Recommended Standards and Guidance for Performance, Application, Design, and Operation and Maintenance

Subsurface Drip Systems

August 2020
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<td>O&amp;M section is new</td>
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Additional checklists and information has been added to the appendices.
Preface

The standard recommended in this document are developed for statewide application. Regional differences, however, may result in application of this technology in a manner different than what is presented here. In some areas, greater allowances than those described here may be granted. In other areas, allowances provided for in this document may be further restricted. In either case, the local health officer has full authority in the application of this technology, consistent with WAC 246-272A and local jurisdictional rules. If any provision of these recommended standards is inconsistent with local jurisdictional rules, regulations, ordinances, policies, procedures, or practices, the local standards take precedence.

Local jurisdictional 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 more accurately reflect local conditions, 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 more accurately reflect local conditions, may be used locally as technical guidance.

Application of these recommended standards may combine these two approaches. How these recommended standards are applied at the local jurisdictional level remains at the discretion of the local health officer and the local board of health, provided the application does not deviate from WAC 246-272A.

The recommended standards are provided in typical rule language to assist those local jurisdictions where adoption in local rules is the preferred option. Other information and guidance is presented in text boxes in italics to easily distinguish it from the recommended standards.

**Glossary of Terms:** A glossary of common terms for all RS&Gs can be found on the DOH Web site at [http://www.doh.wa.gov/Portals/1/Documents/Pubs/337-028.pdf](http://www.doh.wa.gov/Portals/1/Documents/Pubs/337-028.pdf).

The recommended standards contained in this document have been primarily written to support the design of on-site sewage systems (OSS) with design flows less than 3500 gpd, but may also be applied to large on-site sewage systems (LOSS).

With the adoption of the revised LOSS rule, chapter 246-272B WAC, in 2011, some provisions of the RS&Gs may not be appropriate or allowed for LOSS. Many applicable requirements from the RS&Gs have already been included in the LOSS rule. Design engineers and others interested in LOSS are directed to consult the rule and LOSS program staff before or instead of the RS&Gs.
Typical RS&G Organization:

<table>
<thead>
<tr>
<th>Standards Section</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>Performance</td>
<td>How this technology is expected to perform (treatment level and function)</td>
</tr>
<tr>
<td>Application</td>
<td>How this technology is to be applied. This section includes conditions that must be met prior to proceeding with design. Topics in this section describe the “approved” status of the technology, component listing requirements, permitting, installation, testing and inspection requirements, etc.</td>
</tr>
<tr>
<td>Design</td>
<td>How this technology is to be designed and constructed (includes minimum standards that must be met to obtain a permit).</td>
</tr>
<tr>
<td>Operation and Maintenance</td>
<td>How this technology is to be operated and maintained (includes responsibilities of various parties, recommended maintenance tasks and frequency, assurance measures, etc.)</td>
</tr>
<tr>
<td>Appendices</td>
<td>Design examples, figures and tables, specific applications, and design and installation issues.</td>
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</table>
Introduction

Drip irrigation has been used for many years in agricultural settings but has only been employed successfully in the United States to distribute wastewater since the late 1980s. Most of the initial experience with drip technology has been in the Southeastern United States. In the past few years the technology has garnered widespread interest nationally and there are now a number of states that are conducting research, developing standards and/or actively permitting these systems.

A subsurface drip system (SDS) is an efficient pressurized wastewater distribution system that can deliver small, precise doses of effluent to shallow subsurface dispersal/reuse fields. SDS distribution piping is small diameter, flexible polyethylene tubing (dripline) with small in-line emitters (orifices that can discharge effluent at slow, controlled rates, usually specified in gallons per hour). Dripline can be trenched (by hand or with a trenching machine) into narrow, shallow trenches (see Figure 1 below) or plowed (with a vibratory plow or other insertion tool) directly into the soil and backfilled without gravel or geotextile. The typical installation depth is between 6 and 10 inches.

Figure 1. Shallow Drip Installation Trench Detail

Typical dripline installations in other states feature emitters spaced 2 feet apart and the dripline is 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. A computer-generated model shows the idealized effluent distribution pattern around an emitter with timed dosing (see Figure 2). 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 (see 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.

**Figure 2a. Soil Wetting Pattern Around a Drip Emitter with Timed Dosing**
To avoid effluent surfacing during dosing, care must be taken 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 (see Table 4).

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

SDS can be used to distribute either primary, secondary or tertiary effluent. The level of pre-treatment 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.

Dripline can be pressurized quickly resulting in very even distribution.

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:

<table>
<thead>
<tr>
<th>Engineering Concerns</th>
<th>Technical Solutions</th>
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<tbody>
<tr>
<td>Small diameter drip piping installed in shallow, narrow trenches and backfilled without drain rock provides insignificant emergency storage to handle occasional flow surges.</td>
<td>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.</td>
</tr>
<tr>
<td>Dripline and emitters are vulnerable to clogging from suspended solids.</td>
<td>Primary settling and filtration in accordance with dripline manufacturer’s specifications is required for all drip systems. Additional treatment is recommended.</td>
</tr>
<tr>
<td>Low emitter discharge rates result in low pipe flow rates. Insufficient scouring velocity is provided during dosing to prevent sludge build-up in dripline and other distribution piping.</td>
<td>Distribution piping must be installed in closed-loop networks with control valves, supply and return manifolds to allow for 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.</td>
</tr>
<tr>
<td>Engineering Concerns</td>
<td>Technical Solutions</td>
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</table>
| Small diameter dripline and emitters are vulnerable to plugging from a buildup of  | **To reduce bacterial slime buildup in dripline:**  
  bacterial slime and/or scale.                                                         1. Periodic line flushing is required for all drip systems.  
  2. Geoflow coats the interior wall of their dripline with a bactericide;  
  3. Netafim applies an antibacterial coating to its emitters and stresses adequate flushing velocity in their design manual and literature.  
  4. If necessary, a mild chlorine bleach solution may be injected periodically. |
<p>| Dripline installed directly into the soil without geotextile and subject to frequent  | Air / vacuum release valves are essential to help prevent soil particles from being sucked into emitters and are required on all drip systems.                                                                                     |
| changes in system pressure can result in suction of soil particles into and plugging of |                                                                                                                                                                                                                      |
| emitters.                                                                          |                                                                                                                                                                                                                      |
| Shallow placement of dripline where plant roots are common and nutrient-rich        | 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 by the manufacturer to be resistant to root intrusion. |
| discharge encourages root intrusion, plugging emitters which may result in uneven   |                                                                                                                                                                                                                      |
| distribution.                                                                      |                                                                                                                                                                                                                      |
| Shallow dripline installations may be susceptible to freezing during winters and     | 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, use patterns and local climate before recommending a drip system to clients. (See Frost Protection in Appendix A.) |
| cold-weather climates.                                                             |                                                                                                                                                                                                                      |
| Shallow installations of dripline are more susceptible to damage from surface       | Owners should avoid activities that might damage the drip tubing or compact the soil, such as driving or using heavy equipment over the dripsfield, digging, driving stakes into the ground, etc. Designers are advised to |
| activities than conventional drainfields.                                           |                                                                                                                                                                                                                      |</p>
<table>
<thead>
<tr>
<th>Engineering Concerns</th>
<th>Technical Solutions</th>
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<tbody>
<tr>
<td>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.</td>
<td>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-PPM solution of butyric acid (smells like vomit and gives spoiled butter its rancid smell) injected into the dripline occasionally during dosing reportedly discourages rodents. Head works and valve boxes may be underlined with hardware (wire mesh) cloth 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.)</td>
</tr>
<tr>
<td>Emitter discharge rates can exceed soil capacity to absorb effluent during dosing which can result in surfacing in fine textured soils.</td>
<td>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 also Drainback and the Chimney Effect in Appendix A.)</td>
</tr>
<tr>
<td>In fine textured soils effluent can accumulate during dosing in the trench or channel where dripline or conveyance piping are installed and drain to low points in the system and possibly surface.</td>
<td>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.)</td>
</tr>
</tbody>
</table>

The preceding discussion underscores the importance of having a good working knowledge and understanding of drip technology and of proper product/component selection and 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 to the greatest extent possible, even distribution and unsaturated subsurface flow. (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.

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SDS in general provide very 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.

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2. Application Standards

These 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 (WAC 246-272B) apply.

2.1. Listing

2.1.1. Department of Health (the department) reviews and lists proprietary subsurface dripline products when the manufacturer or designated manufacturer representative demonstrates that the product meets or exceeds the performance criteria in WAC 246-272A.

2.1.2. Before a local health jurisdiction (LHJ) may issue a permit for an on-site system incorporating subsurface dripline, the specific brand and model dripline must be included on the current List of Registered On-site Treatment and Distribution Products. Listing is not required for all other SDS components (filters, control valves, air-vacuum relief valves, and controllers) but 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 (WAC 246-272A). 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 Line Trenches, Mounds, and Intermittent Sand Filters. The SDS RS&G (including Table 2 requirements) apply to SDS installation in these public domain technologies. SDS may also be used with Recirculating Gravel Filters, but the RS&G for this technology contains unique media, filter sizing, loading and dosing requirements which supersede 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 a permit designers must submit an application acceptable to the LHJ addressing, at a minimum, items outlined in WAC 246-272A.

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. For single-family residences the minimum constructed primary and reserve area depends on treatment (see Table 2). Primary and reserve area requirements for multi-family and other commercial applications can be determined by applying the minimum area per emitter values in Table 2.

2.3. Influent Characteristics

2.3.1. SDS may be used to distribute either greywater or combined wastewater (combined wastewater means 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 gallons/bedrooms/day must be used.
2.3.3.2. Non-Residential—Design flows from recognized standards (e.g., 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 WAC 246-272A in conjunction with these standards and the dripline manufacturers’ recommendations.

2.4.2. Any treatment technology used must be listed on the most current version of the department publication List of Registered On-site Treatment and Distribution Products and 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 (where at least two feet of vertical separation is available below installed dripline depth) is residential sewage treated by a properly sized septic tank with standard effluent filter and additional filtration meeting the dripline manufacturer’s recommendations. When influent waste strength is higher than normal residential sewage values, treatment to Treatment Level E, or better, must be provided.

2.4.4. Installations of SDS where only minimum treatment is provided must include an effluent filter (1/8 inch mesh or finer) installed at the outlet of the septic tank, and 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 manufacturer’s recommendations must also be provided.

Manufacturers’ recommendations vary but generally filtration of particles larger than 100 - 120 microns is required. Designers should consult the dripline manufacturer’s filtration requirements before specifying SDS filters. Servicing frequency for effluent filters depend on the size (length and diameter) of the filter, size of filter mesh, influent characteristics, and flow rate. Consult with the effluent filter manufacturer or vendor for recommended cleaning frequency.

Residential septic tank effluent means waste typical from a residential source that has received treatment equal to or better than that provided in a properly sized and registered septic tank. Actual values for septic tank effluent parameters vary with lifestyle and household chemical and
water usage. Reasonable estimates are: CBOD5 < 228 mg/L; TSS < 80 mg/L and Oils and Grease < 20 mg/L. These values correspond to Treatment Level E.

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 WAC 246-272A.

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

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 and are solely responsible for obtaining any needed training. The installer should install SDS in accordance with the designer’s specifications and is responsible for notifying the designer when conditions are not suitable for installation as specified are encountered.

2.6.3. Installation method: the SDS designer must specify the installation method based on site and soil characteristics and dripline manufacturer’s recommendations. Installation techniques that pull or stretch dripline or smear the trench’s sidewall are prohibited. Table 6 lists common dripline installation methods.
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 suitable, as determined by the designer.

A ground cover (turf or other appropriate landscaping) as specified by the designer should be planted over the dripfld in order to prevent erosion. Soil placed over the dripfld 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 per the design and ready for use prior to placing the system into service in accordance with state and local rules. Inspections are typically provided initially by the designer or professional engineer with the installer present and followed by a final inspection by the local health officer.

2.7.2. SDS inspectors should 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, verify the system is watertight, and record baseline flow-rate and pressure information for inclusion in the Operation and Maintenance (O&M) manual. LHJs may require the hydraulic and pressure tests to 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 has shown for an accurate hydraulic test during the initial inspection the system should be allowed to run for at least 3 minutes.

2.7.4. The system must be re-inspected after 30 days of use to verify it’s still operating as designed or if any repair or adjustment are required.

Gopher damage to dripline (from chewing) has been reported in some areas. Where gophers are present, it’s advisable, when possible, to start up and test the system just prior to placing it into continuous service. This is because gophers have been reported to avoid areas where the soil is
continually moist, but may be attracted when the system is not in service and/or has been allowed to dry. If it’s 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

All design standards not found in this section 3 can be found either in the department’s publication Recommended Standards and Guidance for Pressure Distribution Systems or in WAC 246-272A.

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

Design criteria and guidance varies with each dripline 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, for providing oversight of construction and component testing, and developing post-construction documentation (e.g., O&M manual). A record drawing must be provided to the health officer and the OSS owner per WAC 246-272A. Designers must include, in permit applications and to installers who bid projects, the approved construction drawings and specifications for materials, installation, component testing, inspections, and final grading/landscaping.

3.1.3. Designers are responsible for scheduling a preconstruction meeting with the installer to go over important topics including 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 to the local health officer:

3.2.1. A design package for approval consistent with WAC 246-272A-0200, local code, these standards, and applicable standards in the Pressure Distribution RS&G.
3.2.2. A management plan including a narrative identifying the service provider, a copy of a signed service contract and outlining management responsibilities, including compliance with any LHJ O&M program requirements.

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 and report that information with the permit application in accordance with applicable requirements of WAC 246-272A. SDS are suitable for residential applications or equivalent and are not allowed for industrial waste.

3.3.2. Where waste strength is characterized as higher than residential sewage, the designer must propose a suitable treatment component and demonstrate to the satisfaction of the local health officer that the level of treatment provided 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). Based on local management plans, setbacks, vertical separation and soil type, higher levels of treatment may also be required.

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

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 BOD₅, 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 WAC 246-272A 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 and that the dripfield area will be protected from development and other damaging activities, how service providers can access systems 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 determine compliance with vertical separation requirements.

3.6. Materials

3.6.1. All SDS materials must be warranted by the manufacturer for use with sewage and resistant 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 or better.

3.6.3. Fittings used to join dripline to the distribution and flush manifolds must be in accordance with manufacturer’s recommendations. Both compression and barb fittings may be specified, depending on the manufacturer recommendations and system operating pressure.

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

SDS piping has historically been associated with 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 dripline must incorporate emitters with a maximum nominal rated discharge of 1.3 gallons per hour. Emitter discharge may be controlled either by use of pressure-compensating emitters or with a pressure regulator.

It’s advisable to only use or specify components (such as fittings, valves, filters, controls, etc.) that are made, distributed, or endorsed by the chosen dripline manufacturer. 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 that changes don’t 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 Registered On-site Treatment and Distribution List with maximum rated discharge as shown in Table 4.

3.7.2. All SDS must be warranted by the dripline manufacturer to be resistant to root intrusion into emitters.

3.7.3. Headworks: for housing serviceable components in an accessible, protective enclosure such as a large valve box. Headworks enclosures must be insulated in the cold climates, installed below grade with an access riser, and have 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. To prevent rodent intrusion, place chicken wire or smaller mesh wire/hardware cloth below the gravel.

Headworks typically come pre-assembled and are sold by dripline and component manufacturers and distributors.

3.7.4. Filters (disk or fine-mesh screen type) in accordance with dripline manufacturer’s specifications (i.e., must filter minimum particle size specified by the dripline manufacturer) are required on all SDS. Designers must specify and installers may only install filters that meet dripline manufacturer’s specifications.

3.7.4.1. Filters must be corrosion resistant and warranted by the manufacturer for use with wastewater.

3.7.4.2. 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.
3.7.4.3. All SDS filters must be installed so they are readily accessible for inspection and servicing.

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

3.7.4.5. 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) in accordance with manufacturer’s recommendations, or may be the continuously self-cleaning type.

*Flushing typically requires specialized plumbing and flush valves. See Section 3.9 for discussion on flushing filters.*

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

3.7.5. 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 to 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 or no pressure may indicate a leak within the system due to damage or disconnected dripline or broken/inoperable valves.

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

3.7.7. Flow meters and pressure gauges or means to connect them must be installed in an accessible location within the headworks to facilitate reading and servicing. Flow meters and pressure gauges must be warranted by the manufacturer for use with wastewater and be accurate within the expected operating ranges of the system.
Decreasing flow rate may indicate emitter/dripline plugging. Increasing flow rate may indicate malfunctioning check valves, vacuum release valves, broken drip tubing, or breaks in other piping.

A flow meter may be installed permanently and dedicated for use with a particular drip system or provided by the O&M provider who installs it during each service visit and removes it after the visit. 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, which together provide useful long-term performance information for pressurized system and are also recommended for drip applications. However, a key performance measure the SDS O&M provider needs is instantaneous pump rate, which a flow meter more easily provides. Together, the flow meter and pressure gauge provider to assess current performance of an SDS.

3.7.8. 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, in order to prevent 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).

3.7.9. Supply and return manifolds to distribute effluent to dripline during dosing, and collect flush-water and return it to either the pump chamber or septic tank, typically the septic tank.

3.7.10. Chemical injector port is required to allow future connection of a chemical injection pump. Chemical injection may be needed occasionally 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 in order to protect beneficial microorganisms and other biota in the dripfield absorption area.

3.7.11. 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.
3.7.12. Pump chamber for all SDS a minimum volume is 1,000 gallons for single family residential SDS applications. For all other applications, the minimum pump chamber size depends on design flow (see Pressure Distribution 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.

3.7.13. 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

3.8.1.1. Must be rated for wastewater applications [irrigation values are not allowed and installed to be readily accessible for inspection and servicing (e.g., in a valve box with access to grade)].

3.8.1.2. 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 100% primary and 100% reserve dripfield. 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 (within 95% of) the values in Table 3, 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, for applications on steep slopes, for sensitive sites, in fine-textured soils, to provide additional resting time, to support needs of the vegetative cover, or in anticipation of future expansion.**

3.9.5. Dripline installation

3.9.5.1. Only registered dripline may be used for wastewater applications of SDS.

3.9.5.2. 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. For this reason, dripline should always be installed along contours and as level as possible.**

3.9.5.3. Minimum installation depth is 6 inches into original, undisturbed, unsaturated soil. Maximum installation depth is 3 feet.

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

3.9.5.5. Dripline may be installed in ASTM C-33 sand or Course 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 be a minimum of 6 inches of sand media between any emitter and sidewall of the bed/trench.

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

3.9.5.7. Where slopes are ≥ 20% the dripline spacing must be increased by at least one foot from the values listed in Table 2.

3.9.5.8. 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 effected by flushing requirements, which must be considered during design.

3.9.5.9. SDS on sloped sites must be designed and installed to prevent drainage between doses to lower discipline, distribution sectors or other components such as tanks and valve boxes. (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, by feeding dripline from above (see Pressure Distribution RS&G), by connecting dripline to manifolds over an elevated berm (see Figure 9), or by installing dripline at a lower elevation than manifolds.
3.10. Flushing

Because emitter discharge rates are much lower than rates from orifices in conventional pressure systems, SDS typically provide inadequate scouring velocity in piping during routine dosing. (See discussion below on continuous flush systems.) Also, filters with opening sizes measured in microns can easily plug over time.

Dripline flushing (sometimes called field flushing) always occurs in a forward (normal flow) direction. Filter flushing may occur in a forward direction (for screen-type and some disk filters) and in a reverse flow direction (referred to as backflush or backwash) for most disk filters. (See discussion below on special case of continuous flush systems.) In larger or commercial applications disk filters are sometimes installed in parallel and plumbed so one remains in service while the other filter is backflushed. Flushing dripline always occurs simultaneously with a dose cycle.

Flushing is typically accomplished by manually or automatically opening a flush valve connected to the return manifold for dripline, or to piping connecting filters. It’s essential to size pumps and piping (particularly dripline lengths) to allow for proper flushing, not just for routine dosing, in order to achieve scouring velocities in accordance with the dripline manufacturer’s recommendations. Whenever flushing occurs, the flush debris is typically returned to the pump chamber, secondary treatment component or septic tank, depending on the type of flushing provided and whether any other treatment is provided.

Key components that require regular flushing include dripline and filters but flushing other components (including supply and return piping, valves and fittings) is also needed. Except as noted in this document, flushing may be performed automatically, continuously, or (where allowed) manually.

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

3.10.2. All SDS must include 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 and are strongly recommended for all SDS. Supply and return manifolds and flush valves (where required) must be shown/located 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 and 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 as well as normal dosing cycles. Calculations for flushing must be included in the design 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 specify the selected flushing method on construction documents and permit applications and provide related design parameters such as design flow rate and pressure, frequency and duration of flush cycle. Designers must ensure that 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 or better treatment, flush debris may be returned to the settling basin, septic tank, secondary treatment component, or pump chamber. A gravity return is recommended wherever possible.

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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 or (b) routing the return line to an appropriately sized pump basin upstream of the septic tank. Routing to a settling basin is recommended where the return line is pressurized. Settling basin, unless buried, should have a locking or secured access to grade and be insulated in cold weather climates.

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

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3.10.9. Manual flushing of dripline and filters is a forward flush process, 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). Manufacturer recommended flushing velocities must be achieved to assure any accumulations of organic and inorganic particulates are removed.

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

**Continuous flushing (see Figure 5a)** forward flushes dripline and filters with each dose cycle, at a rate that achieves manufacturers recommended scouring velocities in dripline. This may be utilized in a variety of applications other than where only minimum treatment is provided.

This flushing method simplifies design, eliminates the need for automated flushing components and reduces upfront costs, but will increase energy consumption, flow and solids passing through the system. The most important of these concerns can be addressed in the design phase and O&M procedures.

Recommendations include:

- Have a service contract with a qualified provider for periodic supplemental O&M services as needed including running diagnostics, additional flushing, manually cleaning filters, etc.
- Install a larger filter than would normally be required for the system in order to reduce the need for cleaning between service visits.
- Install a manually operated valve on return manifold to enable the service provider to manually flush the system during service visits.
- Route flush debris to septic tanks in a manner that minimizes the stirring of solids.
- Specify installation of ports where needed to enable connection of pressure gauges and flow meters to help 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 (to prevent contamination of potable water supply).

3.10.12. Use of chemical solutions to scour the dripline of scale or slime must 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 dripline is time dosed, then the dripline downstream may be demand dosed. The timer for the upstream treatment component indirectly controls downstream dosing so that a second timer for the dripline is usually not needed. The dripline is considered to be time dosed in this case since the waste stream feed is time dosed.
In areas with higher precipitation rates (> 30 inches per year, which includes 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 is especially a concern with SDS installed in finer textured soil.

Timed dosing helps maximize horizontal, unsaturated flow in the soil and provides better treatment than demand dosing. However, because state minimum design flows (e.g., 120 GPD/bedroom) are conservative values (higher than average flows), SDS designed per rule don’t normally provide the minimum number of doses per day specified in Table 2 and will in fact under typical conditions dose only a few times per day during peak use periods (e.g., 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 providing timely maintenance for all components. This includes inspecting the entire system at a frequency specified by the LHJ, the submitted O&M manual, and be appropriate for the site conditions and specific components. Contact the LHJ for maintenance provider qualifications, and for any specialized monitoring 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, in the opinion of the LHJ, optimum operation of the SDS is assured by such an agreement.

4.1.3. If a maintenance agreement is not required, then the owner is fully responsible for operating and maintaining the system, and complying with all applicable state and local requirements.

4.2. Operation and Maintenance (O&M) Manual

An O&M manual for the SDS must be provided by the system designer to the owner, operator and local health officer prior to use of the system. The manual must contain the following, at a minimum:

4.2.1. Name/contact information for owner, operator, designer, installer, electrician and sewage pumper. Identify the primary person (with contact information) responsible during emergencies (e.g., power failure, alarms, abnormal conditions, failure).
4.2.2. Description of owner’s responsibilities regarding operation, maintenance and monitoring, inspection, record keeping, reporting, and permit requirements.

4.2.3. Design description: a narrative citing 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. For each component and proprietary product, include manufacturer’s standard product literature, including performance specifications and maintenance recommendations needed for operation, monitoring, and maintenance.

4.2.5. Flow schematic showing all major components, record drawings, and schematics for all installed electrical and mechanical components.

4.2.6. Information on periodic monitoring and maintenance requirements of the system: including but 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. List and describe operating activities and steps that should be followed or avoided to protect the sewage system’s treatment processes and components. Examples include: water conservation, use of low flow fixtures, scheduling laundry or other high water-use activities over several days, infrequent and limited use of bleach and other household chemicals, not using garbage grinders, not disposing harmful chemicals, unused or outdated medications down the building drains, protecting the dripfield area, and maintaining landscaping/vegetation over the SDS, and reserve area. Paving, parking, and planting or allowing trees or other vegetation with deep root systems over the dripfield must be avoided.

4.2.8. A trouble-shooting guide, with information on identifying and fixing problems that might occur. This information should be as detailed and complete as needed to assist the system owner to make decisions about when and how to attempt corrections of operational problems, and when to call for professional assistance.

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

4.3.1.2. 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. Life style 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

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Soil Textural Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>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.</td>
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<tr>
<td>2</td>
<td>Coarse sands.</td>
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<tr>
<td>3</td>
<td>Medium sands, loamy coarse sands, loamy medium sands.</td>
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<tr>
<td>4</td>
<td>Fine sands, loamy fine sands, sandy loams, loams.</td>
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<tr>
<td>5</td>
<td>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).</td>
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<tr>
<td>6</td>
<td>Other silt loams, sandy clay loams, clay loams, silty clay loams.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Unsuitable for treatment or dispersal</strong> 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.</td>
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Table 2. Primary Drip Design Parameters

<table>
<thead>
<tr>
<th>Emitter spacing (inches)</th>
<th>Dripline spacing (ft.)</th>
<th>Area per emitter (ft²)</th>
<th>Soil Type</th>
</tr>
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<tr>
<td></td>
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<td>1² 2 3 4 5 6**</td>
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<table>
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<tr>
<th>Treatment Provided Prior to Dripfield</th>
<th>Soil Type</th>
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<tbody>
<tr>
<td>≥ Septic tank Effluent or Treatment Level E</td>
<td>Maximum Daily Discharge per Emitter (gpd/Emitter)</td>
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<td>1² 2 3 4 5 6**</td>
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<th>Treatment Provided Prior to Dripfield</th>
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<tr>
<td>≥ Treatment Level C</td>
<td>Maximum Daily Discharge per Emitter (gpd/Emitter)</td>
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<td>1² 2 3 4 5 6**</td>
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<th>Treatment Provided Prior to Dripfield</th>
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<tr>
<td>Minimum Doses per Day</td>
<td>1² 2 3 4 5 6**</td>
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</table>

1These values apply to conforming sites with moderate to good soil structure; the local health officer may require lower rates or increased emitter/dripline spacing with justification (e.g., if
soils are compacted or cemented, if soil structure is poor, for sensitive sites, or areas of special concern).

Designers should verify with the dripline manufacturer that these rates don’t exceed their recommendations; if they do, follow dripline manufacturer recommendations.

²Type 1 soils typically require (where adequate vertical separation is available) Treatment Level B or better or a minimum 2 feet of ASTM C-33 sand or coarse sand media; where sand media is used, follow applicable guidance in the Sand Lined Trench RS&G; for all other site conditions follow requirements in WAC 246-272A.

Values in red font indicate higher discharge rates are not allowed at the corresponding emitter dripline spacing.

The values in blue font and shading indicate this discharge rate and corresponding emitter/dripline spacing may only be used when applying the table for Treatment Component Performance levels and Method of Distribution or the table for Treatment Component Performance Levels for Repair of OSS Not Meeting Vertical and Horizontal Separations in WAC 246-272A and where the designer specifies appropriate installation instructions that preserve native conditions throughout the dripfield area.

An area of equal size to primary dripfield determined above must be set-aside as a reserve area. Where allowed by the LHJ, the reserve area may be placed between driplines if the selected line spacing in Table 2 is doubled.

**How to use Table 2 to determine minimum dripfield requirements (primary area):**

1. Determine the **maximum daily discharge per emitter** (GPD/emitter) value from Table 2 that corresponds to the soil type in the proposed dripfield area and the desired emitter and dripline spacing.

2. Calculate the **minimum number of emitters** required by dividing the daily design flow (in GPD) by the maximum daily discharge per emitter determined in step 1.

3. Calculate the required **dripline length** (feet) for your project by multiplying the required number of emitters determined in step 2 by the selected emitter spacing.

4. Determine the **minimum dripfield area** required for your project by multiplying the total number of emitters determined in step 2 by the area (ft²) per emitter that corresponds to the selected treatment level and emitter and dripline spacing.

**Table 3. Bulk Density Where Root Restrictions Occur for Various Soil Textures**
A bulk density test is recommended if soil is determined to be compacted or cemented. If soil density approaches (within 95% of) the values shown in this table, 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>
<thead>
<tr>
<th>Soil Textural Class</th>
<th>Bulk Density Where Root Restriction Begins to Occur (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse, medium, and fine sand and loamy sands other than loamy very fine sand</td>
<td>1.69</td>
</tr>
<tr>
<td>Very fine sand, loamy very fine sand</td>
<td>1.63</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>1.63</td>
</tr>
<tr>
<td>Loam, sandy clay loam</td>
<td>1.60</td>
</tr>
<tr>
<td>Clay loam</td>
<td>1.60</td>
</tr>
<tr>
<td>Sandy clay</td>
<td>1.59</td>
</tr>
<tr>
<td>Silt, silt loam</td>
<td>1.54</td>
</tr>
<tr>
<td>Silty clay loam</td>
<td>1.49</td>
</tr>
<tr>
<td>Silty clay</td>
<td>1.45</td>
</tr>
<tr>
<td>Clay</td>
<td>1.39</td>
</tr>
</tbody>
</table>

*Drainfields are not allowed in these soil types in Washington*
Table 4. Maximum Emitter Discharge Rates by Soil Type (gallons per hour)

<table>
<thead>
<tr>
<th>WA Soil Type</th>
<th>1, 2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geoflow Dripline with PC emitters</td>
<td>1.02</td>
<td>1.02</td>
<td>0.53</td>
<td>0.53</td>
<td>0.53</td>
</tr>
<tr>
<td>Geoflow Classic Dripline (non PC emitters)</td>
<td>1.33</td>
<td>1.33</td>
<td>Not recommended</td>
<td>Not recommended</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Netafim Dripline</td>
<td>0.92</td>
<td>0.92</td>
<td>0.62</td>
<td>0.62</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Table 5. Primary Drip Design Parameters (non-residential applications) \(^1\)

<table>
<thead>
<tr>
<th>WA Soil Type</th>
<th>1, 2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6 (^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum daily discharge per emitter (gpd / emitter)</td>
<td>1</td>
<td>0.8</td>
<td>0.8</td>
<td>0.5</td>
<td>0.25</td>
</tr>
<tr>
<td>Minimum emitter spacing (ft)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Minimum dripline spacing (ft)</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Minimum area per emitter (ft(^2))</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

\(^1\) TABLE VALUES APPLY REGARDLESS OF PRETREATMENT

\(^2\) On site systems with design flows of 1000 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 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 and multiply the number of emitters required by the value in the bottom row (minimum area per emitter) to determine minimum dripfield area.
Table 6. Dripline Installation Methods

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

**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 before making the installation technique decision is recommended.
Table 7. Minimum Pump Chamber Sizes for Commercial Applications

<table>
<thead>
<tr>
<th>Daily Design flow (gpd)</th>
<th>Minimum pump chamber capacity (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>1,000 – 2,000</td>
<td>1,500</td>
</tr>
<tr>
<td>2,000 – 3,000</td>
<td>2,500</td>
</tr>
<tr>
<td>3,000 – 5,000</td>
<td>3,500</td>
</tr>
<tr>
<td>5,000 – 7,500</td>
<td>4,000</td>
</tr>
<tr>
<td>7,500 – 14,500</td>
<td>5,000</td>
</tr>
</tbody>
</table>

For the purpose of these standards multi-family housing uses include residential subdivisions with ≥ 2 homes on a common system, mobile home parks, apartments, condominiums, etc., and commercial means any non-residential (non-industrial) use such as offices, factories, stores, churches, schools, food establishments, lodging, mini-marts, learning centers, resorts, etc. See text box titled Pump Chamber Volume in the Pressure Distribution RS&G.

SDS provide minimal emergency storage in the small diameter of dripline and trenches, so 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

![Shallow Drip Installation Trench Detail Diagram]

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

![Soil Wetting Pattern Diagram]
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. Looped Drip Distribution Field with Supply and Return Manifolds*

Note: A run is identified as one continuous dripline along the length of the zone while a lateral is defined as one dripline from the supply manifold to the return manifold.

Figure 5a. Example of Continuous Flush Headworks (Courtesy of H.D. Fowler)
Figure 5b. Control Valve, Filter and Pressure Regulator in Protected Vault

Note: Drawing is for illustration of protected vault – a pressure regulator is required only for non-pressure compensating emitters and is not needed with pressure compensating emitters. A pressure gauge is required on both sides of the filter.

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

**Legend**

- REMOTE CONTROL VALVE WITHER IN VALVE BOX WITH GRAVEL SUMP
- AIR VACUUM RELIEF AT HIGHEST POINT(S) SEE DETAIL.
- FLUSH VALVE

**Legend Details**

- SUPPLY LINE
- RETURN LINE
- AIR RELIEF LATERAL BLANK APPROVED DRIPLINE (CENTERED ON MOUND OR BERM)
- LAYOUT

**Section A**
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

Dripline and manifold section view - freezing

- PVC to drip adapter
- 1/2" or 3/4" PVC flex or poly line
- 1/2" diameter dripline installed level on contour
- 2" styrofoam insulation (typical)
- Compacted backfill
- Sch. 40 PVC Supply Main
  - >= 2" will not sag
  - Slope back to drain
  - Top of supply main must be lower than lowest dripline in zone/subzone
- Vegatative cover with grasses, trees or shrubs to trap snow and insulate
- 8'-16' deep
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) whenever practical should drain by gravity to the design destination (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 and assure it remains open for sufficient time to allow the entire dripfield to drain between doses.
- For cold weather applications 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 see section of Frost Protection for recommendations.

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.

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.


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 B or better is provided (must be shown on the department’s List of Registered On-site Treatment and Distribution Products.). The minimum area per emitter is one square foot, but may be reduced to ½ square foot per emitter if dripline with emitters spaced 6 inches apart is installed and where pretreatment to Treatment Level B or better is provided (treatment must be listed on the department’s List of Registered On-site Treatment and Distribution Products). Dripline/emitters may be located no closer than 6 inches to the outside edges of the trench or bed. Dripline must be covered with a minimum of 6 inches (8-10 in areas where frost is a concern) of ASTM-C33 sand. [See Table 2 for design criteria for residential applications and Table 5 for design criteria for commercial (including multi-family) applications.]

Frost Protection

Subsurface drip systems installed in accordance with these standards have some inherent features that tend to make them resistant to frost damage, including polyethylene tubing (which is resistant to cracking when frozen), frequent timed dosing which maintains soil moisture (creates 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 can contribute to freezing:

- System not used, under used, or used intermittently for a prolonged time during winter;
- Dripline is not installed deeply enough;
• Vegetative cover is not established;
• Air/vacuum relief valves freeze (hampers drainage);
• Little or no snowfall during periods of sub-freezing temperatures;
• The dripline does not completely drain;
• Emitters are clogging;
• Supply and return lines are not installed below the frost level.

Outlined below are some measures that may help prevent frost damage:

- The system should be kept in continuous service whenever possible.
- Manifolds (supply and return) whenever practical should drain by gravity to the specified destination (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.
- The top of air vacuum relief valves must be 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 you can find it in the winter if needed when covered in snow.
Rodent Protection

Rodents are active in some areas and 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 simply fill the valve box up with soil. One dripline manufacturer reports that rodents will not burrow near dripline when the ground is kept continuously moist (one reason for high frequency dosing). Rodents could still pose a problem when a drip system is left out of service for a period of time (e.g., during a family vacation or prior to a new home being occupied). When necessary a chemical application may help (see 2nd paragraph below).

Ideally, a drip system should be tested shortly before it is placed into continuous service. Another option to discourage rodents, if sufficient vertical separation exists, is to install the dripline at least 18 inches deep since rodents reportedly do not routinely burrow that deep.

An occasional application of butyric acid (injected into the dripline via the pump chamber to achieve a recommended 2 ppm solution) reportedly discourages rodents. Butyric acid is the compound that gives spoiled butter its rancid smell. 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 both dripline manufacturers address in their design manuals and is also 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/orifaces 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 and 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.

The 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 contribute to the problem. Vibratory plows or insertion tools where dripline follows a pulled bullet can compact or smear the soil, 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.

- Transport and supply manifold piping should be installed up gradient from dripline (see Pressure Distribution RS&G Figure 3B for example). If this isn’t practical the manifold can be installed below the dripline laterals if check valves are employed to 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 (0.5 and 0.6 GPH are recommended) in fine textured soils.
- 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 and 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 hints.

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

Chimney Effect
Another problem reported with new drip systems installed in fine textured soils is called the chimney effect (see Figure 10) where effluent surfaces above the dripline during dosing. This can occur in shallow, trenched installations where finished backfill above the dripline is looser 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.
• After installation, lightly compacting the backfill making compaction similar to the native soil compaction level.
• Installing dripline deeper, if feasible.
• Lower the discharge rate.
Figure 10. Example of Chimney Effect
Appendix B - Checklist

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
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,
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 Meter is installed in a readily accessible location.
____ Flow meter is as specified on the design and rated for expected operating range

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 non-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.
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.):
____________________________________________________________________
____________________________________________________________________

**Comments:**
Appendix C - Bibliography

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


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


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


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


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


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


