HD Fowler Co. Continuous Flush

Subsurface Drip Design Manual, 4.0

Table of Contents

Overview

Subsurface drip dispersal systems are designed to hydraulically accomplish two functions: 1.) deliver a set volume of wastewater to the receiving soil or media and 2.) flush the interior of the drip tubing network to remove accumulated biological slimes or "re-growth". Most drip dispersal design manuals call for two distinct cycles: a dose and a flush cycle. The two cycles are distinguishable by the position of a flush valve. When the flush valve is closed, the system is dosing effluent into the receiving soil at relatively high inlet pressure and low flow. When the flush valve is open, the system is flushing the network at low inlet pressure and high flow. In these two scenarios, the flush valve can be operated either automatically or manually. Automatic flushing requires complex control equipment and electronic valves, synchronized with the pump. Manual flushing is accomplished with the use of simple ball valves and requires an operator to periodically open and close the valve(s). A third option is called "continuous flushing".

With *"continuous flushing"*, both the minimum pressure for dosing and minimum flow for flushing are achieved at every dosing cycle, simultaneously. (The emitters used in this application are *pressure compensating*. Pressure compensating means that within a give pressure range, of 7 to 60 psi, each emitter will discharge at the same rate, within 2%). The flush valve position is static and does not require any adjustment between the dosing and flushing cycles. In most applications, the minimum scouring velocity throughout the entire piping network is 2 ft/sec. This velocity is achieved by increasing the flow of wastewater through each lateral by 1.6 gpm more than the emitter discharge rate for that lateral.

Regardless of the flushing method (manual, automatic, or continuous) all systems must be designed to accomplish a dose and flush cycle. The number of emitters, zones, laterals within each zone, and length of laterals are all factors that determine the pump and supply line size and can affect the system's ability to adequately prevent or remove slime build-up from the interior walls of the piping network.

The HD Fowler continuous flush process has several basic parameters for design and operation. For virtually all single family residence designs, the same headworks, pump, flow inducer (appendix I), and drip tube (0.42 gph Bioline with a maximum of 1000 emitters per zone) are used.

Pump

The same pump can be used when the maximum number of emitters is limited to 1000 per zone. The type of pump that fits virtually all residential application is a 20 gpm turbine pump, such as an Orenco PF200511. This type of pump can deliver the flows necessary for flushing and simultaneously supplying the minimum pressures needed for dosing.

Head requirement

45 psi at supply manifold (maximum recommended by Netafim for Bioline)
10 psi residual at flush manifold
5-psi misc. head loss

Suggested maximum total head requirement = 60 psi or 138.6 ft. head. The suggested maximum flow rate (15 gpm) and head loss values should not be exceeded, nor the maximum length of tubing in a lateral, depending on inlet pressure, although the number of emitters per lateral and number of connections (or laterals) can vary depending on dripfield layout and site constraints.

Emitters

The emitters used within the continuous flush method are inserted in Netafim's Bioline drip tubing: the 0.42 gph Netafim drip emitters at 12" emitter spacing.

Design Aids

Residential Calculator: The Residential calculator is an excel format design aid that allows the engineer/designer to manipulate a number of input design variables to determine the total amount of tubing and emitters, minimum and maximum number of laterals, length of tubing per lateral, pump "on" and "off" times per cycle per zone, dripfield area requirements, and pump flow rates and head demand while maintaining minimum scouring velocity throughout the piping network. The calculator produces TDH and flow values for both dosing with flushing, simultaneously. (go to www.hdfowler.com, click "on pumps", then click "continuous drip".) The calculator can also be found at www.netafimusa.com. Click on the "wastewater" link.

In the appendices of this manual, you will find a worksheet for hand calculations and two design examples.

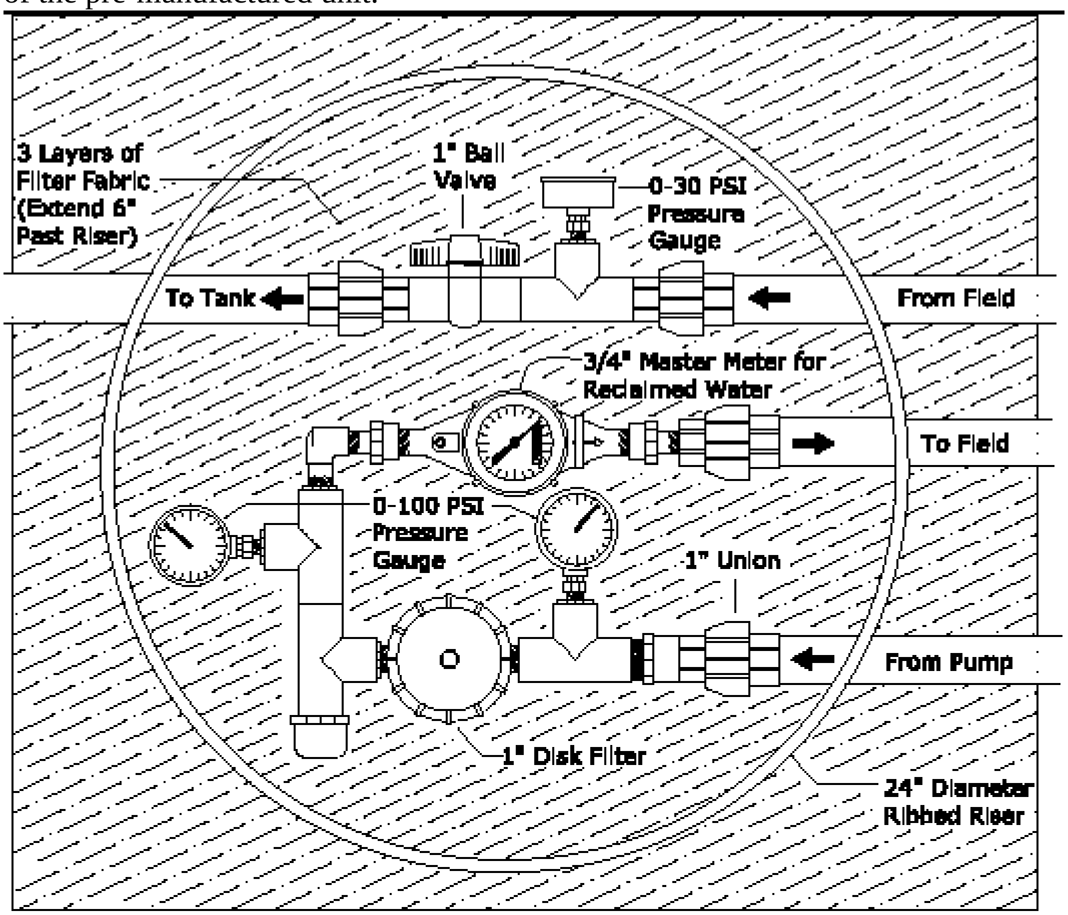
Headworks

The *HD Fowler Continuous Flush Headworks* is a simplified headworks that meets the intent of automatic flushing. This headworks is set-up for a maximum flow rate of 15 gpm at 60 psi (138.6 ft. head) and an upsized Netafim disk filter (1" disk filter). The system, when designed according to this manual, will be continuously forward flush through the disk filter while maintaining a 2 ft/sec velocity in the dripfield network during each dosing event. To adjust the headworks for continuous flush operation use the following steps:

1. Flush the entire piping network of construction debris by running the pump for several minutes with the field flush valve completely open.

2. Shut off pump and clean disk filter of accumulated debris.
3. Turn the pump on, again. With the pump running, slowly close the field flush valve. Once the needle on the pressure gauges stabilize, record the flow rate through the flow meter for one minute. This will be the actual dose flow rate in gpm needed to calculate the timer settings.
4. Next, calculate the flushing flow rate by multiplying the number of supply manifold connections, or laterals, by a factor of 1.6 gpm. Add the dosing flow rate from step 2 to the flushing flow rate. This new accumulative, minimum flow rate is the minimum flow rate needed to achieve adequate scouring velocity in the entire system when the system is dosed.
5. While the pump is running, open the field flush valve slowly until the return pressure gauge reads 10 psi.
6. Now record the flow rate through the flow meter. I should be greater than the new accumulated flow rate required in step 3. More is better.

The Fowler headworks part number PUHEADWORKS4. Below is an illustration of the pre-manufactured unit.



HD Fowler Continuous Flush Headworks

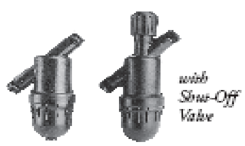
The main components of the headworks are:

- 1” disk Filter

- Three pressure gauges
- Reclaimed water flow meter
- One ball valve

Disk Filter

The disk filter is upsized from what would be required for a 1000 emitters at 0.42 gph flow rate: normally a ¾" disk filter (1000 x 0.42 gph/60 = 7 gpm). The ¾" disk filter has a maximum flow rate range of 17 gpm. Up sizing the filter to a 1" disk filter increases the maximum flow rate to 26 gpm. The increase in filter size is equivalent to a 462 % increase in filtration capability, thereby increasing the service interval. This also mitigates the need to "backflush" the filter between service calls. (see illustrations below).



3/4" Filter	
Flow range:	1-17 GPM
Maximum pressure:	140 psi
Filtering surface area:	24.8 sq. in.
Filtering volume:	5.8 cu. in.
Length:	8 1/16"
Width:	9 5/8"
Weight:	.8 lbs.
Distance between end connections:	6"
Inlet/outlet diameter:	3/4" male
Model Number:	25A45-XXX
With Shut-Off Valve	
Model Number:	25A46-XXX

1" Filter	
Flow range:	5-26 GPM
Maximum pressure:	140 psi
Filtering surface area:	48.91 sq. in.
Filtering volume:	26.8 cu. in.
Length:	8 7/8"
Width:	5 1/8"
Weight:	2.4 lbs.
Distance between end connections:	6 7/32"
Inlet/outlet diameter:	1" male
Model Number:	25A47-XXX

Netafim Disk Filter Charts.

Continuous Flush vs. Manual Flush

Manual flushing means that a small amount of liquid is allowed to bypass the field flush valve during the dosing cycle. The amount of liquid that bypasses is not specified, neither is it intended to allow sufficient scouring velocity for any part of the network. The bypass flow is intended to allow the material that could accumulate and then dislodge from the interior wall of the tubing a path of escape, and not clog the emitters. Continuous flushing is intended to prevent the accumulation of material on the interior tubing wall. The defining difference between manual flushing and continuous flushing is the minimum velocity of the liquid through the network during the dosing cycle. Manual flushing has no minimum velocity while continuous flushing has at least 2 feet per second (fps) velocity at all points in the network.

Options

<u>1.) Drip with Septic Tank Effluent or ATUs: Continuous Flushing and Timed Dosing</u>

The *Continuous Flush Headworks* will require a timer control panel capable of operating a 110- volt, ½ hp pump with 18 amps starting capacity. Commercially available panels are: Orenco, Aquaworx, Rhombus… No additional features for electronic zone or flush valves are needed. If multiple zones are desired, the design needs only to incorporate a hydro-indexing valve with the same corresponding outlets as the number of zones. For example: an Orenco V4400A distributing valve series has the capability of operating up to four zones. Every dose is a flush cycle so there is no need for a control panel to "flush" the dripfield automatically. Systems with multiple zones will need a check valve on each of the flush lines between the individual flush manifolds and common flush line connection. This will prevent the resting zone(s) from being dosed through the common flush line. <u>*NOTE: during the dose cycle, additional hydraulic flow through the septic tank or ATU will be generated if flush line is terminated at the beginning of the system. Best practice is to terminate the flush line in the pump chamber.*</u>

<u>2.) Drip with Intermittent Sand Filters, timed dosing:</u>

Dosing a dripfield from a sand filter will require the dripfield dosing to be time-dosed. There is really no other way to insure a specific dose volume to the dripfield out of the sand filter basin. A panel such as an Orenco MVP SSF-1PTRO/PTRO or equivalent will be needed. <u>*NOTE: during the dose cycle, additional hydraulic flow through the system will be generated if flush line is terminated at the beginning of the system or the pump tank. Best practice when designing a sand filter is to terminate the flush line in the sand filter pump basin.*</u>

<u>3.) Drip with AdvanTex: manual or Continuous flushing, timed dosing.</u>

Manual flushing after an AdvanTex treatment system is very common. Some jurisdictions require time dosing the dripfield. When the system is started up, the field flush valve is closed and the pump is activated. Once the pressure has stabilized the field flush valve is slightly opened to allow a small amount of bypass back into the tank.

For continuous flushing, follow the procedure outlined in *Continuous Flush Headworks* section. A 1000- gallon surge tank will be needed. <u>*NOTE: during the dose cycle, additional hydraulic flow through the processing tank will be generated if flush line is terminated at the beginning of the system. Best practice is to terminate the flush line in the pump chamber.*</u>

4.)Drip with AdvanTex: manual or continuous flush, demand dosing.

The most common combination of Drip with AdvanTex treatment is the use of manual flushing and demand dosing. The same basic headworks with a manual ball valve is employed. Dosing is achieved with a 24” diameter pump basin. Timed dosing is accomplished through the AdvanTex system and the dripfield pump is then indirectly timed dosed. The pump basin is sized to give a dose volume and submerge the pump. Storage capacity is located in the AdvanTex processing tank. When the pump basin high level in tripped, the system overrides the recirculation pump.
If continuous flushing were desired in this option, the flush return line would have to enter the pump basin. Otherwise, the pump would run out of liquid before the proper dose volume could be achieved. *NOTE: during the dose cycle, additional hydraulic flow through the processing tank will be generated if flush line is terminated at the beginning of the system. Best practice is to terminate the flush line in the discharge pump basin.*

Appendix A

Design Guide for HD Fowler
Residential Applications
(see appendix H for detail explanation)

Design Flow: __________gpd
Soil Type: _________
Number of Emitters:____________ (design flow/emitter discharge per day) see appendices E and/or F
Emitter spacing: _____ ft.
Total Drip line: ______ (# of emitters x emitter spacing in feet)
Number of Zones: _____ (Any system over 1000 emitters must be broken up into two zones)
Number of Emitters per Zone: ______ (total number of emitters / number of zones)
Emitter discharge rate per Zone: _______ gph (emitters per zone x emitter discharge rate gph)
Emitter discharge rate per Zone: _______ gpm (emitter discharge rate gph x # emitters / 60)

Select Inlet Pressure and Max Lateral Length: ______ psi, lateral length:_____ft. (see Bioline Flushing Chart on page 17)
Determine Maximum Number of Laterals: ______ (pump discharge rate – zone discharge rate gpm) / 1.6

Pump Selection:

TDH

Dripfield pressure (psi x 2.31= ft head): _______ ft. head
Disk Filter loss: ______
Elevation: ________
Friction loss through pipe network: ________ (see Head loss chart, appendix D)
Valves (hydrotech): _________

Total head loss: __________

Flow rates:

Dosing: __________ gpm (from above)
Field Flushing: _________ gpm (dosing + (1.6 x number of connections))
Filter flushing: 20 gpm

Appendix B

NETAFIM™
GROW MORE WITH LESS

14 May 2009

Mr. David Lowe
H.D. Fowler, Inc.

Dear Dave,

This letter is approval of the use of Netafim Bioline® dripperline with the continuous flush headwork as designed and manufactured by H.D. Fowler which incorporates Netafim disc filters.

While many onsite systems using Bioline employ an advanced treatment system that brings the BOD/TSS into the 30/30 range or better, residential strength septic tank effluent in the 150 range is being successfully dispersed with Bioline. FOG should always be under 20.

As it relates to velocity, there are no hard and fast rules, nor is there peer-reviewed science on velocity and frequency. Our position is that a flushing velocity of 1 fps in a system using advanced treatment is acceptable. One fps equates to a Reynolds number of 4500 which is just inside the 'turbulent' zone and thus, scouring is occurring. This is probably a very adequate velocity when working with a continuous flush headwork since there is ongoing scouring during operation. With STE dispersal, a more aggressive flush in the 2 fps range is probably good counsel. This brings the Reynolds number to 9000. Again, a continuous flush headwork offers the benefit of continuous scouring.

Regarding filter maintenance, follow a regularly-scheduled regime that includes:

- Cleaning should be done whenever it is visibly dirty or when pressure loss across the filter is 7 PSI or greater.
- If you believe that the filter may not be serviced as often as it should be, always use a filter with greater capacity. You need to increase filtration capacity to ensure the filter does not load with debris and degrade the system's performance between cleanings.
- Whenever possible, mount gauges on the upstream and downstream sides so you can easily determine the pressure differential across the filter.

Thank you for the opportunity to work with you and H.D. Fowler on this project.

Best regards,

Market Manager - Wastewater Division
Netafim USA

NETAFIM USA 5470 E. Home Ave., Fresno, CA 93727 CS 888 638 2346 F 559 453 1043 www.netafimusa.com

Appendix C

O&M Requirements:

Operation and maintenance shall be provided at twelve (12) months intervals. Servicing shall include:

1.) Physically removing filter cartridge and washing all debris from all disks when the pressure differential across the filter is 7 psi or greater,
2.) Flushing the dripfield,
3.) Verifying dosing flow rate,
4.) Check for wet spots in dripfield,
5.) Check operation of air relief valves,
6.) Verify and adjust operating pressure.

The service provider must have been trained in servicing procedures for this particular headworks and system arrangement.

Appendix D

FRICTION LOSS CHARACTERISTICS PVC SCHEDULE 40 IPS PLASTIC PIPE

(1120, 1220)

C=150

Sizes ½" to 6"

Flows 1 to 900 GPM

PSI Loss of 100 Feet of Pipe (psi per 100 feet)

SIZE		½"		¾"		1"		1 ¼"		1 ½"		2"		2 ½"		3"		4"		6"	
I.D.		0.622"		0.824"		1.049"		1.380"		1.610"		2.067"		2.469"		3.068"		4.026"		6.065"	
O.D.		0.840"		1.050"		1.315"		1.660"		1.900"		2.375"		2.875"		3.500"		4.500"		6.625"	
Wall Thk		0.109"		0.113"		0.133"		0.140"		0.145"		0.154"		0.203"		0.216"		0.237"		0.280"	
Flow GPM	Flow GPH	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss
1	60	1.06	0.43	0.60	0.11	0.37	0.03	0.21	0.01	0.16	0.00	0.10	0.00	0.07	0.00	0.04	0.00	0.03	0.00	0.01	0.00
2	120	2.11	1.55	1.20	0.39	0.74	0.12	0.43	0.03	0.32	0.02	0.19	0.00	0.13	0.00	0.09	0.00	0.05	0.00	0.02	0.00
3	180	3.17	3.28	1.80	0.84	1.11	0.26	0.64	0.07	0.47	0.03	0.29	0.01	0.20	0.00	0.13	0.00	0.08	0.00	0.03	0.00
4	240	4.22	5.59	2.41	1.42	1.48	0.44	0.86	0.12	0.63	0.05	0.38	0.02	0.27	0.01	0.17	0.00	0.10	0.00	0.04	0.00
5	300	5.28	8.45	3.01	2.15	1.86	0.66	1.07	0.17	0.79	0.08	0.48	0.02	0.34	0.01	0.22	0.00	0.13	0.00	0.06	0.00
6	360	6.34	11.85	3.61	3.02	2.23	0.93	1.29	0.25	0.95	0.12	0.57	0.03	0.40	0.01	0.26	0.01	0.15	0.00	0.07	0.00
7	420	7.39	15.76	4.21	4.01	2.60	1.24	1.50	0.33	1.10	0.15	0.67	0.05	0.47	0.02	0.30	0.01	0.18	0.00	0.08	0.00
8	480	8.45	20.18	4.81	5.14	2.97	1.59	1.72	0.42	1.26	0.20	0.76	0.06	0.54	0.02	0.35	0.01	0.20	0.00	0.09	0.00
9	540	9.50	25.10	5.41	6.39	3.34	1.97	1.93	0.52	1.42	0.25	0.86	0.07	0.60	0.03	0.39	0.01	0.23	0.00	0.10	0.00
10	600	10.56	30.51	6.02	7.77	3.71	2.40	2.15	0.63	1.58	0.30	0.96	0.09	0.67	0.04	0.43	0.01	0.25	0.00	0.11	0.00
11	660	11.61	36.40	6.62	9.26	4.08	2.86	2.36	0.75	1.73	0.36	1.05	0.11	0.74	0.04	0.48	0.02	0.28	0.00	0.12	0.00
12	720	12.67	42.77	7.22	10.88	4.45	3.36	2.57	0.89	1.89	0.42	1.15	0.12	0.80	0.05	0.52	0.02	0.30	0.00	0.13	0.00
14	840			8.42	14.48	5.20	4.47	3.00	1.18	2.21	0.56	1.34	0.16	0.94	0.07	0.61	0.02	0.35	0.01	0.16	0.00
16	960			9.63	18.54	5.94	5.73	3.43	1.51	2.52	0.71	1.53	0.21	1.07	0.09	0.69	0.03	0.40	0.01	0.18	0.00
18	1,080			10.83	23.06	6.68	7.12	3.86	1.88	2.84	0.89	1.72	0.26	1.21	0.11	0.78	0.04	0.45	0.01	0.20	0.00
20	1,200			12.03	28.03	7.42	8.66	4.29	2.28	3.15	1.08	1.91	0.32	1.34	0.13	0.87	0.05	0.50	0.01	0.22	0.00
22	1,320			13.24	33.44	8.17	10.33	4.72	2.72	3.47	1.28	2.10	0.38	1.47	0.16	0.95	0.06	0.55	0.01	0.24	0.00
24	1,440					8.91	12.14	5.15	3.20	3.78	1.51	2.29	0.45	1.61	0.19	1.04	0.07	0.60	0.02	0.27	0.00
26	1,560					9.65	14.08	5.58	3.71	4.10	1.75	2.49	0.52	1.74	0.22	1.13	0.08	0.66	0.02	0.29	0.00
28	1,680					10.39	16.15	6.01	4.25	4.41	2.01	2.68	0.60	1.88	0.25	1.22	0.09	0.71	0.02	0.31	0.00
30	1,800					11.14	18.35	6.44	4.83	4.73	2.28	2.87	0.68	2.01	0.28	1.30	0.10	0.76	0.03	0.33	0.00
35	2,100					12.99	24.41	7.51	6.43	5.52	3.04	3.35	0.90	2.35	0.38	1.52	0.13	0.88	0.04	0.39	0.00
40	2,400							8.58	8.23	6.30	3.89	3.82	1.15	2.68	0.49	1.74	0.17	1.01	0.04	0.44	0.01
45	2,700							9.65	10.24	7.09	4.83	4.30	1.43	3.02	0.60	1.95	0.21	1.13	0.06	0.50	0.01
50	3,000							10.73	12.44	7.88	5.88	4.78	1.74	3.35	0.73	2.17	0.25	1.26	0.07	0.56	0.01
55	3,300							11.80	14.84	8.67	7.01	5.26	2.08	3.69	0.88	2.39	0.30	1.39	0.08	0.61	0.01
60	3,600							12.87	17.44	9.46	8.24	5.74	2.44	4.02	1.03	2.60	0.36	1.51	0.10	0.67	0.01
65	3,900							13.94	20.23	10.24	9.55	6.21	2.83	4.36	1.19	2.82	0.41	1.64	0.11	0.72	0.02
70	4,200									11.03	10.96	6.69	3.25	4.69	1.37	3.04	0.48	1.76	0.13	0.78	0.02
75	4,500									11.82	12.45	7.17	3.69	5.03	1.55	3.25	0.54	1.89	0.14	0.83	0.02
80	4,800									12.61	14.03	7.65	4.16	5.36	1.75	3.47	0.61	2.02	0.16	0.89	0.02
85	5,100									13.40	15.70	8.13	4.65	5.70	1.96	3.69	0.68	2.14	0.18	0.94	0.02
90	5,400											8.61	5.17	6.03	2.18	3.91	0.76	2.27	0.20	1.00	0.03
95	5,700											9.08	5.72	6.37	2.41	4.12	0.84	2.39	0.22	1.06	0.03
100	6,000											9.56	6.29	6.70	2.65	4.34	0.92	2.52	0.25	1.11	0.03
110	6,600											10.52	7.50	7.37	3.16	4.77	1.10	2.77	0.29	1.22	0.04
120	7,200											11.47	8.82	8.04	3.71	5.21	1.29	3.02	0.34	1.33	0.05
130	7,800											12.43	10.22	8.71	4.31	5.64	1.50	3.28	0.40	1.44	0.05
140	8,400											13.39	11.73	9.38	4.94	6.08	1.72	3.53	0.46	1.55	0.06
150	9,000													10.05	5.61	6.51	1.95	3.78	0.52	1.67	0.07
160	9,600													10.72	6.33	6.94	2.20	4.03	0.59	1.78	0.08
170	10,200													11.39	7.08	7.38	2.46	4.28	0.66	1.89	0.09
180	10,800													12.06	7.87	7.81	2.73	4.54	0.73	2.00	0.10
190	11,400													12.73	8.70	8.25	3.02	4.79	0.81	2.11	0.11
200	12,000													13.40	9.56	8.68	3.32	5.04	0.89	2.22	0.12
225	13,500															9.76	4.13	5.67	1.10	2.50	0.15
250	15,000															10.85	5.02	6.30	1.34	2.78	0.18
275	16,500															11.93	5.99	6.93	1.60	3.05	0.22
300	18,000															13.02	7.04	7.56	1.88	3.33	0.26
325	19,500																	8.19	2.18	3.61	0.30
350	21,000																	8.82	2.50	3.89	0.34
375	22,500																	9.45	2.84	4.16	0.39
400	24,000																	10.08	3.20	4.44	0.44
425	25,500																	10.71	3.58	4.72	0.49
450	27,000																	11.34	3.98	5.00	0.54
475	28,500																	11.97	4.40	5.28	0.60
500	30,000																	12.60	4.83	5.55	0.66
550	33,000																	13.86	5.77	6.11	0.79
600	36,000																			6.66	0.92
650	39,000																			7.22	1.07
700	42,000																			7.77	1.23
750	45,000																			8.33	1.39
800	48,000																			8.88	1.57
850	51,000																			9.44	1.76
900	54,000																			9.99	1.95

Note: Shaded areas of the chart indicate velocities over 5 Ft/Sec. Use with Caution.

Velocities are calculated using the general equation:
V = (0.4085 * (Q / d^2)

Friction Losses are calculated using the Hazen-Williams Equation:
Hf = 0.2083 * (100 / C)^1.852 * (Q^1.852 / d^4.866)

V = FPS (feet per second)

Hf = PSI/100 Ft. (pounds per square inch per 100 feet)

C = 150

Q = GPM (gallons per minute)

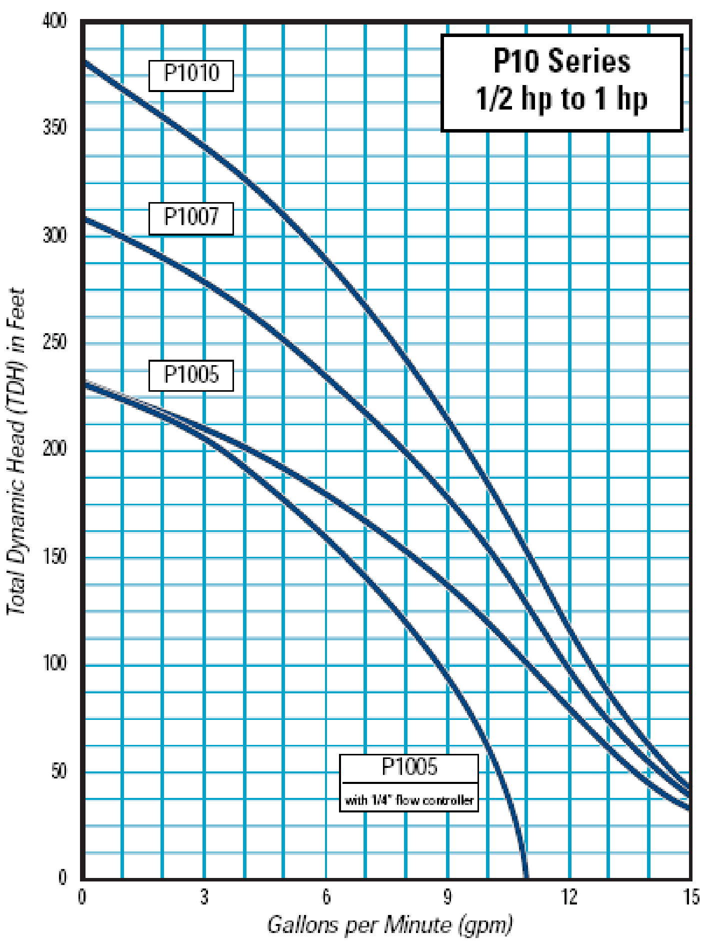
d = ID (inside diameter)

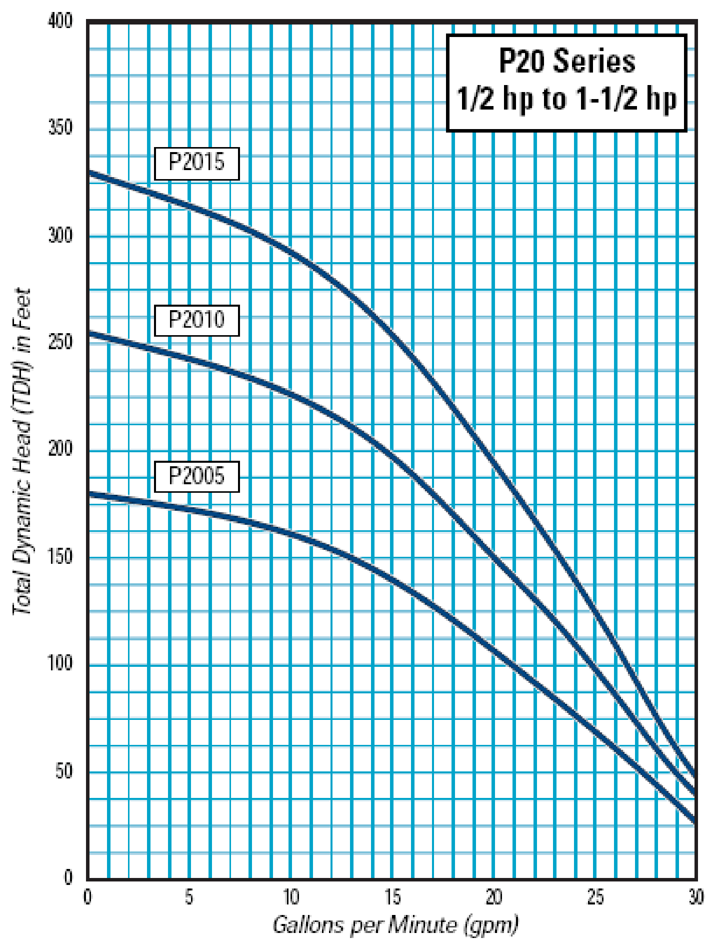
Appendix E, Design chart for 120 gpd/bedroom.

Treatment	Soil Type	1	2	3	4	5	6
≥ STE	max daily discharge per emitter (gpd/emtr)	1	1	0.8	0.8	0.5	0.25
≥ TLD*	max daily discharge per emitter (gpd/emtr)	2	2	1.6	1.6	0.75	0.375
	minimum eitter spacing (ft)	1	1	1	1	1	1
	minimum dripline spacing (ft)	1	1	1.5	2	2	2
	minimum area per emiter (ft^2)	1	1	1.5	2	2	2
	minimum number doses per day	12	12	12	12	8	4

* if allowed by local health jurisdiction

Appendix F, Sample pump curves.





Appendix G

Design steps

Properly sizing a drip dispersal system requires addressing a number of factors: total number of emitters, inlet pressure, number of zones, number of laterals within each zone, and desired flushing velocity. Use Appendix A as a guide for the steps listed below.

Step 1. Determine the number of emitters:

The number of emitters is determined by soil type and numbers of bedrooms for residential applications. For 120 gpd design flow criteria, see appendix E. For all other design flows, see appendix F.

Step 2. Determine maximum lateral lengths:

Refer to *Bioline Flushing Chart*, page 17. Always use the flushing chart to determine lateral lengths. The *Dosing lateral Lengths* are longer than the flushing chart. Consequently, the longer lateral lengths will have great head loss at the distal ends and scouring velocities will not be achieved.

Step 3. Calculate the number of laterals:

The number of laterals is determined by dividing the lateral length into the total amount of tubing within the zone. For all fractional results, round up to the next whole number. An adjustment to the lateral length as a function of the number of laterals will be required. Divide the number of laterals into the total number of emitters required will result in a new, shorter, lateral length.

Step 4. Calculate minimum flow rate:

Two flow rates, dosing and flush, are combined to determine the minimum flow rate.

Dosing flow rate:

$$\frac{\text{Total number of emitters in one zone x emitter discharge rate (gph)}}{\text{60 minutes/hour}} = \textbf{dosing flow in gpm}$$

Flushing flow rate for 2 ft/sec:

Total number of laterals per zone x 1.6 gpm = **flushing flow rate in gpm**

Minimum flow rate = flushing flow + dosing flow

Step 5. Determine friction loss in supply line and supply line size:

Refer to Appendix F. Select the pipe size that provides between 2 to 5 ft/sec velocity. Note the fiction loss.

Step 6. Calculate Total Dynamic Head (TDH):

Add the values for:

- Inlet pressure
- Elevation lift
- Supply line friction loss
- Misc. fittings and valves

Step 7. Select pump:

With the values in Steps 4 and 6 (minimum flow and TDH), select the pump that best matches the flow and pressure requirements.

Examples of the basic design for continuous flush:

Example 1:

Four (4) bedroom design flow, 480 gpd.
Soil type 5 (0.5 g/emitter/day)
Supply line length 60 ft.
Elevation change, 25 ft.

Step 1. Determine total number of emitters:

480 gpd/ .5 gpd/emitter (see appendix H) = 960 emitters @ 12" spacing = **960 ft.**

Step 2. Maximum lateral length:

Use the 0.42 gph emitter discharge rate at 12" spacing. Select **35 psi** inlet pressure from *Bioline flushing Chart*. Maximum laterals length is **260 ft**.

Step 3. Calculate the number of laterals:

# of laterals = 960 emitters / 260 ft = 3.69 laterals, round up to **4**.

Lateral lengths = 960 ft / 4 = 240 ft.

Step 4. Calculate minimum flow rate:

Dosing flow rate = 960 emitters x 0.42 gph / 60 minutes / hour = **6.72 gpm**

Flushing flow rate = 4 laterals x 1.6 gpm/lateral = **6.4 gpm**

Minimum flow rate = **6.72 gpm** + **6.4 gpm** = **13.12 gpm**

Step 5. Determine friction loss in supply line and supply line size:

To achieve between 2 and 5 ft/sec velocities in the supply line, see appendix F. At 13.12 gpm (rounded up to 14 gpm) a **1.25”** diameter pipe provides a velocity of **3** ft/sec and a fiction loss of 1.18 psi (**2.7 ft** of head) per 100 feet.

Step 6. Calculate Total Dynamic Head (TDH):

Inlet pressure	35 psi = 81 ft	
Elevation lift	25 ft	
Supply line friction loss (.6 x 2.7 ft)	1.6 ft	
Misc. fittings and valves	10 ft	Total= **117.6 ft.**

Step 7. Select pump:

With the values in Steps 4 and 6 (minimum flow and TDH), select the pump that best matches the flow and pressure requirements.

TDH = 117.6
Minimum flow= 13.12 gpm

Refer to appendix I, sample pump curves.

Example 2.

Four bedrooms, 480 gpd flow rate
Soil type 2, 1.0 g/emitter/day
Elevation difference 45 ft.
Supply line length, 120 ft.

Step 1. Determine the number of emitters:

480 / 1.0 g/emitter/day = 480 emitters

Step 2. Determine maximum lateral lengths:

15 psi inlet pressure, maximum lateral length, 115 feet

<u>Step 3. Calculate the number of laterals:</u>

480 feet of Bioline/ 115 ft = 4.17, round up to 5 laterals
New lateral length, 480 / 5 = 96 ft.

<u>Step 4. Calculate minimum flow rate:</u>

Dosing flow rate:
480 emitters x 0.42 gph/ 60 minutes/hour = **3.36 gpm**

Flushing flow rate for 2 ft/sec:
5 laterals x 1.6 gpm/lateral= **8 gpm**

<u>Minimum flow rate</u> = **3.36** + **8** = **11.36 gpm**

<u>Step 5. Determine friction loss in supply line and supply line size:</u>

A 1” diameter pipe at 11.36gpm rounded up to 12 gpm has a velocity of **4.45** ft/sec and a fiction loss of 4 psi or **9.3 ft of head**.

<u>Step 6. Calculate Total Dynamic Head (TDH):</u>

Add the values for:
Inlet pressure = 35 ft.
Elevation lift = 45
Supply line friction loss = 9.3 ft.
Misc. fittings and valves = 5 ft.
TDH = **94.3 ft head**

<u>Step 7. Select pump:</u>

Minimum flow = 11.36 gpm
TDH = 94.3

In the examples given, the number of emitters and laterals are significantly different. Yet, the flow and head requirements are met by the same pump curve.

BIOLINE DOSING CHART Maximum Length (feet) of a Single Lateral

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4	0.6	0.9	0.4	0.6	0.9	0.4	0.6	0.9
Inlet Pressure (psi)	15	292	233	175	410	322	247	510	405	308
	25	397	312	238	558	438	335	660	550	423
	35	486	365	279	656	514	394	760	649	497
	45	520	407	311	732	574	439	880	725	555

Lateral lengths are calculated for operation while dosing, and allow for the pressure at the end of the dripperline to be 7 psi or greater. These data do not take scouring velocity into account.

BIOLINE FLUSHING CHART Maximum Length of a Single Lateral (feet) Allowing for 2 fps Scouring Velocity

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4	0.6	0.9	0.4	0.6	0.9	0.4	0.6	0.9
Inlet Pressure (psi)	15 Inlet 8Δ	115	100	85	160	140	120	210	190	170
	25 Inlet 18Δ	200	170	140	270	230	200	360	320	280
	35 Inlet 28Δ	260	210	180	360	300	250	470	410	350
	45 Inlet 38Δ	310	250	210	420	350	290	560	490	420

Lateral lengths are calculated to achieve 2 fps scouring velocity and pressure at the distal end of the lateral to be 7 psi.

Appendix H

Flow Inducer

HD Fowler Flow Inducer

High head turbine pumps are a valuable tool in the onsite sewage industry. Their performance over a wide range of total dynamic head requirements make these pumps a good fit for a number of system arrangements: subsurface drip dispersal, STEP systems, or any application requiring a high head pump with no solids handling requirement. Turbine pumps are different than normal centrifugal pumps. Turbine pumps were developed for the water well market. The flow of water needs to pass over the motor before entering the volute, thereby cooling the motor. There are some expensive filtering devices available that are not necessary for all applications. The following instructions are intended to illustrate a very simple method of achieving the proper flow path for motor cooling. It is referred to as the ***HD Fowler Flow inducer***.

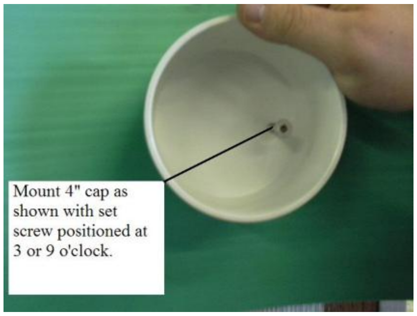
The *HD Fowler Flow Inducer* can be used where wastewater has been treated to secondary standards or with septic tank effluent that has been screened.

The HD Fowler flow inducer comes completely assembled and includes all the materials necessary for easy field installation. The list of parts includes:

- The flow inducer
- 4” mounting cap and set screw
- Mounting tee and set screw

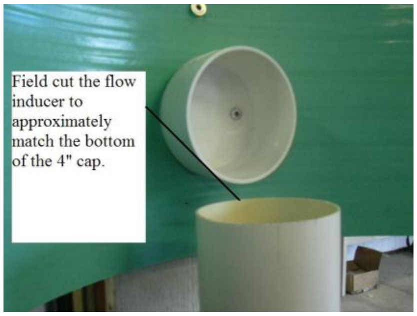
Tools needed:

- Cordless drill
- Square head screw driver bit
- Pilot hole drill bit (any size from 1/8” to 3/16”)



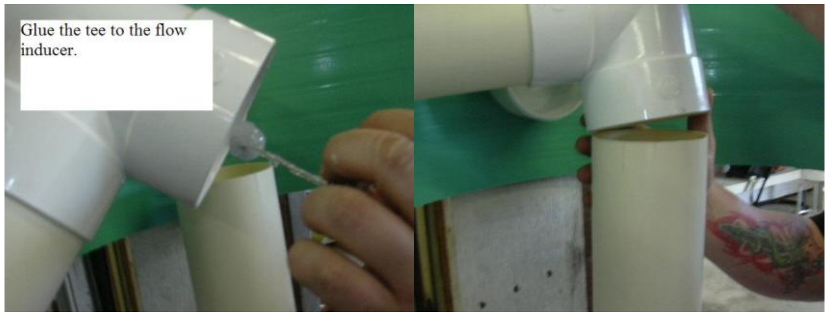
<u>Step 1.</u>

Mount a 4” mounting cap at the approximate location desired on the interior of the tank riser. Drill a pilot hole in the side of the riser for the set screw. The set screw is installed at either the 3 or 9 o’clock position. The top of the mounting cap should be no less than 5” below the top of the riser.



<u>Step 2. Field cut the flow inducer.</u>

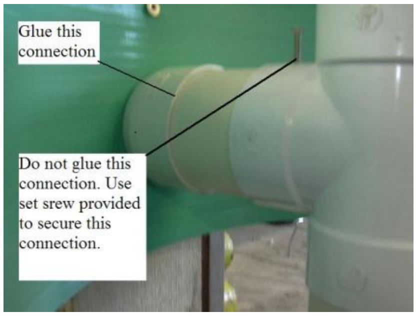
Measure the distance from the floor of the tank to the invert of the mounting cap. Cut the flow inducer to this length.



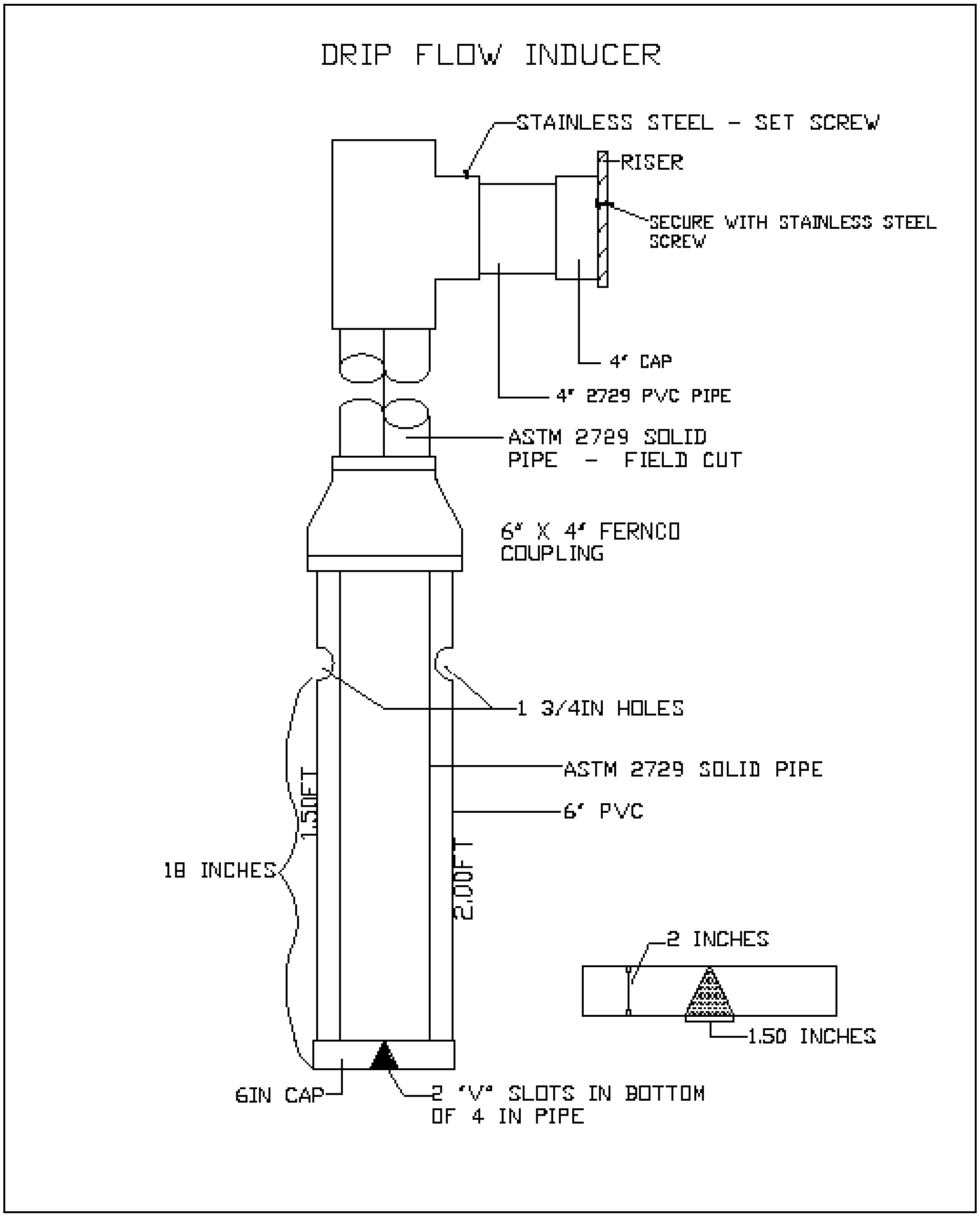
<u>Step 3. Glue mounting tee.</u>
Glue the mounting tee to the flow inducer as shown.

<u>Step 4. Secure flow inducer to mounting cap.</u>
Stand the flow inducer on the floor of the pump tank. The mounting cap and mounting tee will probably not match up exactly. The mounting cap can be rotated to match the mounting tee and then glued into place.

Note: ***<u>Do not</u>*** glue the tee to the horizontal pipe with the set screw. Once the flow inducer is installed, removing the set screw allows the flow inducer to be removed for servicing.



Do not glue the tee connection with the set screw!



Drawing by: J. Baima, Baima Enterprises (modified by Perry Almassy, HD Fowler Co.)