Greywater Drip Irrigation Design Manual

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Introduction

The purpose of this Greywater Drip Irrigation Manual is to detail the equipment and design considerations necessary for the effective application of drip technology to greywater irrigation systems. Greywater system can either use a Greywater Treatment System (GTS) or a Greywater Diversion Device (GDD) upstream of the Netafim dripperline system.

Drip technology was originally developed for the agricultural industry as a technique to improve the efficient delivery of water to plants, especially in environments where the water supply was limited. The technique involves delivering water that plants actually use directly into the root zone and relying on horizontal as well as vertical movement through the soil to disperse the water evenly. Netafim is the world leader in drip applications and its drippers, filters, valves, automation and other products have become the industry standard in over 110 countries.

Sub-surface drip is the most efficient method of dispersing wastewater effluent into the soil which presents the designer a superior option for all soil types. Drip has the ability to deliver greywater into the root zone of plants for plant uptake of nutrients and slow dispersal into the soil medium for further treatment.

Government authorities in each state across Australia and regional councils across New Zealand have recognised that greywater systems are able to be installed in sewered areas. As the demand increases for residential GTS and GDD, the importance of alternative technologies increases. GTS and GDD with drip dispersal is the best available strategy for a wide variety of the most demanding onsite design considerations.

Subsurface drip dispersal has a number of benefits;

- With proper design, drip technology can be applied in almost any climate or soil conditions
- Reduction in environmental and health risks
- Water can be re-used for dispersal of lawns, shrubs, or trees
- Beneficial greywater nutrients are available for plant uptake.

This design manual provides basic guidelines for drip system design, installation, maintenance and operation. However, because such designs are subject to state and local regulations for all greywater systems, any regulatory specification must be given precedence over the recommendations included here. If local regulations allow design parameters which are more liberal than those expressed in this manual, the designer should bear in mind that the following conservative recommendations are based on actual design experience and analysis of both properly functioning and failed onsite systems.

System Design

System Components

A simple schematic design for greywater dispersal using drip follows:

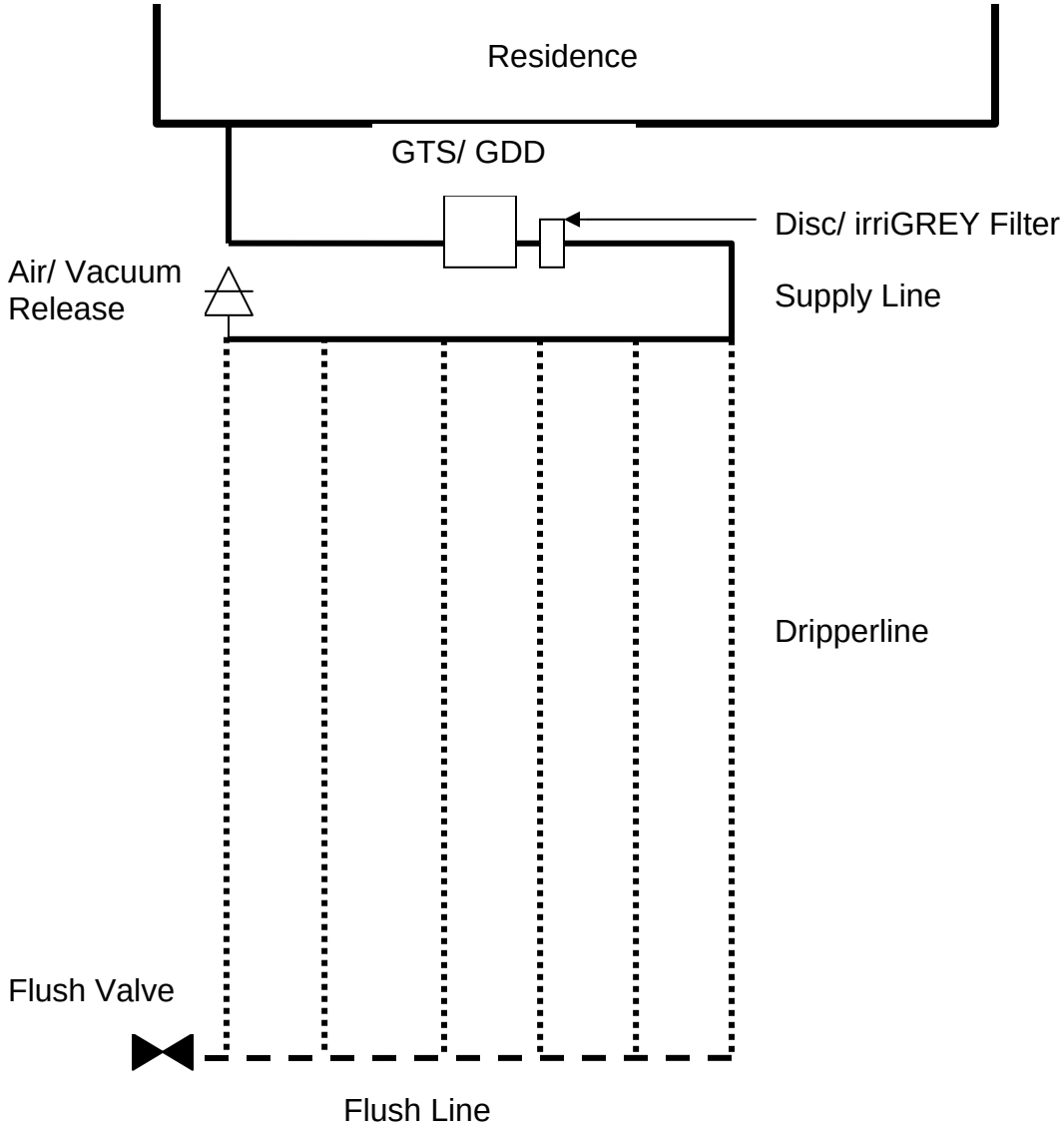

Figure 1 is a standard layout of a drip dispersal system

Dripperline

Dripperline is low volume tubing with integral and evenly spaced emitters at specific intervals. The two dripperline for this market are either;

1. Bioline (non compensating dripperline used for greywater diversion systems)
2. Bioline AS (pressure compensating anti siphon used for greywater treatment systems)

These products are specifically manufactured for the use with greywater systems and are the heart of the system.

Spacing between laterals is very important to ensure even distribution of greywater over all types of soil categories. As a general rule the following table shows the recommended spacings for each soil type. It is also important to ensure the application rate for a soil types doesn't exceed recommendation set by the local authorities and/ or set out in the *Australian Standards ASNZ 1547:2000.*

Soil Type	Emitter spacing	Lateral spacing
Sand	0.3m	0.3m
Loam	0.3m	0.4m
Clay	0.3m	0.5m

Table 1- Dripper recommended spacings

Bioline AS has a specific flow rate of 3.0l/hr at 0.3m spacing and is pressure compensating (between 4-30m) therefore maintaining the same flow rate over a given area.

Bioline (Tiran) dripperline is 8.0l/hr at 0.3m spacing. Please note the Bioline is non-compensating and has a nominal flow of 8l/hr at 10m pressure. The majority of GDD on the market will operate at 3-5m pressure and therefore the nominal flow of the Bioline dripperline will be considerably lower in the order of 2-4l/hr.

The lower the flow rate per emitter and more frequent the emitters along the dripperline the better the distribution and therefore reducing the hydraulic load on the soil.

Dripperline due to friction loss has a limited run length that it will operate within its performance. The below table outlines the maximum distance that Bioline AS and Bioline can run.

Dripperline	Pressure				
	1m	2m	5m	7m	10m
Bioline AS 3.0l/hr	0m	0m	0m	33m	45m
Bioline 8.0l/hr	16m	17m	17m	17m	18m

Table 2- Dripperline Run Lengths

Filtration

Every drip system must include a filter to prevent introduction of sediments and suspended organic materials into the dripperline. Without proper filtration, sediment can accumulate over time and cause plugging.

The below table outlines the minimum filtration requirements that are needed when either a GTS or GDD are used. It is important to note some GDD have

inbuilt filtration into their system and thus do not require a irriGREY filter. Please check with the GDD and Netafim to ensure compatibility before proceeding.

System	Dripperline Used	Level of Filtration	Recommended Type of Filtration
Treatment	Bioline AS	130 micron	Disc
Diversion	Bioline (Tiran)	400 micron	Foam

Table 3- Dripperline filtration recommendations

When the irriGREY filter is installed downstream of the pump in a GDD it is recommended to install a Netafim DNL valve in the system. It is installed between the pump and irriGREY filter on a bypass line to either atmosphere or back into the sewer. This is a valve that opens on a given pressure and can act as a pressure relief valve if the filter blocks. This ensures the pump isn't working against a closed head and thus protecting the unit.

Zone Valves

When multiple zones are used, indexing valves are customarily used to turn zones on and off. These indexing valves have various zone capacity and inlet thread sizes. Alternatively solenoid valves and irrigation controllers can be used.

Air/ Vacuum Release

Drip system design should include a minimum of one air/ vacuum release valve per zone. Their purpose is to relieve the vacuum created on the system at the end of the dose cycle; this will minimise soil particles from being aspirated into the emitters.

They function to release the air at the beginning of the dose cycle to eliminate air-binding in the piping and to help ensure a more rapid filling of the lines. They should be located at the highest point of the zone and placed in a lilac lid valve box lined with gravel for protection.

Supply Manifold

The supply manifold delivers water to each row of dripperline from the greywater system. 19mm or 25mm Purple LDPE is recommended however MDPE, HDPE and PVC can be used. It is recommended it is buried a minimum of 100mmm and lilac pipe is used to indicate effluent contained within the pipe.

System pressure drop must be minimised to ensure that a sufficient flushing velocity is maintained. The connections to the supply and flush manifolds should be minimised for system efficiency.

Flush Manifold

The characteristics of the flush manifold are the same as the supply, with limited and equal number of connections. It is typical to use the same diameter pipe size as the supply manifold.

The flush manifold terminates in the field in a flush valve assembly. The flush line should have a conveniently placed manual valve to activate the field flush or manually open the end cap periodically.

Installation

Site Preparation

The drip field should be viewed as a wastewater dispersal field and many of the same considerations for conventional land application systems should apply. These limitations should include:

- No future expectation of building(s), decks, or other impervious surfaces
- No long term storage of equipment or vehicles over the site
- A permanent vegetative cover

Drip Tubing Installation

The drip tubing should be installed 100mm below the soil surface. Colder climates may require deeper placement or additional cover to avoid freezing during periods of inactivity.

Dig the manifold trenches wide enough to provide sufficient working room to cut and fit connectors between manifold and tubing. Give yourself enough room to work. Always avoid installing drip tubing in wet soil.

There are three common ways to install the dripperline are;

1. **Plowing:** Installed the same way as telecommunication cable, plowing refers to the method of knifing, or using a vibratory plow, to insert the drip tubing. This method is increasing common as the equipment becomes more widely available. The use of a ripper inserting the dripperline by a small machine such as a Dingo is an alternative to the vibrating plow. Either way this is the preferred method of installation due to the minimum impact on existing soil structure and texture.
2. **Trenching:** This method uses a commonly available chain trenching machine to cut a narrow trench for tubing installation. The advantages of this method are that these machines are widely available and easy to use. The disadvantage is that the trench may leave wall surfaces that are ‘slicked’ and therefore less receptive to horizontal water flow. The trench must be filled with original materials and watered in from the top down.
3. **Fill:** In this method, tubing is laid on the ground and fill material is placed over it. If there is any vegetative cover, it should be removed and the original soil scarified (plowed or deep raked) to minimise any inhomogeneity between soil types. It is recommended that the fill material be the same as the original, if possible.

For all methods of drip tube installation, it is very important that the disturbed soil above the dripperline be the approximate texture and compaction as the soil around the dripperline to avoid creating a preferential pathway of the effluent to the surface. Some careful, manual compaction of the soil above the dripperline may be advisable when the tube has been trenched or plowed in (local codes permitting).

Every effect must be made to avoid excessive mechanical stress on the tubing before, during and after installation. Sharp rocks should also not be placed next to the dripperline.

Manifold to Dripperline Connection

The supply and flush lines are installed using standard techniques for LDPE (low density Polyethylene), MDPE (Medium density Polyethylene- commonly known as Rural B), HDPE (High density Polyethylene commonly known as Metric Poly) or PVC piping.

If the manifold is LDPE a punch tool can be used to punch a hole into the LDPE. The fitting then is pushed directly into the LDPE and over the dripperline. It is important the LDPE is a minimum of 19mm to allow the fitting to seal and the ability of flow to easily pass through the fitting. It is also recommended that straight take-offs are installed perpendicular to the manifold again to ensure a seal.

Start-up

The installer should take special precautions to troubleshoot the system and insure that it is working properly over an initial start-up period, typically 2-3 weeks.

Do not start the system with a massive dose. This can cause preferential water passages, or chimneys, to the surface and saturate the soil and it could take a long time to recover the drip field. Construction debris (Mainline/ flush line scraps, soil, etc) found in the pipe network after the initial assembly needs to be flushed. It is recommended that the initial flushing not be done through the dripperline to avoid plugging with large, unfiltered particles. If the dripperlines must be used for flushing, do not exceed the scheduled dosing cycle in the process.

Routine Maintenance

Other service and maintenance of the system can be coordinated with regulatory requirements for monitoring of the GTS or GDD. Most states/ regions have regulations that specify a routine maintenance schedule for GTS's.

When a drip distribution system is properly sized, designed, and installed, it should operate with little maintenance and easy monitoring. In addition to the

fundamental design considerations already outlined, several other installation steps will simplify maintenance. These are as follows:

- Check and clean filters periodically
- Maintain access to a short length of drip tubing for inspection
- Keep a detailed as constructed drawing readily accessible
- Flush the dripperline on a regular basis
- Monitoring any changes in the number, activities, and water usage patterns of members of the household.

With this information framework, a maintenance contractor can quickly and easily determine if the system is operating within specifications. If problems are identified by changes in pressure or flow, they can be located and corrected easily using information in the plans..

Typical Layouts

The layout for a typical greywater system is made-up of several components. In the following illustrations, each design scenario will contain all or part of the following components and systems:

- GTS or GDD
- Pump
- Disc filter (130 micron) or sponge filter requiring manual cleaning
- Air/ vacuum relief valves
- Zone control valves- water actuated, motor driven or solenoid activated hydraulic valves
- Underground LDPE, MDPE, HPDE or PVC piping, typically minimum 19mm or larger
- Dripperline connectors to mainlines and flush manifolds
- Dripperline

The following layouts illustrate the various ways that drip irrigation areas might be laid out from a greywater system. These are too used as guides only. Each individual system will have special requirements that will require the designer to modify these typical layouts in the order to adapt to the site. The following are basic considerations that should be taken prior to beginning any design:

- Shape of the proposed irrigation area
- General slope or direction of rise and fall of the site
- Location of property lines, buildings, trees, bores, water lines, buried power lines, swimming pools etc.
- Soil type including profiling to determine depth to most restrictive layer and or water table
- Location of the greywater system
- Location of power outlets

Opposing Manifold Layout

Rectangular field with supply and flush manifold at opposite ends of the dripperline;

- Can be used where dripperline lengths will be long and drip field is narrow.

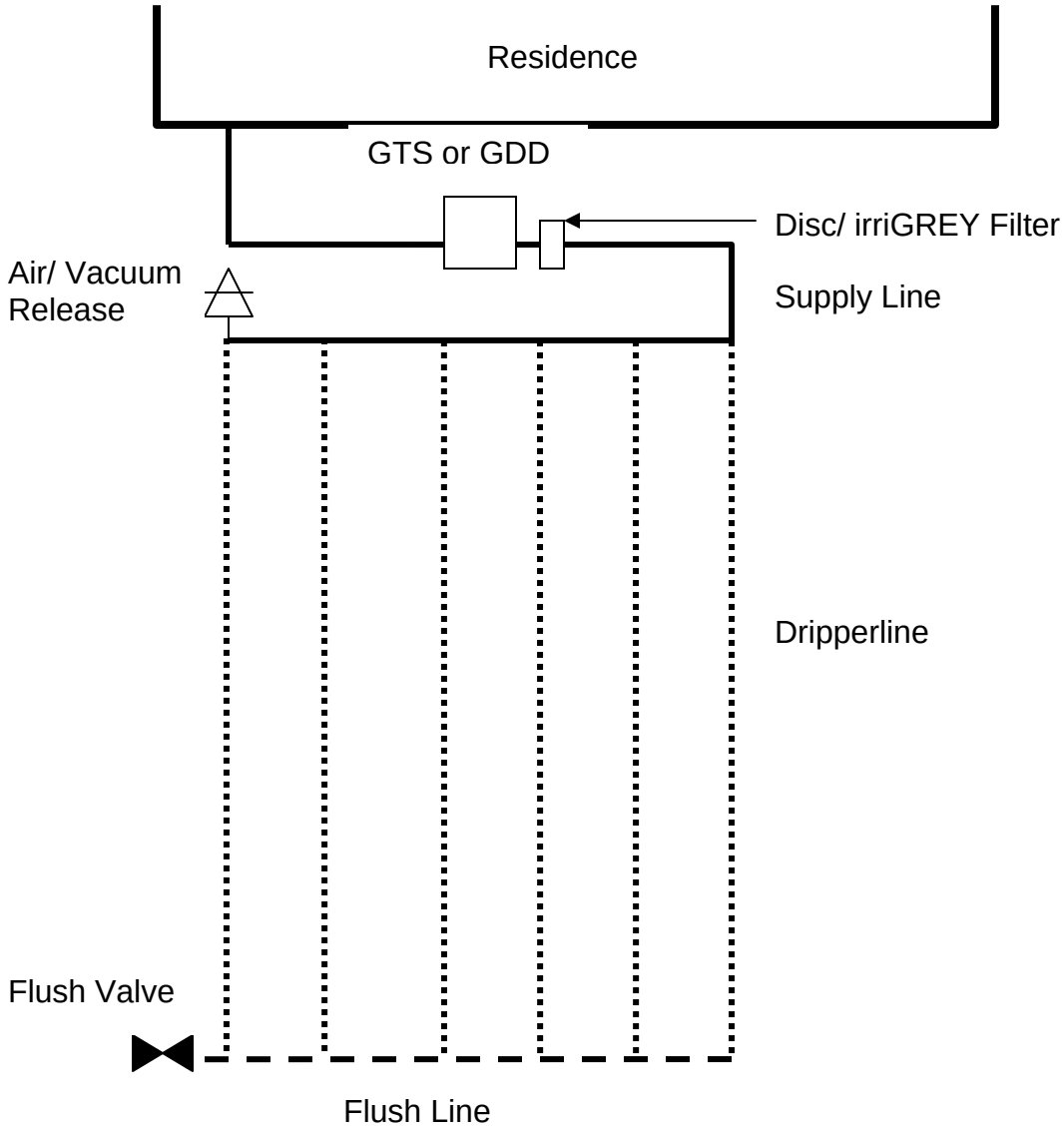

Figure 2 Opposing Manifold Layout

Single Trench Layout

Rectangular field with supply and flush manifold on the same side in the same trench;

- Locate supply and flush manifold in same trench.
- Dripperlines are looped at the end opposite the supply and flush manifolds
- The longest dripperline length should not exceed maximum recommended run lengths.

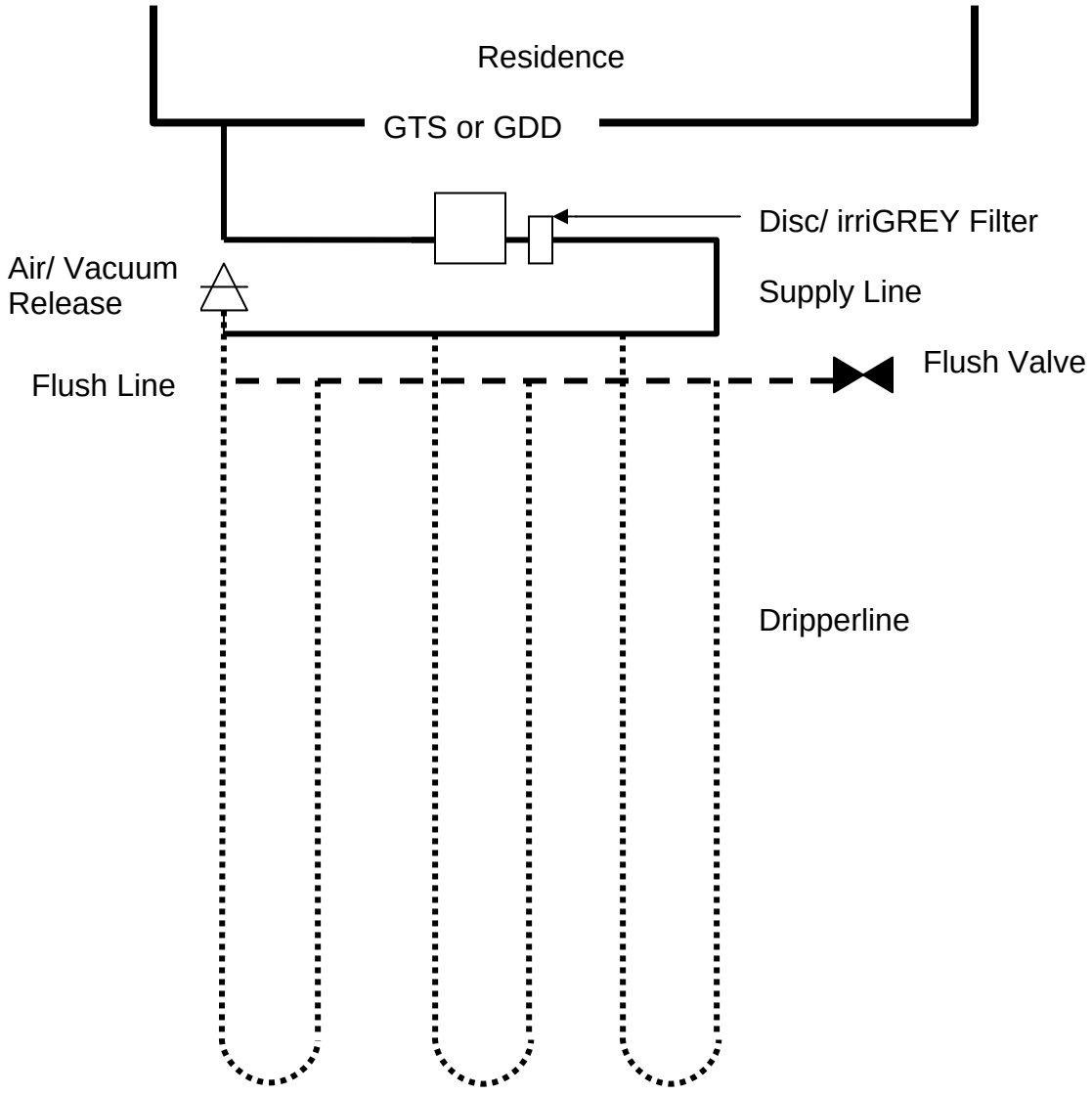

Figure 3 Single Trench Layout

Multiple Zone Layout

Multi- zone system with looping laterals;

- Should be used when single zone accumulated dripperline length exceeds pump duty capabilities.
- Should be used when soil require additional resting time between doses.
- Should be used when there is a potential need for expansion of the system, which is common in commercial systems. Second zone may be left out until needed.
- Additional check valves are needed to isolate each zone on the flush line side.
- Zone changes are typically accomplished using a electronic valve with a controller or index valve.
- Zone layouts must be parallel systems or may follow any of the scenarios discussed.
- Zones should have similar flow when possible.

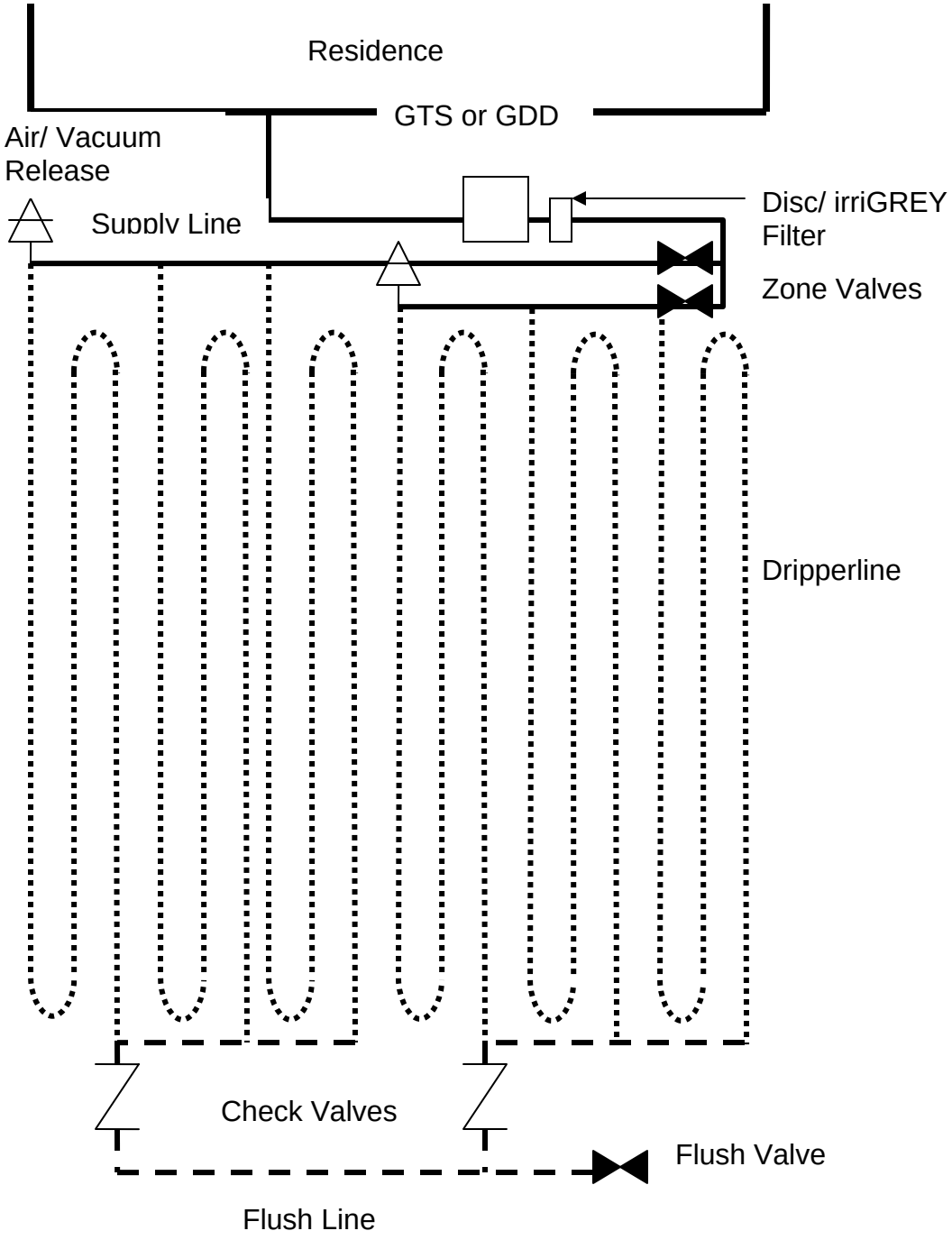

Figure 4 Multi- Zone Layout

Regulations and Legislation

Each state and council has regulations and by-laws concerning the dispersal of greywater which must be strictly complied with. This manual is intended to be an aid to installers and end users of the greywater systems and according to local, state or federal law and regulation shall take precedence over this manual. You are accordingly advised and requested to check with your own council and state government as to their specific requirements for the installation of land application dispersal systems. Furthermore, the user of the greywater systems is subject to all local conditions that prevail at the site and further subject to any appropriate expert tests including but not limited to soil tests and water tests, which may be required prior to the installation to determine the fitness for use.

In addition, other factors must be considered to determine fitness for use including but not limited to slope and landscape contours and acceptable hydraulic loading rates.

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