DRAFT
DESIGN REGULATIONS
FOR
SUBSURFACE DRIP DISPERSAL SYSTEMS

Boone County Regional Sewer District

Boone County, Missouri

Adopted xx/xx/xxxx

Chapter 5

Contents

Appendices

5.1. Introduction

Subsurface Drip Dispersal (SDD) is a proven technology for uniformly dispersing wastewater over a large area beneath the soil surface. A small volume of wastewater is dosed at predetermined time intervals throughout the day to the soil through a pressurized piping network that comes close to achieving uniform distribution over the footprint of the dispersal area.

These Regulations are for SDD systems that disperse only domestic wastewater with average day flows of up to 50,000 gallons per day (gpd).

5.2. General Provisions

These Provisions apply to any person(s) who proposes to design and construct a facility that will treat or dispose of domestic wastewater using a SDD system within the jurisdiction of the Boone County Regional Sewer District (District).

The applicant for a permit for a domestic wastewater treatment facility with a SDD system shall submit an engineering report, drawings and specifications (all signed and sealed by a Licensed Engineer in the State of Missouri) to the District that meet the requirements found in these Regulations. Construction shall not begin on a facility until the District approves the engineering report, plans and specifications. The applicant shall also secure all approvals and permits required by the Missouri Department of Natural Resources (MDNR).

The District reserves the right to modify or change any of the criteria in these Regulations. The applicant may submit a variance request from these Regulations with the engineering report. The technical justification for the variance shall be included in the report.

The applicant shall reserve an area equal in size to the drip field area for future construction of a SDD system in the event the original system fails.

Approval of the submitted engineering report, plans, or specifications by the District does not relieve the permittee of any liabilities or responsibilities associated with designing, constructing and operating the SDD system and the associated treatment facility in accordance with applicable MDNR regulations and in a manner that protects human health and the environment.

5.3. Subsurface Drip Dispersal System Alternatives

The designer of the SDD system shall select to design and install one of the systems by the following manufacturers:

1. Geoflow, Inc.
2. Netafim USA

The designer shall use the design spreadsheets and tools developed by the selected manufacturer to design the system, and use the proprietary equipment supplied by that manufacturer to construct the system.

The descriptions of the system components and some of the design parameters were taken from the “Subsurface Drip Dispersal and Reuse - Design, Installation and Maintenance Guidelines” by Geoflow, Inc.

5.4. System Components

A typical SDD system installation will consist of the elements listed below. Minimum standards for each of these elements are included in Appendix A of these Regulations.

5.4.1 Drip Line

Drip line carries the water into the dispersal area. The drip line is connected to the supply and return manifolds with fittings supplied by the manufacturer.

5.4.2 Controllers

Controllers are used for time dosing and time flushing of the filter and drip fields. Controllers shall include a programmable logic controller to increase flexibility and reliability in the field. All controllers shall include a surge arrestor, elapsed time meter and counter.

5.4.3 Pumps, Pump Tanks and Floats

Drip fields depend on pumps to dose effluent under pressure to the field. These must be sized according to flow and pressure requirements. Two (duplex) submersible effluent pumps shall be used on SDD systems.

Pump tanks are an important part of an onsite system design for small systems and serve to equalize flow, settle solids and even continue oxidation in some instances. Controllers shall be set-up for four floats with the lowest one in the tank being the redundant off float. The primary timer on/off float is second from the bottom, followed by the secondary timer float third from the bottom and the high level alarm float on the top.

Larger SSD systems must use large tanks, piping or lagoons to store wastewater flow.

5.4.4 Filters

The SDD system shall include filtration to keep any oversized upstream contaminants from entering the drip line.

5.4.5 Supply Manifold and Line

This carries the water from the dosing tank to the dispersal area. Rigid PVC pipe shall be used in accordance with the manufacturer's recommendation.

5.4.6 Return Manifold and Line

In order to help clean the system, the ends of the drip lines are connected together into a common return line, most often made of rigid PVC pipe per the manufacturer's recommendation. This line will help equalize pressures in the system.

Flushing should be done frequently during the installation period. Periodic flushing during operation will help to keep the manifolds clean.

5.4.7 Pressure Regulator

Pressure regulators fix the inlet pressure at a given rate. All drip lines shall have a pressure regulator to avoid oversized pumps from damaging fittings.

5.4.8 Air Vacuum Breaker

Air vacuum breakers are installed at the high points, above drip line and below grade to keep soil from being sucked into the emitters due to back siphoning or backpressure. This is an absolute necessity with underground drip systems. They are also used for proper draining of the supply and return manifolds in sloping conditions. One is required on the high end of the supply manifold and one on the high point of the return manifold. Additional air vents shall be required in undulating terrain.

5.4.9 Filter Flush Valves

Filter flush valves shall be used to flush debris from the filter cleanout port back to the pretreatment or dosing tank. This shall be an electronically activated solenoid valve. Automated electronic flushing is required for all systems.

5.4.10 Field Flush Valves

Field flush valves shall be used to flush out fine particles that have passed through the filter and accumulated on the bottom of the pipe at the end of each lateral. The field flush valve shall be electronically activated by the controller.

5.4.11 Zone Valves

Zone valves are used to divide single dispersal fields into multiple zones. These valves shall be hydraulically activated index valves or electrical solenoid valves.

5.4.12 Headworks

The headworks shall be a pre-assembled unit including the filter, valves and pressure gauge, all housed in a box or on a skid, and shall be installed between the pump and the field. The housing shall be insulated.

5.5. Design Parameters

5.5.1 Drip Field Area Selection

The applicant shall develop and submit, with the engineering report, a Site Preparation Plan (scale 1 in. = 50 ft.) that incorporates the following items in order to alleviate potential site-specific limitations and ensure suitability for the SDD system. This Site Preparation Plan shall include the following:

A. General Site Considerations

1. All of the items contained in the Rules of Department of Health and Senior Services (DHSS) 19 CSR 20-3.060 (2) Site Evaluation (A), excepting percolation testing. Percolation testing is not permitted.
2. A plan to minimize the effects of surface rainfall runoff on the dispersal zones via water diversion berms, curtain drains or other methods.
3. A plan to minimize the effects of dispersal zones on subsurface water tables and perched water tables via curtain drains or other methods.
4. Design criteria to compensate for any restrictive layers within the soil column.
5. Any planned removal of existing vegetation.

B. Protection of Groundwater

1. A SDD system shall not pollute groundwater quality.
2. Groundwater shall be a minimum of 10 feet below the lowest point in the SDD system.

C. Buffer Zone Requirements

1. The SDD system shall maintain minimum set-back distances as specified in Table 1 – Minimum Set-Back Distances specified in DHSS 19 CSR 20-3.060.

5.5.2 Wastewater Quality

The sewage shall be assessed for flow and constituents. The SDD system shall include upstream wastewater treatment facilities capable of achieving the following treatment levels:

1. BOD: Weekly Average < 45 mg/L and Monthly Average < 30 mg/L
2. Total Suspended Solids: Weekly Average < 45 mg/L and Monthly Average < 30 mg/L
3. Oil and Grease: Monthly Average < than 15 mg/L

Wastewater with very high levels of minerals or other abnormal chemical or physical characteristics shall require special consideration and custom design. Iron or iron bacteria shall be eliminated upstream of the drip system.

5.5.3 Soil Loading Rates

Soil loading rates, as expressed in gallons per square feet per day shall be derived from soil conditions, properties and permeability as determined by a soil morphology examination as described in DHSS 19 CSR 20-3.060 (2) Site Evaluation (D) 2. Soil Morphology. The following conditions also apply:

1. A minimum of three profile pits for the soil morphology examination shall be excavated for all proposed drip line areas less than 15,000 square feet. One additional profile pit shall be excavated for each additional 15,000 square feet of proposed drip line area. Each profile pit shall be excavated to a depth of five feet.
2. Perform a laboratory permeability test in accordance with ASTM D5084 on a soil sample taken from the most restrictive layer near each profile pit.
3. Install a piezometer at the lowest point in the drip line area and monitor every 7 days for a period of three months.
4. The soil morphology examination shall also include a classification of the soils in conformance with the soil classifications found in the Soil Loading Tables from Geoflow, Inc. or Netafim USA. Those Tables are included in Appendix B.

The soil loading rate from the soil morphology examination shall be compared to the soil loading rate values in either the Geoflow, Inc. or Netafim USA Drip Loading Rate Table. The lower of the two soil loading rates shall be used in the design of the SDD system.

This soil morphology examination shall be performed by a soil scientist, professional licensed geotechnical engineer or professional licensed geologist who meets the experience qualifications of DHSS 19 CSR 20-3.080.

5.5.4 Depth and Spacing of Drip Line

SDD systems shall have emitter lines placed on 2 foot centers with a 2 foot emitter spacing such that each emitter supplies a 4 square foot area. These lines shall be placed at depths of 10-12 inches below the surface.

Closer line and/or emitter spacing may be used in heavy clay soils or very coarse sands where lateral movement of water is restricted, if justified by the soils report, and recommended by the manufacturer. Using closer spacing shall not reduce the size of the field.

5.5.5 Soil Layers and Types

The soil within the drip line area shall be uniform and homogeneous non-compacted, free of construction debris, rocks with volumes greater than 0.25 cubic feet and non-uniform soils.

5.5.6 Adding Fill to the Dispersal Field

Some dispersal sites may require additional soil be brought in for agronomic reasons or to increase separation distances from the restrictive layer.

Whenever fill material is to be used, the area to receive the fill should have all surface grasses and other organic material removed or it must be incorporated into the natural soil to prevent an organic layer from forming and restricting downward water movement.

Divert surface and subsurface water prior to adding fill.

Soils used as fill material shall be tested and recommended in the soils report.

The fill material shall be applied in shallow layers with the first 4 to 6 inches incorporated into the natural soil to prevent an abrupt textural interface. Soil shall not be compacted. The soils report shall provide guidance regarding the placement of fill material.

The fill area shall be left crowned to shed surface water and may need diversion ditches or other devices to prevent surface water from infiltrating the dispersal field. The entire fill area should have a vegetative cover to prevent erosion. The fill shall set at least seven to ten days before installing drip line.

Fill shall not be used on slopes greater than 20 percent.

5.5.7 SDD Systems on Sloped or Hilly Sites

A. High Points and Siphoning

A potential problem with buried drip lines is siphoning dirt into the emitters when the pump is switched off. For this reason:

1. Vacuum breakers shall be installed at the high point of the supply line and at the high point of the return manifold.
2. Drip lines shall be connected at the end to a common return line with a flush valve.
3. Drip lines shall be installed along a contour. Avoid installing lines along rolling hills where there are high and low points more than 3 feet off contour along the same line. Drip lines shall not be installed over a ridge.

B. Low Head Drainage

At the end of each dosing cycle, wastewater within the system shall flow down to the lowest point within the drip zone when the pumps shut off (low head drainage). The following precautions shall be taken to mitigate low head drainage:

1. Install check valves or multiple zones to isolate the drip laterals. Check valves shall only be used if there is no risk of freezing in the manifolds. They are placed on the supply and return manifolds coupled with an air vent on the downhill side.
2. Install maximum/minimum length of manifolds and number of drip line runs per the manufacturer's recommendations.
3. Slope the supply and return manifolds down to the pump tank so the effluent drains back down to the tank when the pump is turned off. Open the zone valves fully to drain the lines quickly.

5.5.8 Multiple Zones

Drip dispersal fields can be divided into multiple zones or sections with solenoid valves or index valves for the following reasons:

1. Steep slopes with a risk of low head drainage can be subdivided to distribute the water at system shut-down more uniformly in the field.
2. Smaller zones to reduce the required flow per minute which consequently reduces the size of the pump, valves, filters, supply and return lines.
3. Subdividing the field is a tool used to achieve the optimum ranges required to efficiently operate the pumps, filters and valves.

Recommendations of the manufacturer shall be followed on multiple zone systems regarding the headworks, valving and flushing.

5.5.9 Flushing Design

Proper flushing of the drip system is critical for proper long term operation. Fully automatic flushing is required for all SDD systems and shall be designed in accordance with the manufacturer's recommendations and shall be designed considering the following key points:

1. The flush return should be in a visible location.

2. Flush return flows must not adversely impact treatment system performance; minimize disturbance in the return tank and be sure to not overload secondary treatment.
3. Flush frequency shall be a minimum of one per day.

5.5.10 Winterization

The manufacturer shall provide recommendations for protecting the SDD system from the effects of cold weather in Boone County, Missouri. Those recommendations shall be incorporated into the design and installation of the system.

5.5.11 Pumps

Two (duplex) submersible effluent pumps shall be used on SDD systems. The pumps shall be manufactured by Flygt, Gorman-Rupp or a pre-approved equal.

The design and construction of the pumping facility shall be in accordance with the City of Columbia, Missouri's Standard Specifications.

5.5.12 Wastewater Flows and Storage

Flows used for the design SDD system shall be per the manufacturer's recommendation.

The calculation of those flows and required storage shall be as follows:

1. Average Daily Flow: Per MDNR 10 CSR 20-8.020
2. Peak Flow: Per MDNR 10 CSR 20-8.110
3. Emergency Storage: 8 hours of average daily flow

5.5.13 Lightning Protection

All electrical components in the system shall be grounded in accordance with manufacturer's recommendations and Boone County codes.

APPENDIX A

Minimum Standards for Key SDD Components

THE MINIMUM STANDARDS INCLUDED IN THIS APPENDIX ARE FOR COMPONENTS MANUFACTURED BY GEOFLOW, INC. AND ARE INCLUDED IN THEIR “SUBSURFACE DRIP DISPERSAL AND REUSE – DESIGN, INSTALLATION AND MAINTENANCE GUIDELINES”.

THE SAME COMPONENTS MANUFACTURED BY NETAFIM USA ARE CONSIDERED APPROVED EQUALS.

SUBSURFACE DRIP DISPERSAL KEY COMPONENTS MINIMUM STANDARDS

Component	Standard	Notes
Dripline and blank Dripline	Designed specifically for wastewater use, with purple stripe and a turquoise inner lining or purple color	Do not use non-wastewater tubing or emitters.
	Biocide lining	Required to permit 0.5 fps flushing velocity
	Emitters impregnated with Treflan® or OBPA	Required to prevent root intrusion
Dripline installation depth	10″ to 12″ (15-30cm)	6” (15cm) standard.
Dripline minimum pressure	10 psi during dosing	Minimum pressure required to get flush water back to flush tank.
Dripline fittings	Lockslip fittings. Using barb couplings if Lockslip does not fit through installation shank.	Reduces risk of tubing splitting.
Flexible pipe for loops	1/2″ IPS flexible PVC pipe	To avoid kinking
Air valves	1″ for any drip area under 2500 emitters.	To assist in rapid pressurization, siphon break and to prevent suction of fines into emitters. Install in valve box with drain rock or pea gravel base. Install with no high or low points between valve and Dripline.
Supply mains	Design at 2-5 fps velocity for dosing flushing	
Pressure test ports	At manifolds, filter outlet, flush valve inlet.	
Check valves (if used)	To prevent back feed of sub areas from flush main, or to prevent drain down of one area to another.	Ball style check valves shall be provided with unions for service.
Control valves/flush valve	Contamination resistant solenoid operated hydraulic diaphragm valves	Three way solenoid with external piloting and filtration recommended for larger systems.
	Motorized ball valves	Installed above any water level. Preferred for freezing conditions.
Flush return	Preferred, to septic tank inlet tee with air gap for observation.	Must not cause scouring or disturbance in tank. May be returned to treatment plant inlet if appropriate.
Indexing valve (if used)	Install at high point of system or use check valves.	Consider minimum switching flow rate and head loss in hydraulic design.
Filter	Maximum aperture size 130 microns	
	Screen filters, maximum differential of 2 psi at peak flow rate	For small residential systems with STEP do not use screen filters smaller than 1.5″ to avoid excessive differential

Component	Standard	Notes
	Disc filters to include biocide impregnation in disc material.	To prevent growth of slime.
	Manual clean disc filters to be sized to allow typical minimum one year operation between cleaning.	Screen filters should be self-flushing or self-cleaning.
	Differential pressure alarm/gage, set point 2psi	Optional. May be replaced by pressure test ports.
Pump relief valve	Pressure Sustaining or Relief valve designed to keep pressure within maximum for headworks and achieve pump cooling flow. To be used where pump maximum pressure in excess of 100 psi.	
Pump chamber	To meet minimum timed dose standards.	
Control panel	Timed dosing, with main dose at average flow, override at design flow and alarm for high level.	No dosing in excess of the Design flow.
	Alarm, audible and visual	For high level (optionally for filter differential)
	Low level cut off and alarm	To protect pump, with alarm.
	Drain down capability	For freezing conditions.
	Automatic flush capability.	Continuous flush is not recommended.
	Data logging capability	Record of events with time, day, date stamp.
Septic Tank treatment	Not Applicable	Not Applicable
Secondary treatment facility	To consistently achieve maximum BOD5 of 30 mg/L, TSS of 30 mg/L Oil and Grease of 15 mg/L	Must be provided with outlet barrier filter to 1/16″ if there is risk of sludge escaping from plant.
Tanks	Meeting Missouri Department of Natural Resources standards. Watertight tested, with waterproof risers to grade.	Installed to meet standard practice.
Pipe and plumbing components	Designed and manufactured to resist the corrosive effects of wastewater and common household chemicals, and meet applicable ASTM standards.	
Valve boxes	Provide valve boxes for all valves and pressure test points. With pea gravel or gravel base and positive drainage. Frost protected where necessary. Mark valve box locations.	
Electrical components	Should comply with appropriate local and national regulatory requirements. The installation of all electrical components must comply with local Electrical Code. Control valves must be wired to manufacturer standards.	

APPENDIX B

Geoflow Inc. and Netafim USA Soil Loading Tables

Geoflow Application Guidelines for Secondary Treated Effluent

Soil Class	Soil Type	Estimated Soil Percolation Rate (min/in)	Hydraulic Conductivity (in/h)	Design Hydraulic Loading Rate (gal/d/ft^2)
I	Coarse sand	<5	>2	1.4
I	Fine sand	5-10	1.5-2	1.2
II	Sandy loam	10-20	1.0-1.5	1.0
II	Loam	20-30	0.75-1.0	0.7
III	Clay loam	30-45	0.5-0.75	0.6
III	Silt clay loam	45-60	0.3-0.5	0.4
IV	Clay nonswell	60-90	0.2-0.3	0.2
IV	Clay swell	90-120	0.1-0.2	0.1
IV	Poor clay	>120	<0.1	0.075

Source: *Geoflow Wastewater Design, Installation and Installation Guidelines* [1]

Netafim's Recommended Soil Loading Rate

Soil Texture	Soil Structure	Maximum Monthly Average Loading Rate (gal/d/ft^2)
Coarse Sand; Loamy Coarse Sand	n/a	1.50
Sand	n/a	0.80
Loamy Sand; Fine Sand; Loamy Fine Sands; Very Fine Sand; Loamy Very Fine Sand	moderate to strong massive to weak	0.80 0.50
Sandy Loam	moderate to strong weak to massive	0.50 0.30
Loam; Silt Loamy	moderate to strong weak, weak platy massive	0.50 0.20
Sandy Clay Loam; Clay Loam; Silty Clay Loam	moderate to strong weak, weak platy massive	0.30 0.20 0.15
Sandy Clay; Clay; Silty Clay	moderate to strong massive to weak	0.10 0.05

[1] Netafim guidelines use area required per 1000 gal/d rather than 100 gal/d. The unit is downsized in this document to allow easier comparison with Geoflow guidelines.