resting time, to support needs of the vegetative cover, or in anticipation of future expansion. This is useful for applications on steep slopes, on sensitive sites, and in fine-textured soils.

3.9.5. Dripline installation

3.9.5.1. Dripline must be installed as level as possible and parallel to contours on sloped sites. Elevation differences within a single distribution zone must not exceed manufacturer recommendations.

Use of air/vacuum relief valves (which facilitate draining between doses) and frequent dosing combine to increase risk of point-loading where effluent continuously drains between doses to the lowest point in a distribution zone. Dripline should always be installed along contours and as level as possible to prevent this from occurring.

3.9.5.2. Minimum installation depth is 6 inches into original, undisturbed, unsaturated soil. Maximum installation depth is 36 inches.

3.9.5.3. Where frost is a concern, dripline installation depth should be at least 8 to 10 inches with a maximum depth of 36 inches.

3.9.5.4. Dripline may be installed in ASTM C-33 sand or Coarse Sand Media specified in Appendix A of the Sand Lined Trench System RS&G. Dripline installed in approved sand media must be covered by at least 6 inches of sand media above the dripline. There must also be a minimum of 6 inches of sand media between any emitter and sidewall of the bed/trench.

3.9.5.5. Maximum daily discharge per emitter (affects dripfield sizing) depends on soil type and dripline/emitter spacing. (See dripline spacing options in Table 2.)

3.9.5.6. Where slopes are greater than or equal to 20 percent, the dripline spacing must be increased by at least one foot from the values listed in Table 2.

3.9.5.7. Maximum dripline runs must not exceed manufacturer recommendations.

Manufacturer recommended maximum dripline runs are generally much longer than maximum lateral lengths allowed for conventional pressure systems. Dripline runs depend on emitter spacing and applied pressure. Greater lengths are possible with increasing pressure (within manufacturer's recommendations). See dripline manufacturer for design recommendations.

Note: Maximum dripline runs are not necessarily as shown in the dripline manufacturer's literature and will be affected by flushing requirements, which must be considered during design.

3.9.5.8. Sloped sites require special consideration during design and installation to protect SDS components at lower elevations (i.e., driplines, distribution boxes, and other components). The design and installation must ensure drainage between doses does not impact these SDS component functions. (See Drainback and Chimney Effect in Appendix A.)

Low-level drainage can be prevented by installing check valves between manifolds and dripline laterals and/or between individual drip laterals. This is done by feeding dripline from above (see Pressure Distribution Systems RS&G), connecting dripline to manifolds over an elevated berm (see Figure 9), or by installing dripline at a lower elevation than manifolds.

3.10. Flushing

SDS typically provide inadequate scouring velocity in piping during routine dosing because emitter discharge rates are lower than rates from orifices in conventional pressure systems (see discussion below on continuous flush systems) Filters with opening sizes measured in microns can also plug over time.

Dripline flushing, also known as field flushing, always occurs in a forward (normal flow) direction. Filter flushing may occur in a forward direction, such as for screen-type and some disk filters. Filter flushing can also occur in a reverse flow direction for most disk filters. This is known as backflushing/backwashing. (See discussion below on special case of continuous flush systems.) In larger or commercial applications, disk filters can be installed parallel to each other and plumbed so one remains in service while the other filter is backflushed. Flushing dripline always occurs simultaneously with a dose cycle.

Flushing is done by manually or automatically opening a flush valve. The valve is either connected to the return manifold for dripline or to piping connecting the filters. It is essential to size pumps and piping, particularly dripline lengths, to allow for proper flushing to achieve scouring velocities in accordance with the dripline manufacturer's recommendations. The debris returns to the pump chamber, secondary treatment component, or septic tank. This is dependent on the type of flushing done and whether any treatment is provided.

Installing a filter larger than is required for the system may reduce the need for cleaning between service visits.

Key components requiring regular flushing include dripline and filters. Flushing other components, including supply and return piping, valves, and fittings, is also needed. Flushing can be done automatically, continuously, or, where allowed, manually, except where noted in this document.

3.10.1. Regular flushing is an essential element of SDS design and O&M. It must be addressed during the design phase (i.e., in system layout, pump and pipe sizing, component selection, operating procedures, etc.).

3.10.2. All SDS must include a means to backwash filters and flush dripline/manifolds.

3.10.3. Both supply and return manifolds are required on all systems. Flush valves are required for all SDS except continuous flush systems, but they are strongly recommended for all SDS. Supply and return manifolds and flush valves, where required, must be shown on construction plans and record drawings.

All filters that are forward flushed, including screen type and disk filters used on continuous flush systems, require periodic manual cleaning. They should be installed for easy access and/or removal (e.g., with unions) to facilitate cleaning.

3.10.4. All flushing components that require regular service (e.g., flush valves) must be located in headworks or dedicated valve boxes with access to grade. They must be shown on record drawings and identified in the O&M manual to facilitate maintenance.

3.10.5. SDS must be designed for flushing cycles and normal dosing cycles. The design must show calculations for flushing and account for the volume of supply piping, manifolds, and all dripline in a dosing sector to assure lines fully flush.

3.10.6. SDS designers must identify the flushing method in construction documents and permit applications. They must also provide related design parameters, such as design flow rate, pressure, and frequency and duration of flush cycle. Designers must ensure the flushing specifications meet the drip component manufacturer's recommendations.

3.10.7. Dripline and filter flushing must be automatic where only minimum treatment is provided.

3.10.8. Systems with minimum treatment must return flush debris to the septic tank or settling basin in a manner that minimizes disruption of settled solids. With secondary treatment or better, flush debris may be returned to the settling basin, septic tank, secondary treatment component, or pump chamber. A gravity return is recommended wherever possible.

Flush debris return methods that minimize stirring of solids include: (a) increasing diameter of the return line for at least 10 feet prior to the septic tank, (b) routing the return line to an appropriately sized pump basin upstream of the septic tank, or (c) route the return line from the SDS into the pipe upstream from the pump chamber. Routing to the pressurized section of the return line into a settling basin is recommended. The settling basin, unless buried, should have a lock or secured access to grade. It must also be insulated in cold weather climates.

Automated flushing can be scheduled after a preset number of doses. It can also be triggered by a preset pressure loss across the filter or dripfield. (This pressure loss indicates plugging.) The latter method requires actuated valves, extra inputs to the control panel, pressure transducers (if applicable) and appropriate programming for the programmable logic controller (PLC).

3.10.9. Manual flushing of dripline and filters may be a forward flush or a back/reverse process. It is typically controlled with ball valves operated by the service provider. Manual flushing is only allowed where Treatment Level C or better is provided. Flush debris from this method must be returned to the settling basin, septic tank, or pump chamber (see text box above). Flushing velocities set by the system's manufacturer must be met to ensure accumulation of organic and inorganic particulates are removed.

3.10.10. Continuous flushing described in this document meets the intent of the automated flushing requirement but only applies to systems providing minimum treatment. See text box below for a description of this flushing method and department recommendations for these systems.

Continuous forward flushing flushes dripline and filters with each dose cycle at a rate meeting the manufacturer's recommended scouring velocities in dripline (see Figure 5a). This may be utilized in a variety of applications other than where only minimum treatment is provided.

Continuous forward flushing simplifies design, eliminates the need for automated flushing components, and reduces upfront costs. However, it will increase energy consumption and flow and solids passing through the system. These concerns can be addressed in the design phase and O&M procedures.

Recommendations include:

- Have a service contract in place for periodic supplemental O&M services as needed. This may include running diagnostics, doing additional flushing, manually cleaning filters, etc.
- Install a filter that is larger than required for the system. This will reduce the need for cleaning between service visits.
- Install a manually operated valve on the return manifold to enable the service provider to manually flush the system during service visits.
- Measure pressure and flow at startup and during maintenance visits when the filter flush valve and the field flush valve are both in the closed position. This offsets the potential to measure with the valves at different settings from one visit to the next.
- Route flush debris to septic tanks in a manner that minimizes the stirring of solids.
- Specify where ports need to be installed to enable connection of pressure gauges and flow meters. This helps the service provider evaluate whether additional flushing or cleaning is needed.

3.10.11. Hose bibs are not allowed for use as a flushing component. This prevents contamination of the potable water supply.

3.10.12. Using chemical solutions to scour the dripline of scale or slime should be done sparingly and according to the dripline manufacturer's recommendations. Flush debris generated during chemical addition should always be returned to the septic tank. This may require double plumbing return lines where the designer chooses to route normal flush debris to a pump chamber.

3.11. Dosing

3.11.1. Timed dosing is required on all SDS. The minimum number of required doses per day is based on soil type as specified in Table 2.

3.11.2. If a treatment component (e.g., sand filter) upstream from the dripfield is time-dosed, then the dripfield downstream may be demand-dosed. The timer for the upstream treatment component indirectly controls downstream dosing. This usually prevents the need for a second timer for the dripfield. In this case, the dripfield is considered to be time dosed since the waste stream feed is time dosed.

In areas with high precipitation rates [greater than (>) 30 inches per year, i.e., most of western Washington], demand-dosing a soil dispersal component following an open-but-lined sand or gravel filter may lead to hydraulic overloading of the soil dispersal component. This concern greater when SDS is installed in finer-textured soil. The dripfield area may be increased to allow for excess precipitation.

Timed dosing helps maximize horizontal, unsaturated flow in the soil and provides better treatment than demand dosing. However, because state minimum design flows of., 120 GPD/bedroom are conservative values (i.e., higher than average flows), SDS designed per the rule do not normally provide the minimum number of doses per day as specified in Table 2. It will, under typical conditions, dose only a few times per day during peak use periods (morning, early evenings, and weekends).

4. Operation and Maintenance Standards

4.1. Management

4.1.1. Owner responsibilities: The owner of the residence or facility served by an SDS is responsible for assuring proper operation and compliance with all applicable state and local requirements. They must ensure the system received timely maintenance for all components. This includes inspecting the entire system at a frequency specified by the LHJ and the system's O&M manual. The manual must be appropriate for the site conditions and specific components. The owner may contact the LHJ for maintenance provider qualifications and for any specialized operations and maintenance activities and/or reporting requirements.

4.1.2. Prior to approving a proposed SDS, the local health officer may require a maintenance agreement with supporting legal documents. Maintenance agreements are recommended when the LHJ believes optimum operation is assured by such an agreement.

4.2. Operation and Maintenance (O&M) Manual

The manual must include:

4.2.1. The name and contact information for any owners, operators, designers, installers, electricians, and sewage pumpers. It must identify the primary person responsible during emergencies (e.g., power failure, alarms, abnormal conditions, failure).

4.2.2. A description of the owner’s responsibilities regarding operation, maintenance and monitoring, inspection, record keeping, reporting, and permit requirements.

4.2.3. A narrative of the design description. It must describe the approved peak design capacity, number and type of units served, how the system works, its intended performance, and operating limits. List each major component, its function in the system and expected performance.

4.2.4. The manufacturer’s standard product literature for each component and proprietary product. This must include performance specifications and maintenance recommendations needed for operation, monitoring, and maintenance.

4.2.5. A flow schematic showing all major components, record drawings, and schematics for all electrical and mechanical components.

4.2.6. Information on periodic monitoring and maintenance requirements of the system. This includes but is not limited to flow/pressure tracking, effluent sampling, and maintenance activities with recommended frequencies for septic tank, dosing/surge tanks, filters, dripfield, control panel, pumps, motors, valve switches, and alarms. List the recommended component settings for routine operation and monitoring.

4.2.7. A list describing operating activities with instructions clear enough to protect the system’s treatment processes and components. Examples include:

4.2.7.1. Water conservation strategies

4.2.7.2. Use of low flow fixtures

4.2.7.3. Spaced-out scheduling of laundry or other high water-use activities

4.2.7.4. Infrequent/limited use of household chemicals and other harmful chemicals

4.2.7.5. Recommendations against using garbage disposal and the improper disposal of unused pharmaceuticals

4.2.7.6. Protecting the current dripfield and reserve area

4.2.7.7. Landscaping/vegetation recommendations and cautions

4.2.8. A trouble-shooting guide identifying potential issues and solutions. This information must be very detailed in order to assist the system owner in their decisions-making process for correcting operational problems. It must be clear enough that the homeowner knows when they need to call a professional.

4.3. Monitoring and Maintenance

Service providers should follow dripline manufacturer's recommended procedures. Minimum monitoring and maintenance activities and frequencies for SDS components include:

4.3.1. Observed Conditions/Actions

4.3.1.1. When a routine inspection, required evaluation, or any other observation, reveals any of the following listed conditions, the owner of the system must take appropriate action to correct the situation according to the direction and approval of the local health officer:

4.3.1.1.1. SDS failure, as defined in Chapter 246-272A WAC.

4.3.1.1.2. Any condition that threatens public health and safety (e.g., broken, or deteriorating sewage or pump chamber, piping, electrical component) which may, if not addressed, result in system or component failure.

4.3.1.2. Appropriate actions include:

4.3.1.2.1. Evaluation by a qualified professional of the system condition, capacity and use with findings and recommendations reported to the LHJ.

4.3.1.2.2. Repair or modification of the SDS, as permitted/approved by the LHJ, when required.

4.3.1.2.3. Expansion of the SDS, when permitted by the LHJ.

4.3.1.2.4. Lifestyle modifications or changes to reduce flows or waste strength (e.g., implementing water conservation measures or waste strength reduction strategies).

4.3.1.2.5. Any significant problems noted during an inspection, must be reported to the LHJ. Any required repairs or modifications must be permitted by the LHJ prior to construction.

Tables

Table 1: Washington Soil Types and Textural Classifications

Soil Type	Soil Textural Classifications
1	Gravelly and very gravelly coarse sands, all extremely gravelly soils excluding soil types 5 and 6, all soil types with greater than or equal to 90% rock fragments.
2	Coarse sands.
3	Medium sands, loamy coarse sands, loamy medium sands.
4	Fine sands, loamy fine sands, sandy loams, loams.
5	Very fine sands, loamy very fine sands; or silt loams, sandy clay loams, clay loams and silty clay loams with a moderate or strong structure (excluding platy structure).
6	Other silt loams, sandy clay loams, clay loams, silty clay loams.
7 **Unsuitable for treatment or dispersal**	Sandy clay, clay, silty clay, strongly cemented or firm soils, soil with a moderate or strong platy structure, any soil with a massive structure, any soil with appreciable amounts of expanding clays.

Table 2: Primary Drip Design Parameters (residential application based on 120 /bedroom[1]

	Minimum Pretreatment (TL E)						Pretreatment ≥ Treatment Level C					
Soil Type	**1[2]**	**2**	**3**	**4**	**5**	**6**	**1[2]**	**2**	**3**	**4**	**5**	**6**
# Bedrooms	Minimum number emitters required						Minimum number emitters required					
2	240	240	300	300	480	960	240	240	300	300	480	960
3	360	360	450	450	720	1440	360	360	450	450	720	1440
4	480	480	600	600	960	1920	480	480	600	600	960	1920
5	600	600	750	750	1200	2400	600	600	750	750	1200	2400

# Bedrooms	Dripline required at minimum emitter spacing (ft)						Dripline required at minimum emitter spacing (ft)					
2	240	240	300	300	480	960	120	120	300	300	480	960
3	360	360	450	450	720	1440	180	180	450	450	720	1440
4	480	480	600	600	960	1920	240	240	600	600	960	1920
5	600	600	750	750	1200	2400	300	300	750	750	1200	2400

	Minimum emitter spacing (ft)						Minimum emitter spacing (ft)					
	1	1	1	1	1	1	0.5	0.5	1	1	1	1

	Minimum dripline spacing (ft)[3]						Minimum dripline spacing (ft)[3]					
	1	1	1.5	2	2	2	1	1	1	1.5	1.5	2

# Bedrooms	Minimum dripfield area (ft²)[4]						Minimum dripfield area (ft²)[4]					
2	240	240	450	600	960	1920	120	120	300	450	720	1920
3	360	360	675	900	1440	2880	180	180	450	675	1080	2880
4	480	480	900	1200	1920	3840	240	240	600	900	1440	3840
5	600	600	1125	1500	2400	4800	300	300	750	1125	1800	4800

	Minimum number of doses per day						Minimum number of doses per day					
	12	12	12	12	8	4	12	12	12	12	8	4

	Minimum number of distribution zones						Minimum number distribution zones					
	1	1	1	1	1	1	1	1	1	1	1	1
Soil Type	**1**[2]	**2**	**3**	**4**	**5**	**6**	**1**[2]	**2**	**3**	**4**	**5**	**6**

[1]Values in this table were developed for statewide application and are considered conservative. The local health officer may require additional emitters or greater spacing (area) if soils are compacted or cemented, if soil structure is poor, for sensitive sites or in areas of special concern.

[2]Drip trenches/beds in "Type 1" soils must be filled with a minimum 2 feet of ASTM C-33 sand below the dripline and 6 inches (8-10 inches if frost is a concern) above the dripline. Minimum sand depth may be reduced to 1 foot below dripline if pretreatment meets Treatment Level A.

[3] Where slopes are > 20%, dripline spacing should be increased by one foot from the values outlined in this table

[4]Regardless of pretreatment and minimum (constructed) area requirements, a reserve area must be set aside equal to the area requirements listed under "Minimum Pretreatment"

Note: For commercial applications (including mobile home parks, apartments, condominiums, etc.), divide system design flow by maximum daily emitter discharge from Table 3 to determine minimum number of emitters required. Then, multiply the number of emitters by area per emitter (minimum emitter spacing times minimum dripline spacing) for minimum dripfield area. An area of equal size as the primary dripfield must be set aside as a reserve area.

Table 3: Primary Drip Design Parameters[1]

WA Soil Type	1,2	3	4	5	6[2]
Maximum daily discharge per emitter (GPD/emitter)	1	0.8	0.8	0.5	0.25
Minimum emitter spacing (ft)	1	1	1	1	1
Minimum dripline spacing (ft)	1	1.5	2	2	2
Minimum area per emitter (ft^2)	1	1.5	2	2	2

[1]Table values apply, regardless of pretreatment.

[2]On-site systems with design flows of 1,000 GPD or greater are only allowed in soil types 1-5 or on sites with slopes less than 30 percent.

To use this table: Divide the total design flow of the system by the value shown for maximum daily discharge per emitter (top row) to determine minimum number of emitters required. Then, multiply the number of emitters required by the value in the bottom row (minimum area per emitter) to determine minimum dripfield area.

Table 4: Maximum Emitter Discharge Rates by Soil Type (gallons per hour)

WA Soil Type	1, 2	3	4	5	6
Geoflow Dripline with PC emitters	1.02	1.02	0.53	0.53	0.53
Geoflow Classic Dripline (non-PC emitters)	1.33	1.33	Not recommended	Not recommended	Not recommended

Netafim Dripline	0.92	0.92	0.62	0.62	0.42

Table 5: Bulk Density Where Root Restrictions Occur for Various Soil Textures

Soil Textural Class	Bulk Density Where Root Restriction Begins to Occur (g/cm3)
Coarse, medium, and fine sand and loamy sands other than loamy very fine sand	1.69
Very fine sand, loamy very fine sand	1.63
Sandy loam	1.63
Loam, sandy clay loam	1.60
Clay loam	1.60
Sandy clay	1.59
Silt, silt loam	1.54
Silty clay loam	1.49
[1]Silty clay	1.45
[1]Clay	1.39

[1]Drainfields are not allowed in these soil types in Washington

A bulk density test is recommended if soil is determined to be compacted or cemented. If soil density approaches the values shown in this table (within 95% of), the number of emitters and corresponding area should be increased accordingly from values shown in shown in Table 2. (See discussion on Bulk Density in Appendix A for related information.)

Table 6: Dripline Installation Methods

INSERTION METHOD	ADVANTAGES	DISADVANTAGES
a) Hand Trenching	• Handles severe slopes and confined areas • Uniform depth	• Slow • Labor intensive • Disrupts existing turf and ground • Back fill required

b) Oscillating or Vibrating plow. Use the type that inserts the dripline directly in place, not one that pulls the dripline through the soil.	• Fast in small to medium installations • Minimal ground disturbance • No need to back fill the trench	• Depth has to be monitored closely • Cannot be used on steeper slopes >20% • Requires practice to set and operate adequately • Tends to "stretch" pipe. Shorter runs are required
c) Trenching machine: Ground Hog, Kwik-Trench, E-Z Trench	• Faster than hand trenching • May use the 1inch blade for most installations • Uniform depth	• Slower, requires labor • Disrupts surface of existing turf • Back fill required
d) Tractor with proprietary dripline insertion tool	• Fast • Little damage to existing turf because of the turf knife • Minimal ground disturbance • Does not stretch dripline • Adaptable to any tractor	• The installation tool is designed specifically for this purpose and is available from at least one of the dripline manufacturers
e) Tractor mounted 3-point hitch insertion implement (see Figure 3)	• Fastest. Allows up to four plow attachments with reels • Typically used with the insertion tool, a packer roller gently covers the dripline trench and smooths/firms the soil over it	• Generally suitable for large installations only

NOTE: Disturbing the soil may affect the pore structure of the soil and create hydraulic conductivity problems. Drip system designers should specify the installation method. Consultation with a qualified soil scientist or professional engineer is recommended before making decisions about the installation method.

SDS provide minimal emergency storage in the small diameter of dripline and trenches. Therefore, the pump chamber provides crucial storage in emergency situations such as power outages or pump failures. Besides emergency storage, the designer should assure that the pump chamber provides sufficient volume for sludge accumulation below the pump intake and to maintain pump submergence. These criteria require calculations involving interior tank geometry and the size of the pump. See text box titled Pump Chamber Volume in the Pressure Distribution RS&G.

Figures

Figure 1. Shallow Drip Installation Trench Detail

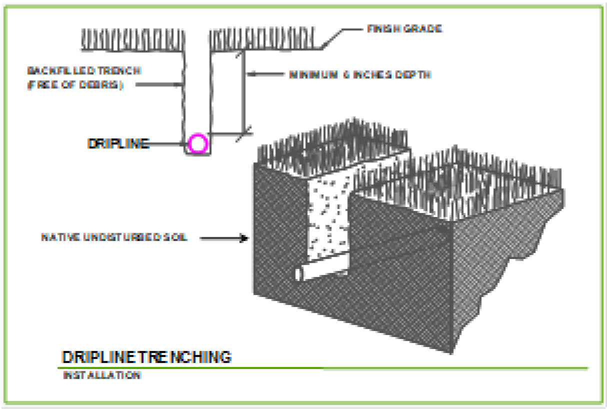


Figure 2a. Soil Wetting Pattern Around a Drip Emitter with Timed Dosing

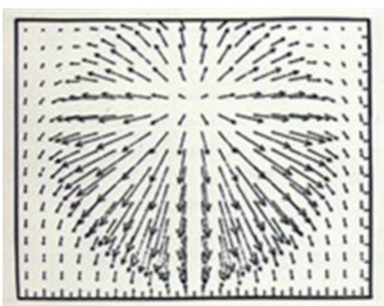


Figure 2b. Wetting Pattern Model for 2 Soil Types or Dose Times (Courtesy of TVA)

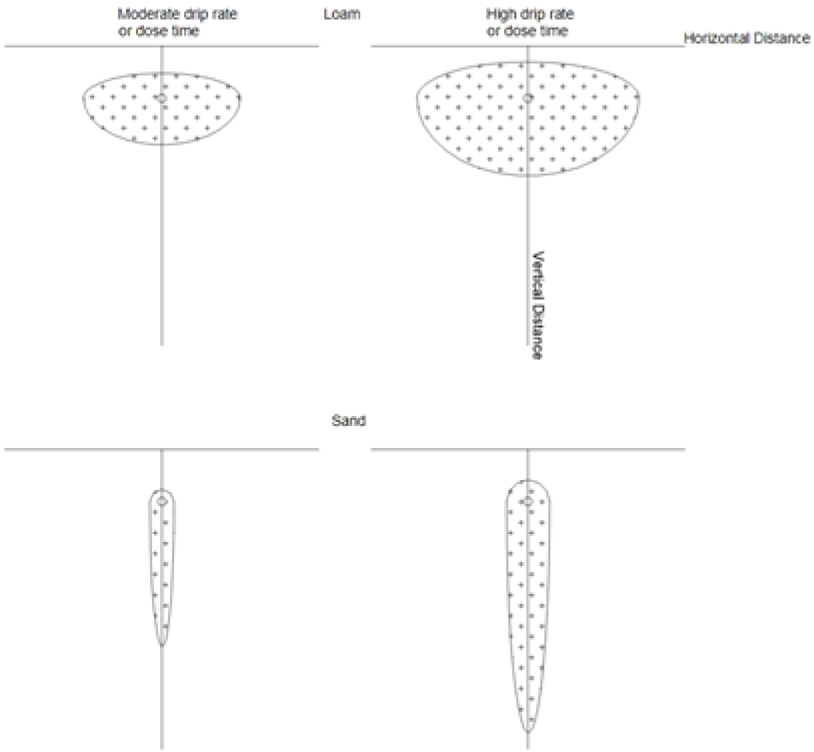


Figure 3. Tractor-Mounted 3-Point Hitch Insertion Implement (Courtesy of Geoflow)

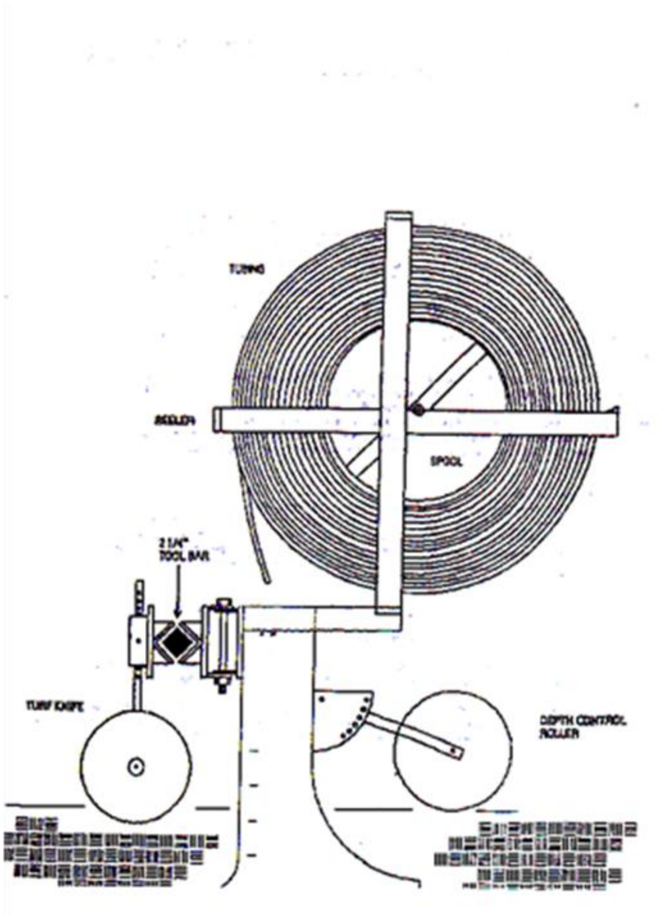


Figure 4. Example of Filter Assembly with Schrader Valves

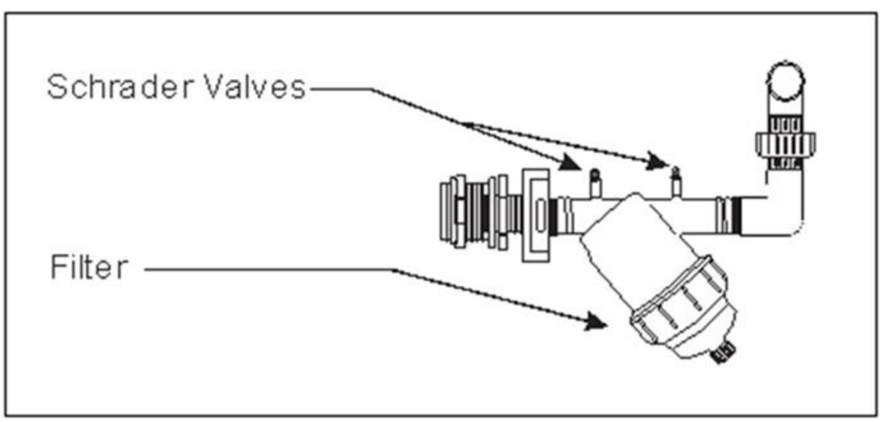


Figure 5a. Example of Continuous Flush Headworks (Courtesy of Indigo Designs)

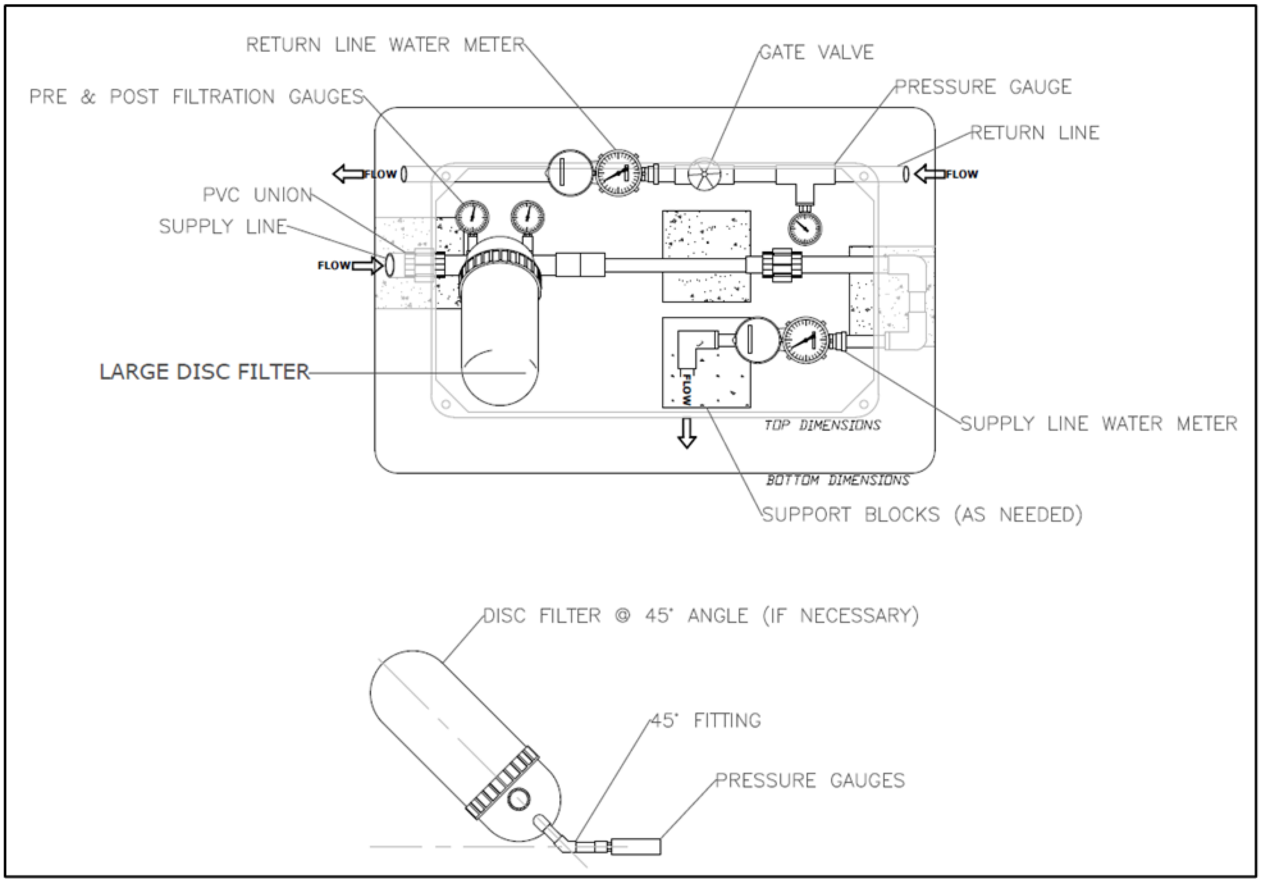


Figure 5b. Control Valve, Filter, and Pressure Regulator in Protected Vault

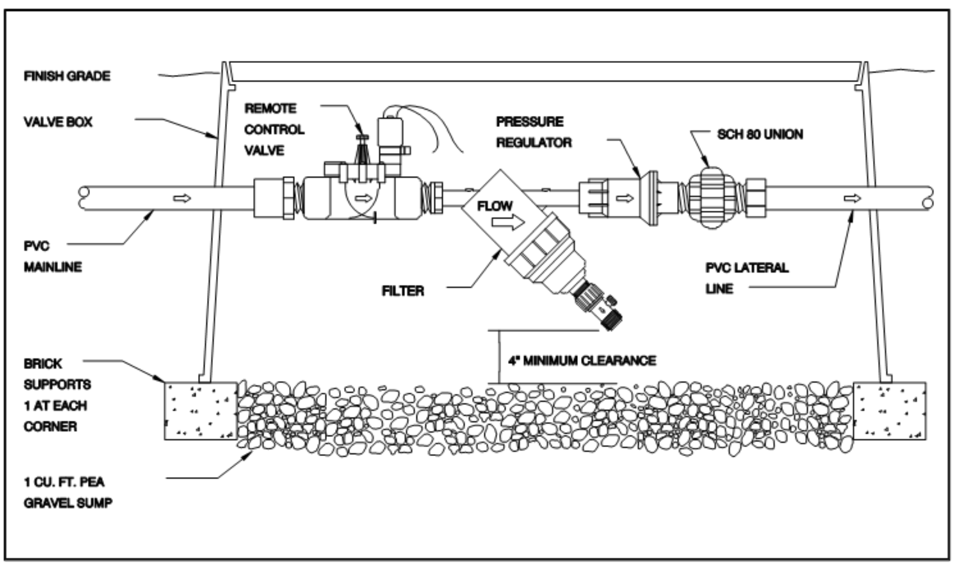


Figure 6. End Feed Subsurface Drip System Installation with Flush/Sub-Manifold

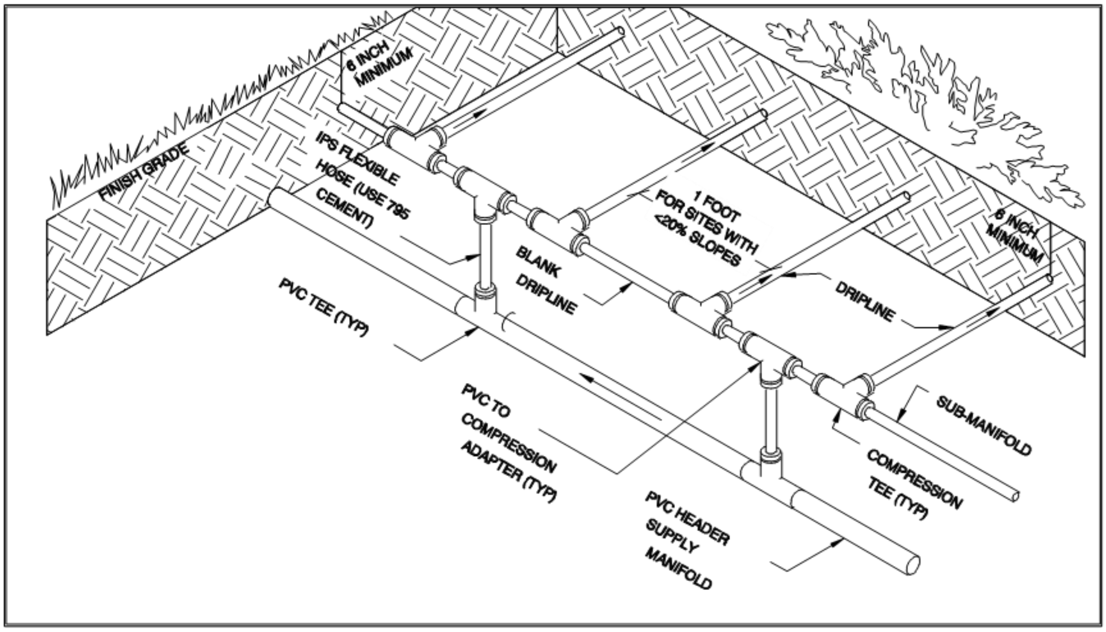
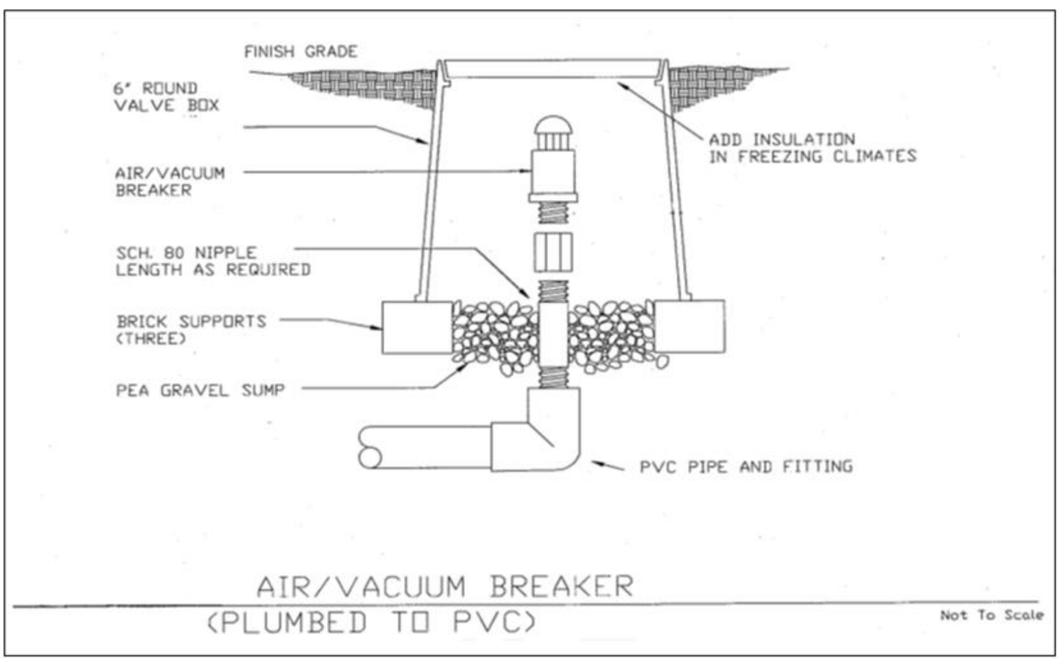


Figure 7. Air/Vacuum Relief Valve in Valve Box with Gravel Sump



The gravel sump should be deep enough to accommodate effluent overflow volume [minimum 6 inches, deeper (8-10 inches) in cold climates]. Where freezing is a concern, insulate the lid (e.g., with Styrofoam) and add insulation material inside the valve box and around the vacuum breaker using a dry material such as perlite, preferably packed in multiple small waterproof bags. The vacuum breaker must remain accessible for inspection and servicing.

Figure 8. Dripfield Installation on Mounded Site

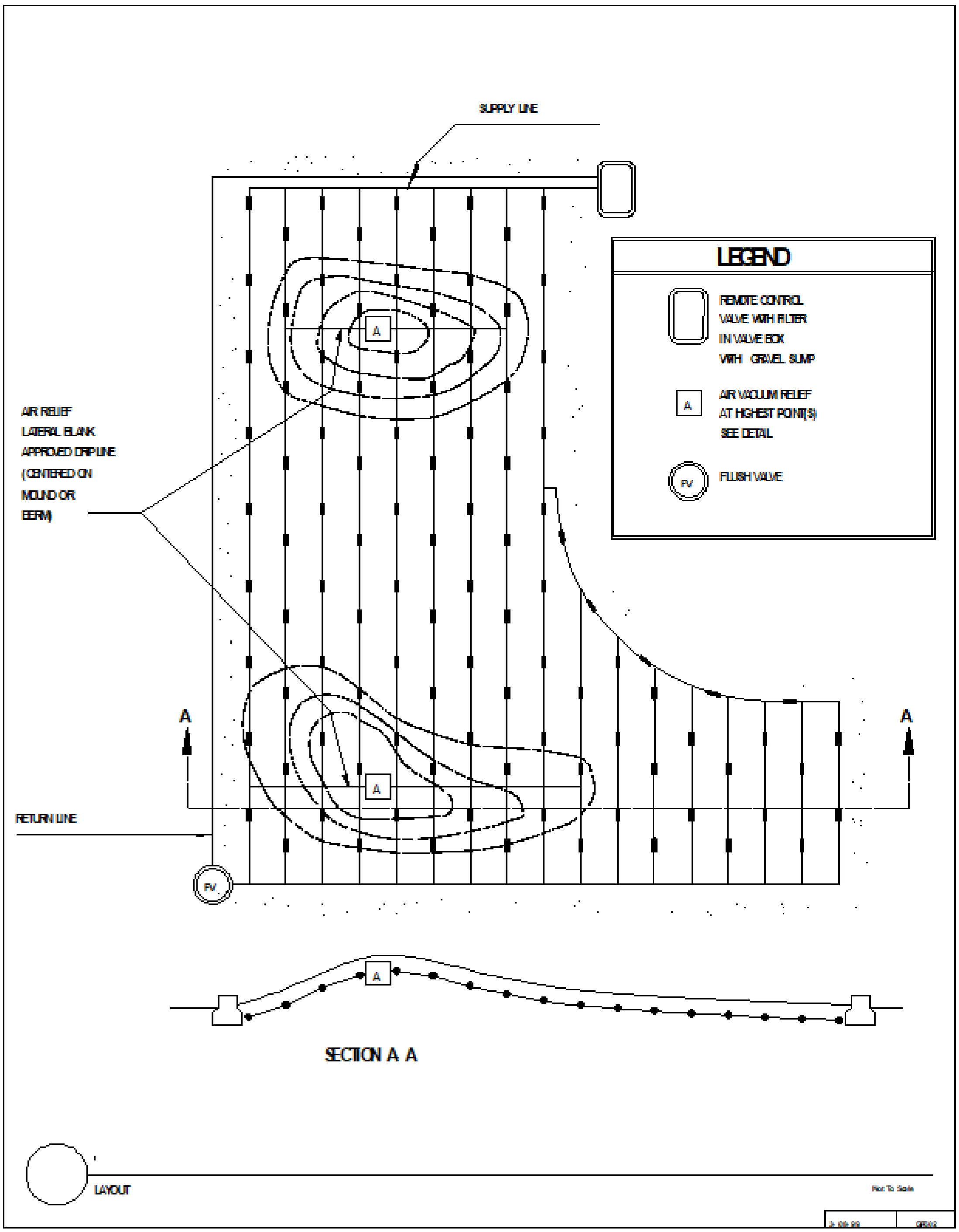


Figure 9. Berm Method to Prevent Low Level Drainage from Dripline on a Sloped Site (Courtesy Geoflow)

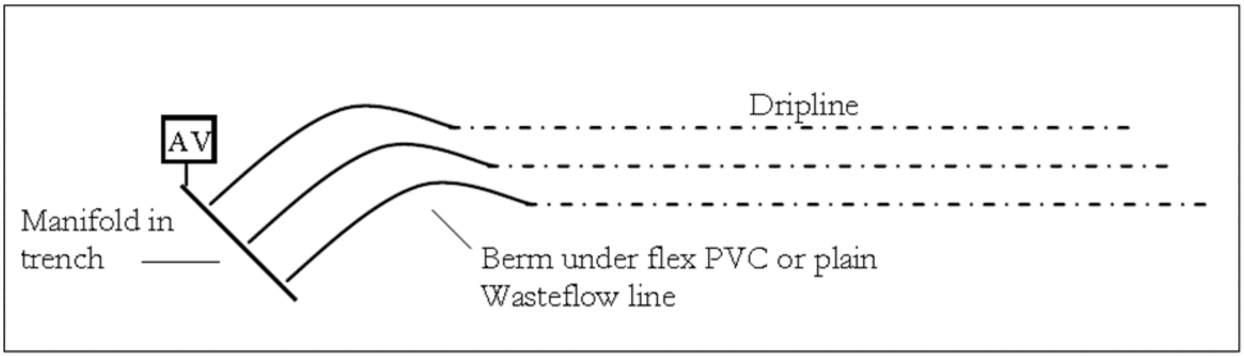
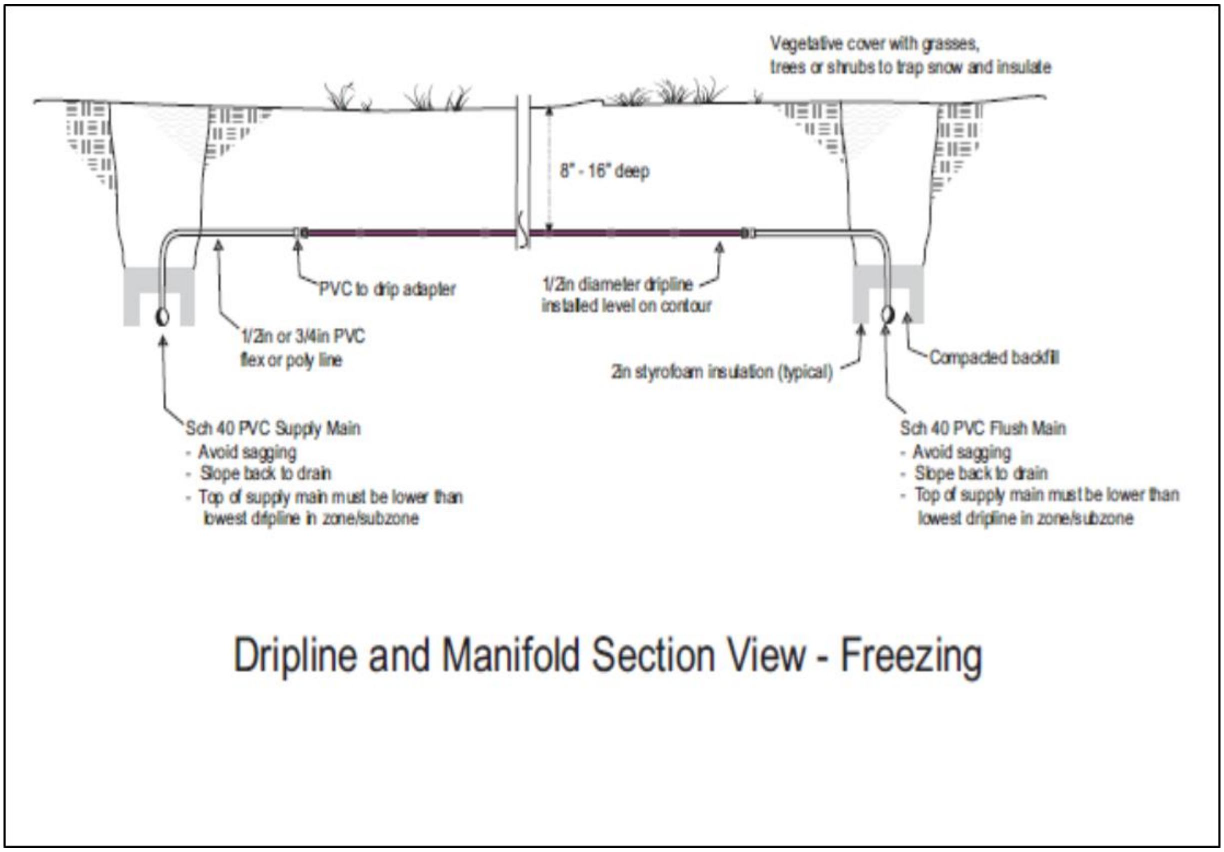


Figure 10. Example of Chimney Effect

Figure 11. Dripline and Manifold Section View for Freezing Prevention



Appendix A—Design Considerations

- If allowed by the LHJ, the reserve area can go in between dripline trenches if the dripline spacing in Table 2 is at least doubled.
- Filters should be rated for the total system discharge rate during flushing.
- One or more air vacuum relief valves are required at the high point(s) of the dripfield.
- The system should be kept in continuous service whenever possible (see Appendix Sections on Frost and Rodent Protection).
- Manifolds (supply and return) should drain by gravity to the design destination whenever practical (e.g., pump, septic tank, trash tank, etc.) . When necessary, supply and return manifolds should be insulated or buried below the frost line (see Figure 11).
- Install a manual or automatic drain valve on the flush/return manifold. Assure it remains open for sufficient time to allow the entire dripfield to drain between doses.
- For cold weather applications, see section of Frost Protection for recommendations. insulate all equipment boxes, including headworks, filter and valve boxes, zone dosing valves, and air vacuum relief valves. Insulate access box interior with closed-cell insulation such as perlite in small plastic bags or employ dripline manufacturer-recommended materials/methods.
- The top air vacuum relief valves must be no higher than soil surface.
- For cold weather applications.

Porosity

As the parent material of the soil becomes weathered and loosened, mixed by a variety of forces, pore space develops, providing a place for air and water to be held. It is not only the amount of pore space that is important but also the sizes of the pores, since small pores retain water very well and large ones tend to drain out to be re-filled with air. Therefore**, it is desirable to have both large and small pores in the soil**. The percentage of pore space is called the soil porosity.

Density

The density of soil is an expression of how loose or tight a soil is. Density of soil is really bulk density because it includes both the solid particles and the pore spaces among them. Therefore, **if a soil is compacted, the amount of pore space is reduced, and the weight of a given volume of that soil is increased**. Density can be expressed in the English system, such as pounds per cubic foot, but it is customary to use metric units. Water has a density of 1 gram per cubic centimeter (cm3), making it convenient to compare other materials to it. The mineral grains in the soil have a density of about 2.6 grams per cm3. The total volume of the soil is around 40-60% pore space, so by using a mean value for porosity we get a bulk density of 1.3 grams per cm3. Note that this is one-half the density of the minerals in the solid rock.

Some soils have naturally compacted pans that may have a bulk density of 2+ grams per cm3. This is **restrictive to root penetration and water movement.** In other cases, heavy tractors and machinery may cause serious compaction, which is very limiting to plant growth.

Source: Soil Science Simplified, 2nd Edition, 1988 Harpstead, M., Hole, F., Bennett, W.; Iowa State University Press

Estimating the Bulk Density of a Soil Sample

Obtain an iron cylinder or a tin can with open ends, which is about the size of a pint ice-cream container. Drive the cylinder or can into the soil so that the top is even with the soil surface. Use a large knife to cut the soil from around the cylinder. Next, dig out the buried cylinder using care to slice off the bottom evenly without disturbing the soil core. Transfer the soil to a pan and oven dry the sample. The bulk density can be calculated by dividing the oven-dry weight in grams by the volume of the iron cylinder (the soil core) in cubic centimeters. Thus, if the oven dry weight of the soil core is 780 grams and the volume of the same soil core is 600 cubic centimeters, the bulk density is obtained by dividing 780 by 600, or 1.3 grams per cubic centimeter (gm per cc). Most plants do best at a soil bulk density of 1.1 to 1.4 gm per cc.

Source: Soils and their Management; 5th Edition, 1983, Donahue, R., Follet, R., Tulloch, R. Interstate Printers and Publishers, Inc.

Note: See Table 3 for a list of soil densities where root restrictions develop for various soil types.

Subsurface Drip Systems (SDS) in Type 1 Soils

Dripline in all Type 1 soils must be laid in a trench or bed lined with at least 2 feet of ASTM C-33 or coarse sand. The sand depth may be reduced to a minimum of one foot below the dripline where pretreatment to Treatment Level A or B is provided (must be on the department's List of Registered On-site Treatment and Distribution Products.). The minimum area per emitter is one square foot. It may be reduced to ½ square foot per emitter if the dripline's emitters are spaced 6 inches apart *and* pretreatment to Treatment Level A or B is provided (treatment must be listed on the department's List of Registered On-site Treatment and Distribution Products). Dripline/emitters may not be more than 6 inches to the outside edges of the trench or bed. Dripline must be covered with a minimum of 6 inches of ASTM-C33 sand (8-10 in areas where frost is a concern).

Frost Protection

Subsurface drip systems installed according to these standards have some inherent features that make them resistant to frost damage. These features include polyethylene tubing ,which is resistant to cracking when frozen; frequent timed dosing, which maintains soil moisture and creates a barrier to frost penetration; and air vacuum relief valves, which allow dripline to drain between doses. Installing more than the minimum vacuum relief valves in strategic places is recommended where frost is a concern.

Some common factors that contribute to freezing:

- System not used, under used, or used intermittently for a prolonged time during winter;
- Dripline is not installed deep enough;
- Vegetative cover is not established;
- Air/vacuum relief valves freeze, hampering drainage;
- Little or no snowfall during periods of sub-freezing temperatures;
- The dripline does not completely drain;
- Clogged emitters;
- Supply and return lines were not installed below the frost level.

Some measures that may help prevent frost damage:

- Keep the system in continuous service whenever possible.
- Manifolds (supply and return) should drain by gravity to the specified destination whenever practical (e.g., pump chamber, septic tank, trash tank, etc.). When necessary, supply and return manifolds should be insulated or buried below the frost line (see Figure 1).
- Install a manual or automatic drain valve on the flush/return manifold and assure it remains open for sufficient time to allow the entire dripfield to drain.
- When practical (where benefit outweighs risk), eliminate use of check valves.
- Insulate all equipment boxes, including headworks, filter and valve boxes, zone dosing valves, and air vacuum relief valves. Insulate access box interior with closed-cell insulation such as perlite in small plastic bags, or
- Employ dripline manufacturer-recommended materials/methods.
- Ensure the top of air vacuum relief valves is no higher than soil surface.
- Install and insulate multiple air vacuum relief valves at appropriate locations places and regular check and service as needed to assure they are working properly.
- If using an index valve to split field zones, be sure it is capable of self-draining.
- Dripline will self-drain through the emitters into the soil. If the cover crop over the dripfield is not yet adequately established, add hay or straw over the field for insulation.
- Mark valve boxes with a metal pin so it can be found if covered in snow.

Rodent Protection

Rodents can damage drip system components. Gophers have been reported to eat through dripline and burrow into valve boxes and other enclosures where they can damage components or fill the valve box up with soil. One dripline manufacturer reported rodents will not burrow near dripline when the ground is kept continuously moist (one reason for high frequency dosing). Thus, rodents can pose a problem when a drip system is left out of service for a period of time. It is a best practice to test a drip system after a period of dormancy before it is placed into continuous service, as described in Section 2.7. Another option is to install the dripline at least 18 inches deep when sufficient vertical separation exists since rodents reportedly do not routinely burrow that deep.

A chemical application may help with rodents. For example, an occasional application of butyric acid, the compound that gives spoiled butter its rancid smell, reportedly discourages rodents. It is injected into the dripline via the pump chamber to achieve the recommended 2 ppm solution. It is relatively harmless but creates an unpleasant odor and should only be used if necessary.

To prevent rodents from burrowing into or storing spoils in valve boxes, line the bottom of the box with bricks, drain rock, or small mesh hardware cloth to create a barrier to digging. Placing mothballs or sprinkling butyric acid or powdered boric acid at the bottom of valve boxes reportedly discourages rodents. Avoid placing anything corrosive on or near electrical wires or other sensitive SDS components.

Drainback and the Chimney Effect

Drainback

Drainback and low level or low head drainage is an issue dripline manufacturers address in their design manuals and is discussed in the department's Pressure Distribution RS&G. It refers to the tendency for time-dosed pressure systems to drain to the lowest point after dosing, with emphasis on the PD laterals/orifices or SDS dripline/emitters. With frequent time-dosing, this can result in overloading low points in the dripline or distribution zone and potentially lead to a failure if not addressed in the design phase. Risk of this occurring is typically higher in finer textured soils.

Designers and installers should be aware of the cause and means to prevent these problems. Drainback occurs when effluent accumulates during dosing in the trench or channel in which dripline is installed. It then flows by gravity to lower points in the system, such as into manifold or transport piping trenches. If the dose volume is too large for the soil to absorb it quickly, effluent can eventually pond or break out to the surface.

This problem occurs in fine-textured soils when the combination of emitter discharge rate, pump run time, and total dose volume exceeds the infiltrative capacity of the soil. Installation technique and soil conditions during installation can also contribute. When dripline follows a pulled bullet, the soil can be compacted or smeared by vibratory plows or insertion tools, particularly when the soil is too wet during installation. This can reduce the infiltrative capacity of the soil and encourage effluent to follow the channel or trench in which the dripline is installed. On sloped sites, where multiple dripline segments connect to a sloped trench carrying transport piping, the cumulative flow into the trench can be significant.

The problem can be solved in a number of ways:

- Always install dripline as level as possible.
- Transport and supply manifold piping should be installed up gradient from dripline (see Pressure Distribution Systems RS&G Figure 3B for example). If this is not practical, the manifold can be installed below the dripline laterals if check valves are employed. This will prevent low level drainage (concept illustrated in Figure 3A Pressure Distribution RS&G).
- Earthen dams can be constructed where dripline connects to the manifold or transport piping to prevent passage of effluent (see Figure 9).
- Select dripline with lower discharge rates in fine textured soils (0.5 and 0.6 GPH are recommended).
- Design drip systems to dose frequently (see Design Standards and Tables for minimum dose frequency for each soil type).
- Pump run times should not exceed manufacturer's recommendations for the soil type. Designers should consider the volume of effluent that drains between doses.
- Select an installation technique and follow manufacturer's instructions to minimize smearing.
- Consult with the manufacturer and/or knowledgeable vendors, designers, or installers for other methods.

Chimney Effect

Another problem reported with new drip systems installed in fine textured soils is called the chimney effect (see Figure 10). This is when effluent surfaces above the dripline during dosing. It occurs in shallow, trenched installations where finished backfill is less dense and has greater porosity than the surrounding native soil. If the application rate and/or dose duration exceeds the infiltrative capacity of the receiving soil, then the soil around the emitter becomes saturated. As more effluent is applied to the now saturated soil, the effluent will create a channel and move upwards through the unsaturated backfill and surface native soil. This problem may be avoided by:

- Using Table 2 for system design criteria.
- Using Table 4 to determine the maximum emitter discharge rates by soil type.
- Lightly compacting the backfill, making compaction similar to the native soil compaction level while not extending the compaction to the depth of the drip lines after installation.
- Installing dripline deeper if vertical separation requirements can be met.
- Increasing the number of doses per day.
- Lowering the discharge rate.
- Planting a cover crop.

Appendix B—Department of Health (DOH) Checklist for Subsurface Drip Systems (SDS)

Inspection Checklist

Name of Owner ___________________________________

Address ______________________________________ Parcel# ____________________

Soil type ____________________

System is designed for residential _____ number bedrooms ____ pipe volume (amount of effluent needed to fill the supply and distribution system) _____ total _______

or commercial ___________ design flow __________ pipe volume _______

total _______

If commercial system type: ______________ is it residential strength wastewater _______ or treated to residential wastewater?

If yes, how? ____

______ Designer has SDS training

______ Owner's manual provided to owner by designer

______ Homeowner or developer has an initial 2 year service contract with a qualified service provider.

Components/Sizing

Dripline manufacturer and emitter size must be noted on the record drawings/as-built.

All dripline is color-coded (purple or pantone 522) to identify the (non-potable) water source.

This SDS includes a known root inhibitor or herbicide incorporated into the material during the manufacturing process to prevent root intrusion into emitters.

All components are from the same manufacturer or approved by the dripline manufacturer _Y/N ____

The discharge is controlled by a pressure regulator with maximum rated discharge of _____ GPD.

Dripline is installed ___ inches deep

Dripline spacing is _____ feet.

Emitter spacing is ______ feet

Maximum daily emitter discharge per Table 2 is ______

Design flow divided by the emitter discharge from Table 2 requires _______ emitters

Total dripline length = # emitters x emitter spacing: _________

Area per emitter ________

Minimum area needed for primary drain field ___________ square feet

Soil type in reserve area __________

Total reserve area needed __________ square feet

Number of doses per day per Table 2: _______
_____Dripline is installed level and parallel to contours ____________
SDS was installed to prevent drainback (effluent that flows back into the pump chamber after a dosing event), and low-level drainage of effluent along dripline or manifolds using the following technique(s):
_____ Manifolds were installed up gradient from dripline,
_____ Dripline installed 4-inches lower than supply line,
_____ Earth dams,
_____ Check valves,
_____ Other (specify) ____

Filters

Filters are ____ disk type or _____ fine-mesh screen type.
_____ Filters are as specified by manufacturer and in the design
_____ All filters are readily accessible for inspection and servicing.
_____ An effluent filter is installed at the septic tank outlet

Means to readily measure flow:

______ Flow meters are designated for wastewater.
______ Flow Meter is installed in a readily accessible location.
______ Flow meter on supply and return lines in continuous flush systems.
______ Flow meter is as specified on the design and rated for expected operating range.
______ Flow Meter is approved for use with wastewater.

Means to readily measure pressure:

______ There is a pressure gauge or Schrader valve on both sides of the filter.

Testing/Inspection

Initial inspection date (within 30 days of installation) _______________
The installer measured the flow rate with the flow meter and pressure tested the distribution system, and verified that the system is watertight, recorded baseline flow-rate and pressure information _______
The installer provided the results of the initial flow rate and pressure tests to me during the Inspection: Yes __________ No _________
I _____ did _____ did not require the hydraulic test to be performed in my presence.
I _____ did _____ did not require the pressure test to be performed in my presence
Initial operating pressure of system (PSI) _________________
Initial measured system flow rate (GPM) _________________

Materials (General)

______ Septic tanks and pump chamber are on the DOH List of Registered Septic Tanks.
______ Materials are warranted by the manufacturer for use with wastewater

______ Dripline is color-coded to identify noon-potable source
______ Dripline is on the DOH List of Registered Treatment and Distribution products.
Dripline is ________ pressure compensating _________ non-pressure compensating
System is _______ automatic ________ manual ______ continuous flush
______ All transport pipe, supply and return manifolds, and fittings are Schedule 40 PVC or better.
_____ Fittings used to join dripline to the distribution and flush manifolds meet manufacturer's recommendations for type, size, material, and pressure rating.

Pump Chamber

Pump chamber size is ______ gal.
_______ Pump chamber is installed at lower elevation, relative to the septic tank, to maximize available storage. If not, describe other method used to maximize available storage
____
____

Valves

_____ Air/Vacuum Relief Valves are installed.
_____ One at the highest point in each distribution zone - REQUIRED
One at the high point of the end of the supply manifold
_____ One at the high point of the return manifold and any other high points in the system.
_____ All valves are installed in valve boxes with access to grade and include gravel sumps.
_____ Valves are insulated (if necessary)
_____ All valves are readily accessible for inspection and servicing
_____ Irrigation type valves were not used
_____ Valves are automatic. (Required with minimum treatment (septic tank only)

Layout/Configuration

_____ Number of zones

Flushing

______ Both supply and return manifolds were installed.
______ Filter backwash and dripline flush is automatic or continuous.
______ Manual valves were installed.
______ The system is continuous flush.
______ Irrigation valves were not used.
______ Hose bibs are not installed for flushing.
______ Return Manifold slopes toward septic tank.
______ A chemical injection port has been installed.
______ Time dosed SDS.
______ The system has telemetry tracking.
______ Number of doses/day.

Dosing is tracked and verified by means of: (check all that apply)
________ Flow meter
______ Digital control panel,
______ Pump elapsed time meters (ETMs),
______ Event counters
______ Other

Installation

______ A qualified on-site sewage system installer, with specific training in the installation of subsurface drip systems, installed this SDS.
The dripline was installed using one of the following methods (check the method used):
_____ Hand-trenching or
_____ Use of a trenching machine, vibratory plow or other approved insertion tool
Describe: ____.
______ Installation technique that pulled or stretched the dripline was not used.
______ Inches installation depth
______ Manifolds are up gradient from dripline
Continue with regular inspection report form for consistency with the design.

Operations and Maintenance (O&M) Checklist

Date of O&M inspection ___________________________
O&M inspector ____
OSS Permit # ________________________ Designer ___________________________________
Name of owner ____
Address ____
Parcel# __________________________________
Residential _________ Commercial _______ Design Flow________________
Date of installation _________________________
Installer ____

Testing/Inspection

Filter
Manually flush for 3 or more minutes
Pressure reading taken while system is running
Is the vacuum release seating properly – push down to flush debris
Reset controller to auto (if system is automatic)
Once a year clean all valves and vacuum release by taking apart
Initial operating pressure of system (PSI) __________ Current ________ Final (end of O&M servicing)____________

An increase in pressure could be due to clogging filter surfaces or tubing. A decrease in pressure or no pressure on the return line could signal a leak within the system, a change in the pump performance, and/or broken or inoperable valves
Initial measured system flow meter reading rate (GPM) _____ Current ____ Final (end of O&M servicing) _______
Decreased flow rates may indicate emitter plugging is occurring within the system.
Increased flow rates may indicate malfunctioning check valves, vacuum release valves, broken drip tubing, and breaks in piping.

System Components
Treatment unit/technology
Condition ____
Attach O&M inspection for the technology
Septic tank:
Condition ____
Outlet filter brand _____________ cleaned _______
Pump Chamber:
Condition ____
Floats operating correctly? ________________ Drawdown in inches/cycle: ______
Time on ________ Time off ________ Doses/day _____ Alarms functioning correctly _________
Controller information: Elapsed time meter (ETM) ______ pump counter ______
overrides ____ High level alarms _____ power failures _____ Reset controller in the auto mode____
Headworks box:
Condition ____
______ water in box _______ no water in box
Filter: it is advisable to replace the filter with a clean one and take the other back to the shop for cleaning in freezing conditions
______ cleaned _____ replaced (if necessary)
Vacuum relief valves:
Condition ____
_______ water leaking from top _____ flushed (push down ball)
Drainfield area: _______ field flushed ____ minutes
Condition: ___ dry ___ wet __ firm __ soft
Replaced parts (include manufacturer no.):
____

Appendix C – References

1. Ben-Asher, J., Phene, C.J.; May 1993; The Effect of Surface Drip Irrigation on Soil Water Regime Evaporation and Transpiration; Proceedings 6th International Conference on Irrigation

2. Benson, Richard, comments, 2020

3. Bouma, J., Anderson,, J.L.; 1973, Relationships Between Soil Structure Characteristics and Hydraulic Conductivity; Field Soil Water Regime; Soil Science Society of America; p 77-105

4. Camp, Busscher, and Sadler; Wetting Patterns for Line-Source Trickle Emitters, ASAE paper No. 87-2524, 1987

5. Clothier, Scotter and Harper, Three-Dimensional Infiltration and Trickle Irrigation, ASAE paper # 83-2518, 1985

6. Converse, J., Jan. 1997, revised Jan. 1999, Drip Distribution of Domestic Wastewater; Small Scale Waste Management Project, University of Wisconsin-Madison

7. Darby, Tchobanoglous Emerick, and Test; Shallow Intermittent Sand Filtration: Microorganism Removal, The Small Flows Journal Vol. 3, Issue 1, Winter 1997

8. Darby, Tchobanoglous, Asri Nor and Maciolek; Shallow Intermittent Sand Filtration: Performance Evaluation; The Small Flows Journal Vol. 2, Issue 1, Winter 1996

9. Donahue, Follett and Tulloch; Our Soils and Their Management, Fifth Edition, The Interstate Printers and Publishers, Inc., 1983

10. Ferguson, Karen, GeoFlow, comments, 2020

11. Geoflow, Inc. Design, Installation and Maintenance Guidelines, October 2007.

12. Geoflow, Inc. Wastewater Dripline Flush Velocity, 2016

13. Gupta, Rudra, and Dickinson, Modelling of Saturated Regime as Affected by Emitter Application Rates;

14. Harpstead, Hold and Bennett, Soil Science Simplified, 2nd Edition, Iowa State University Press, 1988

15. HD Fowler Co., Continuous Flush Subsurface Drip Design Manual, 4.0

16. Heath, R., Basic Ground-Water Hydrology, US Geological Survey Water-Supply Paper 2220, US Government Printing Office, 1989

17. Hung, J., Determination of Emitter Spacing and Irrigation Run-Time Including Plant Root Depth;

18. Knopf, Eric, Indigo Designs

19. Levin, Van Rooyen, P., and Van Rooyan, F., The Effect of Discharge Rate and Intermittent Water Application by Point Source Irrigation on the Soil Moisture Distribution Pattern, Soil Science Society of America Journal, Vol. 43, 1979

20. Lockington, Parlange, and Surin; Optimal Prediction of Saturation and Wetting Fronts during Trickle Irrigation, Soil Science Society of America Journal, Vol. 48, No. 3, May-June, 1984, pp. 498 – 493

21. Lowe, Dave, Lowridge Onsite Technologies., LLC

22. Mahuta Jr., F., Boyle, W.C.; Gas Transport in the Unsaturated Zone of Soil Absorption Systems; On-Site Wastewater Treatment: Proceedings of the 6th National Symposium on Individual and Small Community Sewage Systems, (A.S.A.E.)

23. McCarthy, et. Al, Performance Evaluation of Alternative Treatment Systems in Northern Minnesota, Proceedings of 1998 ASAE Conference

24. Netafim USA, Wastewater Reuse and Drip Design Guide, 6/08

25. Oron, G., Karmeli, D., The Flow Regime in the Root Zone Around a Subsurface Emitter, Israel Journal of Technology, Vol. 17, 1979 pp. 95-101

26. Oron, G., Simulation of Water Flow in the Soil Under Subsurface Trickle Irrigation with Water Uptake by Roots, 1981, Agricultural Water Management, Elsevier Scientific Publishing Co.

27. Osborne, D. and Harman, J., Design of Drip Disposal Systems for Wastewater Treatment and Disposal, Soil Science Society of NC Proc., Vol. XXXVI, 1993

28. Phene, C.J., et al; Research Successes, Applications and Needs of Subsurface Drip Irrigation

29. Phene, C.J., et al; 1993, Evaluation of a Subsurface Drip Irrigation System After 10 Cropping Seasons; Proceedings 1993 International Winter Meeting (A.S.A.E.)

30. Phene, C.J., Ruskin, R.; Potential of Subsurface Drip Irrigation for Management of Nitrate in Wastewater;

31. Risse, L., Chesness; J., A Simplified Design Procedure to Determine the Wetted Radius for a Trickle Emitter, ASAE paper # 89-2081, Oct. 1989

32. Rowan, Michael A., MS The Utility of Drip Irrigation for the Distribution of On-Site Wastewater Effluent. Doctoral degree dissertation, Ohio State University, 2004.

33. Rubin, A.R., S. Greene, Sinclair, T., Jantrania, A.; Performance Evaluation of Drip Disposal System for Residential Treatment.

34. Ruskin, Rodney, Guidelines For Subsurface Drip Disposal of Primary Treated Effluent for Systems <2,000 GPD, February 2010.

35. Siyal, A.A., T.H. Skaggs June 2009. Measured and simulated soil wetting patterns under porous clay pipe sub-surface irrigation. Agricultural Water Management, Volume 96, Issue 6, p 893–904.

36. Tennessee Valley Authority and EPRI, March 2004. Wastewater Subsurface Drip Distribution Peer Reviewed Guidelines for Design, Operation, and Maintenance. Final Report 1007406.

37. Tower, Keith, Tower Designs, Leavenworth, WA

38. Wilson, D., Filtration in Drip Irrigation; Technical Proceedings, Irrigation Association Annual Conference, 1980

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