Reverse Flush Drip Design Manual

Introduction:

Subsurface drip irrigation is intended to utilize the upper horizons of the soil profile by delivering small distinct doses to the soil at a slow flow rate. In this manual the exclusive drip line specified is *Netafim Bioline* with 0.42 gph emitters at 12 inch spacing (08WRAM.4-12V500). The drip tubing can be used with either septic tank effluent or secondary treated effluent.

Design process:

The design process starts with soil loading rate, the design flow rate, amount of area needed and length of tubing. The total length of tubing will need to be divided up into laterals, and zones. The number of zones will dictate the headworks and pump arrangement. Once the number of zones are determined the control panel can be specified. It will either be a standard off-the-shelf unit or a custom panel.

Divide the design flow rate by the soil loading rate to determine the area needed. Then divide the area square footage by 2 to get the total lineal feet drip tubing required. Loading rates for septic tank effluent are listed on Table 2-4. Loading rates for secondary treated effluent are on Table 4-20.

Glossary of terms:

Supply line: pipe that is used to deliver effluent from the pump chamber to the drip field.

Flush line: pipe used to deliver effluent that has scoured the drip tubing back to the headworks.

Vent Line: Pipe that delivers effluent from the headworks to the pump tank.

Total Dynamic Head: the sum of the elevation between the pump tank and top pf drip field plus the friction loss of the supply line.

Friction loss: The amount of head loss caused by effluent passing through a pipe.

Line: A single segment of tubing across the drip field.

Lateral: The length of drip tubing that is connected to the supply manifold on one end and a flush manifold connected to the other end.

Zone: That amount of drip tubing that doses when the pump is activated. If all of the tubing is dosed at one time there is one zone. If half the tubing is dosed there are two zones, and so on.

Laterals:

The length that a lateral can be is determined by the inlet pressure. The higher the pressure the longer to lateral can be. Of course there are some limitations. For instance, the maximum length of a lateral is 310 feet long at 45 psi at 2 fps (which is the highest pressure given in the *Netafim* charts). Two charts given are for the velocities of 1 and 2 fps. It is suggested to use 2 fps in most applications, although with secondary treatment it is fine to use 1 fps scouring velocity (Table 2 and 3).

Head loss, flow rate, and number and length of laterals:

The number of laterals, the length and therefore the inlet pressure are all interrelated. For instance, in Table 2 at 45 psi and 2 fps scouring velocity the longest lateral length is 310 feet. The standard *Lowridge* pump, the LOT-30, has a maximum head of 52 psi, or 120 feet head. So one lateral at 45 psi is all that could be specified. There is no more pressure left under the pump curve. By lowing the inlet pressure and thereby shortening the lateral lengths more laterals can be specified and and more pressure is available for other head losses. For instance, at 15 psi inlet pressure using 2 fps scouring velocity 160 foot long laterals could be used. Each lateral will have a dose rate of 1.12 gpm and an addition flush flow rate of
1.6 gpm. Therefore, each laterals will require 2.72 gpm flow rate during flushing. For this example, assume we need 450 feet of tubing. To stay under the maximum length divide the total tubing required by 3 that equates to 150 feet in each lateral. Flow requirements are:

3 laterals x 2.72 gpm = 8.16 gpm

Comparing 8.16 gpm to the LOT-30 pump curve we see there is 65 feet of head available for supply line head requirement.

Now compare what the available head is left for the supply line if we used a 310 foot later. This lateral supplies 3.77 gpm when flushing and requires 45 psi or 104 feet of head. In this example, there is little head left for the supply line.

Headwork selection:

The correct headworks is selected by determining the maximum flow required during the flushing sequence and quality of effluent. The standard headworks is a HWN-.7-RF: a 3/4" disc filter and a single zone (secondary treatment). Maximum flow is 12-15 gpm. When the maximum flow is at or above this flow rate a two zone headworks will be needed: HWN-.7-RF-C2. The "C2" means a 2 zone headworks. Another option is to increase the filer side to 1 inch.

A system using septic tank effluent will require at least 2 zones, regardless of flow rate. When selecting a headworks version the corresponding control panel will need to be selected, too. A 1 zone control panel is ***LF1P-RF*** and a 2 zone panel is ***LF1P-RF-C2***.

Pump(s) selection:

A single LOT-30 pump will perform in virtually all single family residence applications whether septic tank effluent of secondary treatment is required (See table 4). The LOT-30 has plenty of head and flow for a wide range of residential applications. As a rule of thumb we need twice the flow rate at the same head during the flush cycle as the dose cycle. The LOT-30 is able to perform well in most residential applications. In large flows the pump will reach its performance level first with the flush cycle while the dose cycle can perform at a higher level. To achieve the higher performance during the flush cycle we add a second pump. This is called a duplex system.

Adding a bigger pump, a 230 volt vs. a 115 volt pump, may produce enough pressure and flow for flushing a larger system but will produce too much pressure during the dose cycle. Too much pressure will crack fittings and over pressurize the tubing. Selecting one big pump should be avoided.

When using a duplex system the pumps will alternate between doses. When the flushing sequence is needed both pumps will run at the same time. The sequences will dose a series of doses, say 8 to 24 doses and then the disc filter will backlash once. After the disc filter, each of the zones will flush, then the dose sequences will repeat.

Control panel:

The standard control panels have the following features:

- Simplex pumps
- Duplex pumps
- One zone
- Two zones
- 3/4” disc filter
- 1” disc filter

The following are the different combinations for standard packages:

- Simplex with one zone, 3/4 or 1” disc filter
- Simplex two zones, 3/4 or 1” disc filter
- Duplex one zone, 3/4 or 1” disc filter
- Duplex two zones, 3/4 or 1” disc filter

Simplex, one zone:

Control panel	LF1P-RF
Headworks	HWN-.7-RF (HWN-1-RF, one inch filter)

Simplex, two zones:

Control panel	LF1P-RF-C2
Headworks	HWN-.7-RF-C2 (HWN-1-RF-C2)

Duplex, one zone:

Control panel	LF1P-DAX-RF
Headworks	HWN-.7-RF (HWN-1-RF)

Duplex, two zones:

Control panel	LF1P-DAX-RF-C2
Headworks	HWN-.7-RF-C2 (HWN-1-RF-C2)

Custom packages can be made to adapt to any requirement: larger flow rates, more zones, more pumps, etc,…

Complete design process:

In the complete design process there are many variables to address before a final system is completed. In this manual as many variables as possible will be converted to constant factors. Here is the list of "constants":

1. Pump: Use the LOT-30, 1/2 hp, 120 volt, 30 gpm unit (simplex or duplex).
2. Emitter flow rate is 0.42 gpm, only.
3. Emitter spacing of 12 inches.
4. 1,000 emitters per zone, maximum (rule of thumb).

Step 1. Determine the amount of drip line needed: Divide the design flow rate by the soil loading rate. (For septic tank effluent use Table 2.4 and for secondary treated effluent use Table 4-22). Divide the required area by 2 to get the liner feet of tubing needed.

Step 2. Determine the number of laterals and zones: Divide the total length of Bioline by the length per lateral. Depending on the head requirements several adjustments of lateral length (inlet pressure) may need to be made to arrive at the correct number of laterals. With septic tank effluent break up the drip tubing into at least 2 zones (two is usually enough). Systems with secondary treatment use one zone up to about 1,000 emitters.

Laterals can be many lines looped together to create a single lateral. Some decisions as to length of laterals (and the corresponding inlet pressure) verses the number of laterals will need to be made. Each lateral will need increased flow of 1.6 gpm plus the emitter discharge rate. Fewer but longer laterals need a higher inlet pressure.

If there is a large total dynamic head (TDH) requirement it might be necessary to increase the diameter size of pipe from 1 inch to 1.25 inch. Second possibility for reducing the TDH is to use more zones, thereby decreasing the flow rate per zone.

Step 3. Calculate Total Dynamic Head (TDH): The TDH is the inlet pressure of the laterals, plus friction loss of the supply line, plus elevation lift from the pump tank to the highest portion of the drip field. Elevation difference is straight forward. Inlet pressure of the laterals has already been determined and friction loss is remaining. Use friction loss tables or the Hazen-Williams formula: f=L(Q/K)^1.85, where f = friction loss in feet of lift, Q = flow in gpm, K= is the coefficient constant (1 inch such 40 pipe = 47, 1.25 pipe = 97).

Step 4. Verify the flow and TDH fall under the pump curve: Use Table 4 curve. Notice different flows for duplex pumps. If operating point is above pump curve, make adjustments and re-compare.

Step 5. Select the proper headworks. If the flush flow rate for a single zone is below 12-15 gpm a 3/4" filter (HWN-.7-RF) headworks will work. Over 12-15 gpm for a single zone use a 1 inch filter headworks (HWN-1-RF).

If two zones are needed use the corresponding headworks and control panel, i.e., LF-RF-C2 or LF-DAX-RF-C2.

Calculation tools

To quicken the pace of calculations you may wish to use the system calculator. Use the drip calculator found on *Lowridge's* website, oscaronsite.com, **https://oscaronsite.com/drip-dispersal-systems/** . You can download the file.

Call *Lowridge* for assistance.

Table 1

There is a direct relationship between the I.D. of the tubing and the amount of water flowing through it to velocity.

For the purposes of measuring and stating velocity, calculations are made at the distal (farthest) end of the dripperline lateral. For Netafim Bioline, the chart at the right shows the relationship of additional flow to velocity.

Velocity at the distal end of the lateral	Equates to an additional flow requirement per lateral
3 fps	2.3 GPM
2½ fps	2.0 GPM
2 fps	1.6 GPM
1½ fps	1.2 GPM
1 fps	0.8 GPM
½ fps	0.4 GPM

Table 2

Bioline Data - Maximum Length of a Single Lateral - 2.0 fps Flush Velocity

Additional Flow of 1.6 GPM Required Per Lateral to Achieve 2 fps

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
Inlet Pressure (psi)	15	161	141	119	217	191	164	263	233	201
	25	221	190	157	302	261	218	369	321	270
	35	269	229	187	370	316	260	455	391	324
	40	290	246	200	399	340	278	493	421	347
	45	310	261	212	427	362	296	527	449	369
Flow per 100' (GPM / GPH)		0.67 / 40	1.02 / 61	1.53 / 92	0.44 / 26.67	0.68 / 41	1.02 / 61	0.34 / 20	0.51 / 31	0.77 / 46

Lateral lengths are based on flows allowing for a 2 fps flushing/scouring velocity

Table 3

Bioline Data - Maximum Length of a Single Lateral - 1.0 fps Flush Velocity

Additional Flow of 0.8 GPM Required Per Lateral to Achieve 1 fps

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
Inlet Pressure (psi)	15	248	205	163	344	285	228	427	355	285
	25	315	258	203	440	361	286	549	453	359
	35	367	299	234	513	419	331	643	527	417
	40	389	316	248	545	445	350	683	559	441
	45	409	332	260	574	468	367	721	589	463
Flow per 100' (GPM / GPH)		0.67 / 40	1.02 / 61	1.53 / 92	0.44 / 26.67	0.68 / 41	1.02 / 61	0.34 / 20	0.51 / 31	0.77 / 46

Lateral lengths are based on flows allowing for a 1 fps flushing/scouring velocity

Table 4

DISC FILTER Application Recommendations

	¾"	1"	1" Long
Filtering Volume (cu. in.)	5.8	27	36
Filtering Surface (sq. in.)	25	49	78
5	0.60	0.25	
10	2.50	0.60	
13	3.40	1.34	
17	5.87	2.10	
22		3.24	1.10

Table 5

MODELS | E - 30 GPM

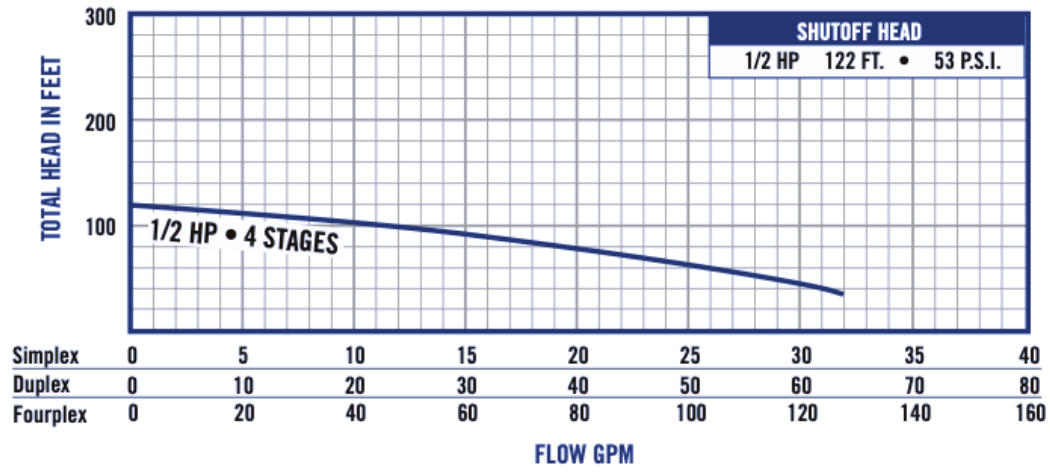

Table 2-4. Soil textural classification design groups.

Soil Design Group	Soil Design Subgroup	Soil Textural Classification	Application Rate (GPD/ft^2)[a]
NS[b]	NS	Gravel Coarse sand	NS
A	A-1	Sand[c]	1.2
	A-2a	Loamy coarse sand	1.0
	A-2b	Fine sand Loamy sand	0.75
B	B-1	Very fine sand Sandy loam Very fine sandy loam	0.6
	B-2	Loam Silt loam Sandy clay loam (≤27% clay)	0.45
C	C-1	Silt Sandy clay loam[d] Silty clay loam[d]	0.3
	C-2	Clay loam[d]	0.2
NS	NS	Sandy clay Silty clay Clay Organic muck Duripan Hardpan Claypan	NS

a. Application rates are for domestic strength wastewater.
b. Not suitable (NS) for installation of a subsurface sewage disposal system.
c. See medium sand definition (section 3.2.8.1.2) for a manufactured material that may be acceptable for use.
d. Soils without expandable clays.
Notes: gallons per day per square foot (GPD/ft^2)

Table 4-20. Secondary biological treatment system hydraulic application rates.

Soil Design Subgroup	Application Rate (gallons/square foot/day)
A-1	1.7
A-2a	1.2
A-2b	1.0
B-1	0.8
B-2	0.6
C-1	0.4
C-2	0.3