WASTEFLOW®

Subsurface Irrigation Systems as Applied to On-Site Effluent Disposal of Wastewater

Design, Installation & Maintenance Manual

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NOTE:

Each State and Council has regulations concerning wastewater disposal which **must** be followed. This manual is intended to be a guide to users of Geoflow™ subsurface wastewater disposal equipment and should be used only as a supplement and secondary to these governing regulations.

GEOFLOW™ SUBSURFACE IRRIGATION SYSTEMS AS APPLIED TO ON-SITE EFFLUENT DISPOSAL OF WASTEWATER.

DESIGN AND INSTALLATION MANUAL§ .

1. INTRODUCTION

Effluent disposal and irrigation are hydraulically similar but the design requirements are not identical. With effluent disposal the aim is usually to dispose of the effluent using the minimum area as quickly and safely as possible at an approximately uniform rate throughout the year. A disposal system has to keep operating in the rain, while an irrigation system does not. With irrigation the aim is usually to optimise the use of water over as large an area as possible with allowance for a wide range of water usage between seasons.

IF THE MAIN PURPOSE OF THE GEOFLOW SYSTEM IS TO IRRIGATE, THEN PLEASE USE THE STANDARD IRRIGATION DESIGN MANUAL FOR LANDSCAPE & TURF.

Subsurface drip is the most efficient method to dispose of effluent. Precise amounts of water are applied under the soil surface. The main advantages of subsurface irrigation for effluent disposal are:

- Minimises health risk
- Well designed systems will not cause puddling or runoff.
- Even uniformity over the entire disposal area.
- Can be used under difficult circumstances of high water tables, tight soils, steep slopes or wind.
- Maximises disposal of water by means of evapotranspiration by the plants.
- Minimises deep percolation.
- Increases consumption of nitrates by the plant material.
- Invisible and vandal proof installations.
- Durable systems with no moving parts for a long life.
- Non intrusive. It allows use of the space while in operation.
- Easily automated.

Subsurface drip irrigation systems have been used in both agriculture and landscaping for over 20 years. Subsurface drip is becoming more popular everyday because of the agronomic and ecological advantages.

The critical factors for subsurface drip to succeed with biologically active water is a well designed, reliable installation and management control. The basis of any design is knowing how much water the treatment system will produce, and how much water can be applied per m2 on a daily basis. This may mean testing each site for absorption rates.

2. SYSTEM COMPONENTS:

A typical drip system installation will consist of the elements listed below:

WASTEFLOW™ Lines (or emitter lines)

These lines carry the water into the area to be irrigated. WASTEFLOW™ lines are connected to the submain and flush lines usually with grommet - barbed fittings. (In small systems < 1500 l/hr capacity through the system, the actual Wasteflow tube can be used for submain & flushing lines). The emitters are "in" the line. With WASTEFLOW™ **Classic** the flow rate delivered by the emitter is a function of the pressure at the emitter. At 100 Kpa the flow rate is 4.0 l/hr.
With WASTEFLOW™ **PC** the flow rate will be constant 2.4 l/hr at pressure ranging from 50 - 400 kPa.

The risk of **root intrusion** with an emitter slowly releasing nutrient rich effluent directly into the soil is well known to anyone who has observed a leaking sewer pipe. GEOFLOW has an exclusive license for **ROOTGUARD®**, which protects emitters from root intrusion for 20+ years, (and comes with a 10 year warranty). This is critical for the long term reliability of any buried system! (For further information refer brochures literature or "Root Intrusion Protection for Subsurface Drip Emitters".

GEOFLOW uses turbulent flow "in line" emitters with large flow paths. Turbulent flow, large flow path emitters have proven over the years to be the most reliable and dependable emitters because of their resistance to blocking. GEOFLOW'S WASTEFLOW™ Classic does not contain any rubber products which may deteriorate from chemicals such as chlorine or build up bacterial slime. GEOFLOW'S WASTEFLOW™ has an inner lining impregnated with a tin based bactericide to inhibit bacterial growth on the walls of the tube, and in the emitter.
WASTEFLOW™ Inpipe emitter line**.** The standard drip line has 4.0 l/hr turbulent flow emitters spaced 60 cm (0.60 m) inside 16 mm O.D. tubing. The pipe has no joints which may pull apart during installation and is ideal for tractor mounted burying machines. It is sold in 200 & 400 m coils (Depending on availability).

Vacuum breaker.

Vacuum breakers installed at the high points protect the system from sucking dirt back into the drip line due to back siphoning or back pressure. This is an absolute necessity with underground drip systems.

Pressure regulator.

Under normal operating conditions, pressure in the drip lines should be between 100 and 175 kPa. For PC 50-400 kPa.

Filters.

An effective filtration system for each system is essential. The type required will depend on the quality of the water to be used. A 120 micron (120 mesh) primary filter should be installed at the treatment plant or main feeder pump.
The size of the system will determine if a manually cleaning or fully automatic filter system would be best suited.
Media, screen or disc filters can be used depending on water quality. Refer to Triangle Filtration for advice.
A secondary or back-up (check) filter should be installed as far down the system/s as practical. This is an insurance policy, in case a break occurs in the main line, or solids coagulate/form on the pipe walls and strip off in larger formations which could cause drippers to block.

Chemical Injector.

This allows chlorine, acids and alkalis to be safely applied through the system. This is required for any system with a BOD > 20 mg/l, optional for BOD < 20 mg/l. If a chemical injector is not used with water with BOD < 20 mg/l then a chlorinator is required.

Controller.

A programmable logic controller (PLC) is recommended for **large** systems or for any system with a BOD > 20 mg/l. This can be linked to the engineer in charge by modem in the event of system failure.
Electric solenoid valves. These control the flow of effluent throughout the system, especially if there are more than one station or dispersal block**.** They also can control/monitor the filter automatic backwashing, and the switch over to fresh water when required.

Submain manifold.

These carry the water from the valve to the area to be irrigated. Either PVC or polyethylene "poly" tubing may be used. Rigid PVC is usually employed for the larger installations. Poly tubing is easier to work with because it is flexible. In small systems with less than 1500 l/hr flow capacity the actual Wasteflow tube can be used as the submain. This can simplify connections and installation.

Flushing manifold

In order to help clean the system, the ends of the drip lines are connected together into a common flushing line. Polyethylene or pvc pipe may be used. This line will help equalize pressures in the system. Periodic automatic flushing, opening one flush line at a time under full system pressure will guarantee a long system life. It should be done frequently during the installation period. To control any possible health hazard this flush water should be return back into the treatment plant, or into the bottom of a gravel lined valve box which cannot be easily opened.

3. DESIGN PARAMETERS.

Select area.

Select the area with careful consideration of the soil, the terrain and your State and Council regulations.

Soil Application Design
Note: This paragraph is extracted from "Subsurface Trickle Irrigation System for On-Site Wastewater Disposal and Reuse" by B. L. Carlile and A. Sanjines. The rules in your shire council and state may vary.

"The instantaneous water application rate of the system must not exceed the water absorption capacity of the soil.
A determination of the instantaneous water absorption capacity of the soil is difficult, however, since the value varies with the water content of the soil. As the soil approaches saturation with water, the absorption rate reduces to an equilibrium rate called the "saturated hydraulic conductivity." Wastewater application rates should be less than 10 percent of this saturated equilibrium
Even though the trickle irrigation system maximizes the soil absorption rate through the low rate of application, thus keeping the soil below saturation, there will be times when the soil is at or near saturation from rainfall events. The design must account for these periods and assume the worst case condition of soil saturation. By designing for a safety factor of 10 or 12, based on the saturated hydraulic conductivity, the system will be under-loaded most of the time but should function without surface failure during extreme wet periods.
Using a safety factor of 12, a suitable design criteria would be to load the system at the estimated hydraulic conductivity but apply water for only a total of 2 hours per day out of the available 24 hours. By applying wastewater for a total of 2 hour per day, particularly if applied in "pulses" or short doses several times per day near the soil surface where the soil dries the quickest, this would keep the soil absorption rate at the highest value and minimize the potential of water surfacing on poor soil conditions.
As stated previously, this design criteria will under-load the system at all times except when the soil is at or near saturation from rainfall. If designing for an efficient irrigation system, the water supply may not be sufficient to meet the demands of a lawn or landscaped area during peak water demand months. This problem can be overcome by either of two solutions: add additional fresh-water make-up to the system during the growing season to supply the needed water for plants in question; or split the system into two or more fields with necessary valves and only use one of the fields during the peak water demand months and alternate the fields during winter months or extremely wet periods
Table 2 shows the recommended hydraulic loading rates for various soil conditions, using a safety factor of 12 with regard to the equilibrium saturated hydraulic conductivity rate of the soil. These loading rates assumes a treated, disinfected effluent with BOD and TSS values of less than 20 mg/l is produced in the pre treatment system.

Table 1. Minimum surface area required to dispose of 1000 litres per day

Soil absorption rates			Design Hydraulic Loading rate mm / m2-day	Total Area required m2 / 1000 l per day	Wasteflow™ tube reqd m @ 60 x 60 cm spacing 4.3 l/hr	Wasteflow™ flow rate litres/hr @ 100 kPa
Soil type	Est.Soil Perc. rate min/25 mm	Hydraulic Conduc-Conductivity mm/hr				
Coarse- sand	<5	>50	81	13	22	158
Fine sand	5-10	38-50	65	16	27	194
Sandy loam	10-20	25-38	53	19	32	230
loam	20-30	19-25	37	27	45	323
Clay loam	30-45	12.5-19	24	42	70	502
Silt-clay loam	45-60	7.6-12.5	16	63	105	753
Clay non-swell	60-90	5-7.6	8	125	210	1510
Clay - swell	90-120	2.5-5	4	250	420	3010
Poor clay	>120	<2.5	3	334	560	4020

Soil layers and types.

The quality and homogeneity of the soil may present a problem. If the soil was not properly prepared and there are pieces of construction debris, rocks and non-uniform soils, it is very difficult to obtain a uniform water spread. In all cases, but particularly if the soil is compacted, soil properties can be greatly improved by ripping and disking, sifting the coarser material and laying it down first. The **ideal** soil is 30 to 45 cm deep, uniform, has an equal amount of fine sand, loam and clay, and is on top of a deep layer of pea gravel and coarse sand that provides drainage.

Disposal Field Design

Flow and pressure drop calculations.

The best way to calculate the water requirements of your disposal system is to make a sketch of the various areas to be watered. A drawing to scale with contour lines is desirable
a) Divide the areas according to the type of soil, plants and irrigation requirements.
b) Calculate how many emitters are in each area. Multiply the number of emitters times the emitter flow rate at the design pressure, which is normally 100 kPa. These flows can be obtained from Table 2 below.
c) In the case that the terain is sloping use pressure compensating PC Wasteflow, in which case output of each driper will remain constant for pressures from 50 - 400 kPa.

Table 2. Line Pressure vs Emitter flow rates .

Pressure kPa	Flow LPH
80	3.7
100	4.0
150	5.0
200	5.9

d) **Check maximum recommended drip line length 67m for non-PC**. If drip lines are too long, the pressure loss is too high and hence the flow through the emitters is uneven. As a rule of thumb, to get a $\pm$5% to $\pm$7.5% flow uniformity, the maximum loss from the point of pressure control to the furthest emitter should not exceed 2 to 3 metres of water head.
The maximum recommended lateral lengths for WASTEFLOW™ 4.0 lph drip lines on the level is 67 metres.
e) Check the layout of the main lines going into the irrigated plot, so that the maximum lateral length is not exceeded.
f) Check the design for flows, select pipe diameters for submains, select filters and valves.
g) Do a complete list of materials and specify all the requirements for the installation.
h) For more precise calculations on slopes use the curves given in Appendix 1 at the end of this manual.

A system will usually have emitter lines (laterals) placed on 60 cm centers with a 60 cm emitter spacing such that each emitter supplies a 0.36 m^2 area . These lines are best placed at depths of 15 - 25 cm below the surface. This is a typical design for systems on sandy and loamy soils which will have a cover crop of lawn grass. Other line spacing may be used for special use situations such as for landscape beds where shrubs and trees are to be watered or if the plants are on an irregular spacing. Closer line spacings of 40 to 45 cm may be used on heavy clay soils where lateral movement of water is restricted.
The shallow depth of installation is an advantage of the trickle irrigation system since the topsoil or surface soil is generally the most permeable soil for accepting water. The topsoil also dries the fastest after a rainfall event and will maintain the highest water absorption rate.

A good vegetative cover is an advantage to prevent erosion from the field and utilize the water applied to the rooting zone. Sites should be planted or seeded immediately after installation. Grasses are particularly suitable for this application. Most lawn grasses will use 6 - 9 mm of water per day during the peak growing season. This calculates to be about 6 to 9 l/m2 /day, a significant part of the daily effluent loading. By overseeding lawns with winter ryegrass, this use efficiency can be continued through much of the year.
For vegetation using 6 to 9 l/m2/day by evapo-transpiration, a sewage flow of 1,000 litres per day would supply the water needs of a landscaped area of 170 to 112 sq. m. without having to add fresh make-up water. For areas larger than this, the plants will suffer water stress during the hot dry months unless additional fresh water is applied.
To determine the rate of water application from various trickle irrigation designs, Table 3.1 gives the application rates for a 4.0 lph Classic emitter at various lateral line spacings. Table 3.2 Gives the application rates for 2.4 l/hr PC.

Table 3.1 * **Commonly used spacing**

Water application rate using 4.0 l/hr Classic dripper mm/m2/hr

Dripper	Dripline Lateral Spacing (cm)						
Spacing cm	30	40	50	60	75	100	150
60	22.2	16.7	13.3	***11.1**	8.9	*6.7	4.4

Table 3.2 * **Commonly used spacing**

Water application rate using 2.4 l/hr PC dripper mm/m2/hr

Dripper	Dripline Lateral Spacing (cm)						
Spacing cm	30	40	50	60	75	100	150
60	13.3	10.0	8.0	***6.7**	5.3	*4.0	2.7

Calculation Example (Note: Triangle has a spread sheet calc's available)
A 3000 LPD system Is to be designed. The system is to be located on a tight heavy natural clay loam soil with an estimated saturated hydraulic conductivity of 2.5 mm/hr. The long term acceptable application rate is 5 mm/m2/day. (Note: Turf grass will be grown on the site with a peak evapotranspiration of 10.5 mm per day. The site is all level, so in actual fact in summer deficit irrigation will occur).

a) Field area required = 3000/5 = 600 m2
b) Emitter line spacing = 60 cm (0.6 m) Emitter line required = 600/0.6 = 1000 m
c) Emitter spacing = 60 cm (0.6 m)
d) Total number emitters = 1000/0.6 = 1667 emitters
e) Emitter flow rate = 4.0 LPH @ 100 kPa
f) Total flow = 1667 x 4.0 LPH = 6668 LPH
g) Daily irrigation time = 3000 l/day / 6668 LPH = 0.45 hours/ day = 27.0 minutes
h) Pumping rate required = 6668 LPH, or 111 LPM, or 1.85 LPSEC
i) System operating pressure = 100 kPa (15 psi).
j) If a 750 litre dosing volume were used for an average flow of 3000 litres per day, about 4 irrigation cycles per day would be made, lasting about 6.8 minutes each.
k) In many cases it may be more convenient to have two (2) or more smaller irrigation stations instead of one single large one. This would be done by dividing the total disposal field into the number of sectors required. These can be controlled with the use of a Waterotor Valve, solenoid valves and controllers
Example:
The above disposal field could be run in two (2) sectors each controlled by a solenoid valve. This would reduce the flow rate proportionally be 1/2 to 7167 L/HR/2 = 3584 l/hr. With the control system sending water to alternate sectors when the pump starts up.

Design & Installation Considerations

Distance from edges.

Allow not more than 6 inches from the edges, particularly if it is the top edge of a slope. Edges tend to dry more easily than the center. Remember that at the bottom of a slope the distance from the edges may be larger. On turf add extra lines along the edge parallel to the flush and header line, i.e. at right angles to the other dripperlines. These extra lines can be coupled into the flush and header line with compression fittings.

Wind.

If there is a prevailing summer wind direction turf may brown at the edge facing the wind. Place the first dripperline as close to the edge as practical and add an extra dripperline 15 cm from the first line.

Beware of high points and siphoning and slopes.

A potential problem with buried drip lines is siphoning dirt in when the system is switched off. For this reason:
a) Drip lines should have a fairly constant slope. If possible run lines along a contour.
b) A vacuum breaker valve should be provided at the highest point in each sector.
c) Check actual flows against maximum available flow rate and if necessary break the system into sectors to divide the flow. Here is where solenoid valves and irrigation controllers become useful.
d) Drip lines should be connected at the end to a common flush line with a flush valve / vacuum breaker.
e) Avoid installing lines along rolling hills where you have high and low points along the same line. If this is the case, connect all the high points together and install a vacuum breaker valve.

Slopes.

When designing on a slope the dripperlines should follow the contour. If slopes are more than 2 m then:
1) Each dripline lateral should have it's own individual pressure reducing valve fitted, with flushing valve at the end of each lateral, or
2) Pressure Compensating Wasteflow™ dripline should be used

Beware of excessive level differences.
Unless the system is designed with individual line pressure regulators, level differences between drip lines belonging to the same valve, should not exceed 2 m.

Interconnect long parallel lines in the middle.
This practice improves the uniformity of the system and helps to avoid siphoning dirt into the system when there is a broken line. Two tees can be used.

Positioning of vacuum breaker / flush valves.
Ensure that these valves are at a point high enough to prevent the system from draining through these valves when the water pressure is switched off.

Mounds.
Concentrate drip lines at the top of the mounds with wider spacing towards the bottom. In the case of compound slopes consult a professional irrigation designer.

Pressure regulator bypass.
It is useful to have a pressure regulator bypass as shown in Diagram 1, in order to increase pressure for flushing and for breaking through any blockage which may occur in the drippers themselves.

4. SYSTEM INSTALLATION

Installation Guidelines

WARNING: ROOTGUARD® is temperature sensitive. To assure a long protection life, store the drip line under shade in a cool place. Avoid hot temperature extremes.

a) Prepare the soil to get the best water saving results with the system. Excavation, filling and grading should have been finished before installation of the subsurface drip system.

b) Be sure you have everything required for the installation before opening trenches. Preassemble as many sets of components as practical above ground and in a comfortable place. Submain and flushing manifolds can be fabricated beforehand, with the holes required for drip tube grommet or barbed fittings pre-drilled. The submain manifold with tees can be preassembled and used to mark the beginning and end of WASTEFLOW™, etc. Do not start opening trenches until you are sure you have all the materials required.

c) Condition soil moisture the day before opening trenches or installing WASTEFLOW™. Remember it is much easier to install the system in moist soil. The soil should be moist but still should allow the proper operation of the installation equipment. The best preparation is to saturate the soil one day before the installation of the WASTEFLOW™, so the soil has time to drain. The soil surface should be dry so that the pipe puller or tractor maintains traction.

d) Install the system head first: Pumps, main valves, solenoid valves, filters, pressure regulator, chemical injector, pressure sensors and water meter. Then install the main lines. These should be buried at a depth of 30 to 45 cm, well below the depth of the WASTEFLOW™ lines (10 to 30 cm). If there is a risk of freezing bury mainlines below the frost line. At all times avoid getting debris into the system. Flush main lines, test for leaks and leave them full of water. Larger diameter pipes left full of air in a trench that has not been compacted may "float".

e) Open trenches for the submain manifold and flush line manifold. These trenches should be 20 to 25 cm deep.

f) Clean submain and flushline manifold trenches, moisten and compact the bottom of the trench**.** (If this is not done, the manifolds may "settle down" and slowly pull out the couplings and fittings). Assemble the submain manifold outside the trench if practical. Connect to main PVC/Poly lines and to the system head. Flush these lines. A high water velocity is required to carry away debris which may have entered the pipes before or during installation. Place the submain and flush manifolds into the trench.

g) Installation method.
The size of the installation, type of soil, slope and cost and availability of labor will determine the best installation method. If the installation is large enough a tractor mounted drip burying system is the most suitable. (Ditchwitch vibratory plough) For smaller installations drip lines are easily installed by hand or with any of the pipe treching/burying machines described in Table 4. A tubing injector tool which can be attached to the $2^1/_4$" tool bar of most tractors is available from GEOFLOW. A diagram of this is available on request.

- Cover all open ends including dripline ends to avoid getting debris into the system.
- Leave enough length at the beginning and end for connections. It is convenient to finish the last foot of the trench by hand. This gives more room for connections. Beware of bending the drip tubing too tight during installation.
- Do not bend tubing below a 0.6 m radius because the pipe may kink, reducing the flow. Use elbows and fittings whenever required or make the trenches with a wide radius bend.
- The pipe puller type machine should not be used in clay soils, as it forms an underground "pipe" and the water applied by the system tends to run in the downhill direction. For clay soils use an alternative method as shown in Table 2.
- Fill the trench early in the morning when temperatures are low. The dripline will elongate at high temperatures. If you fill the trench in warm weather, the dripline will contract and severe stresses and "stretch" , and pulled fittings will result.

h) Connect drip lines to submain and flush manifolds. Flush again.

i) Run the system before covering. Check connections for leaks.

Drip line storage.

WARNING: ROOTGUARD is temperature sensitive. The protected life of your system will be reduced if you leave the drip line outside exposed to the sun for a long period of time. Store the drip line in a cool shaded place until installed. This should be a consideration when installing the system in very warm and sunny areas. Your system life span will be increased if it is buried an extra two or three inches below the soil surface, to avoid the warm temperature extremes.

5. OPERATING.

Amount of water to be applied.

The amount of water applied should not exceed that lost or used by the plants and drained out of the soil:
• Water applied too quickly, in excess of the absorption capacity of the soil will surface and may puddle.
• Water applied in excess of the retention capacity of the soil will be drained and will percolate down. • The water that is retained by the soil will be either transpired by the plant or will be evaporated from the soil surface. This is called *evapotranspiration.*

Table 4. Subsurface drip installation methods.

INSERTION METHOD	ADVANTAGES	DISADVANTAGES
a) Hand Trenching*	•Handles severe slopes and confined areas •Uniform depth	•Slow •Labor intensive Disrupts existing turf and ground •Back fill required.
b) Oscillating or Vibrating plow - of the cable or pipe pulling type.	• Fast in small to medium installations. •Minimal ground disturbance •No need to back fill the trench.	•Depth has to be monitored closely. •Cannot be used on steeper slopes(20%) •Requires practice to set and operate adequately. •Tends to "stretch" pipe. Shorter runs are required.
c) Trenching machine. Ground Hog, Kwik-Trench, E-Z Trench*	•Faster than hand trenching •May use the 1" blade for most installations •Uniform depth	•Slower, requires labor. •Disrupts surface of existing turf. •Back fill required.
d) Tractor with GEOFLOW tubing insertion tool - see diagram 3. **Preferred method.**	•Fast. •Little damage to existing turf. because of the turf knife. •Minimal ground disturbance. •Does not stretch drip line. •Adaptable to any tractor.	• The installation tool is designed specifically for this purpose and is only available from GEOFLOW.
e)Tractor mounted 3-point hitch insertion implement	•Fastest. Up to four plow attachments with reels. •A packer roller dumps back soil on top of the pipe.	•Suitable for large installations only.

* NOTE: Disturbing the soil may effect the pore structure of the soil and create hydraulic conductivity problems. Please consult with your soil scientist or professional engineer before making the installation technique decision.
The State of Georgia specifically does not accept the practice of using a conventional back-hoe.

6. SYSTEM MAINTENANCE

Monitor the system

The best way to assure years of trouble free life from your system is to continuously monitor the system and to automate all maintenance functions. For large systems or systems with a BOD > 20 mg/l automation of maintenance is essential. For smaller systems with a BOD < 20 mg/l quarterly inspections and maintenance is adequate.

• Frequent automatic filter flushing based upon pressure drop across the filter is essential for the correct operation of the system. Filters should be cleaned when the pressure difference reaches 50 kPa. If the filter clogs frequently, a larger filter may be required.

• Flush the system under pressure. The velocity in the pipes should be as high as possible to transport the deposits and scale. Use the pressure regulator bypass or kick-in both pumps if two pumps are used. This should be done at least every 40 cycles of the disposal fields.

• Inject a commercially available cleansing solution with fresh water through the system. Chlorine and either phosphoric or sulfuric acid at low concentrations are suitable. This should be done automatically in the event of the flow rate dropping more than 5% below specified standard flow rate.

• Clean the pressure reducing valves and check that they are working well. Check system pressures.

• Clean flush valves and vacuum release valves.

Before Digging

Locate the driplines by running the system until wetted spots appear above each dripper. This same technique is used to check the system for any blockages. This should be done with fresh water.

Appendix 1: Hydraulic Details

"Classic" Drip Line - Pressure vs Emitter flow rates .

Pressure kPa	Flow LPH
80	3.7
100	4.0
150	5.0
200	5.9

16 mm 2.4 l/hr Wasteflow PC Pressure Loss Tables

Internal Diameter (mm) = 14 mm

Maximum Recommended Run Length (m), vs Pressure (kPa)

Inlet Pressure (kPa)	0.6 m Dripper Spacing
100	71
150	112
200	136
250	154
300	170
350	183
400	194

Based on minimum pressure of 80 kPa
All run lengths calculated on flat ground.

WARRANTY

Product Warranty
Geoflow products as supplied by Triangle Filtration, are warranted to be free from defects in material and workmanship for a period of 10 years when installed below ground, and a period of 2 years when installed above ground from the date of initial installation. This is provided the product is installed according to the manufacturers within a period of one year from the original date of purchase.

Performance Warranty
In addition Geoflow products which contain RootGuard® are warranted to remain free of root intrusion for a period of 10 years from the date of purchase, provided such product is stored and installed according to the manufacturers instructions. Any such product that may become clogged by the intrusion of roots with in the first 5 years from the date of purchase shall be replaced by Geoflow representative, Triangle Filtration. Any such product that may become clogged by the intrusion of roots after the first 5 years from the date of purchase shall be replaced by Geoflow at the price at the time of such replacement less a discount on the price directly proportional to the period of service time left on the 10 year warranty period. Geoflow's obligations under these warranties is expressly limited to providing the original purchaser with a replacement for any defective product, or part and does not include the cost of installation of the replacement, and in no case shall Geoflow be liable for any special incidental or consequential damages.

Warranty Claims
All claims must be made in writing to Triangle Filtration at the address below within 30 days after the defect is discovered.

These Warranties do not cover
Conditions caused by others including, but not limited to: abuse, misuse, neglect, carelessness, animals, chemicals, accident or disaster, unauthorised alterations, modifications or repairs, transportation or installation, water pressure in excess of or short of the recommended amounts, burial depth less than 10 cm from the surface, improper or inadequate water treatment or filtration, or the failure to follow storage, installation, operation and maintenance instructions.

Limitations
As indicated above, in no case shall Triangle be liable for any special incidental or consequential damage based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theories.

Geoflow
Reserves the right to make changes and improvements in their products without incurring any obligation to similarly alter products previously purchased.

Choice of Law
These warranties and any liability of Triangle Filtration hereunder shall be governed and enforced according to the laws of the state of Victoria, Australia.