On-site Wastewater Management
Training Course

Irrigation Systems

Componentry, Selection and Design

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Irrigation Systems

- As effluent quality is not always consistent or compliant, it is important to minimise public health and environmental risks, especially if irrigation is at the surface
- Whilst irrigation area sizing is important, it is equally important to select, match and configure the components of an irrigation system as part of a hydraulic design, to ensure effective even distribution and compliant operation

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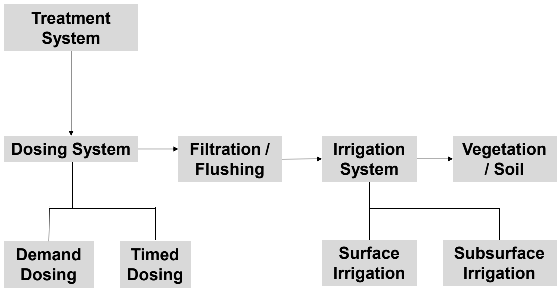
What Makes Up an Irrigation System



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Treatment System

- Secondary or better
- Commonly AWTS
- May be sand or media filter, mound or reed bed
- May require non-return value to prevent backflow
- May require pressure reducing valve

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Dosing System

- Commonly pump driven
- May be low pressure dosing device such as a Flout or siphon (for LPED)
- Tipping bucket not appropriate – dose too small and will not pressurize dripper line
- AS/NZS 1547:2012 recommends minimum 200L/dose
- Should be 2-3 x system fill volume
- Larger volumes result in better field distribution

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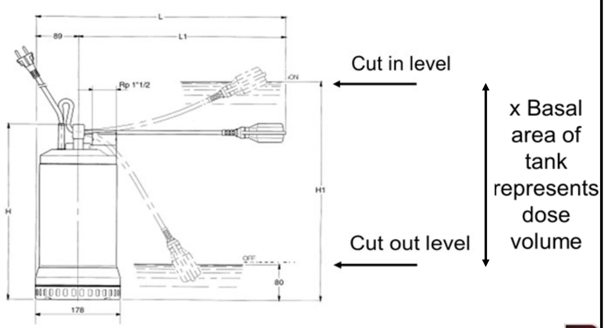
Dose Volume



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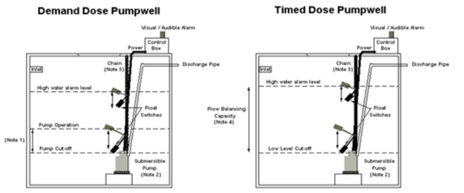
Demand Dosing vs Timed Dosing

- Demand dosing by float switch most common in domestic systems
- Timed dosing significantly better. More common in non-domestic systems



Ensuring Even Distribution

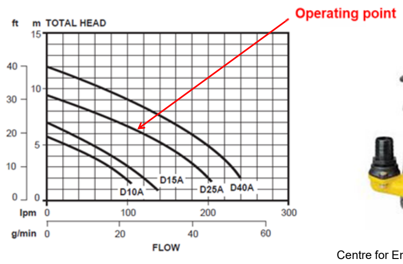
- Float switches do not balance shock wastewater loads
- Constrained sites may require a balance tank and timer controlled pump to avoid saturation and ensure even distribution over time
- Large areas may require division into several zones using an indexing / sequencing valve
- A high level alarm should be fitted to the system to warn of system failure

Pump Selection

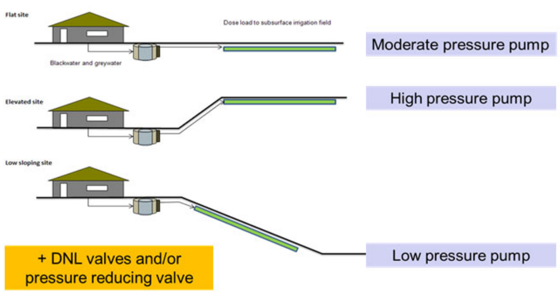
- Needs to be appropriate for wastewater
- Made of non-corrosive materials
- Correct hydraulic duty (Flow (Q) and Head (H)) for actual operating point of the system
- Operating point needs to be as close to optimum efficiency point (mid-point on pump curve) as possible
- Need to determine appropriate operating point
- Affordability – beware cheap pumps

Pump Selection

- Pump performance is described by a pump curve
- In terms of Flow (Q) and Head (H)



Pump Selection



Pump Selection

- Surface irrigation systems with rotary sprinklers and spray heads require ~4-10m head at the top of system with flow rates of 2-6L/min per sprinkler
- Subsurface irrigation systems typically require a 10-30m head operating pressure
- Pumps in many accredited AWTS/STS have:
  - 6-12m maximum head capacity
  - 33-130L/min maximum flow rate

Pump Selection

- Sprinkler operating head + friction loss in the pipe commonly requires most if not all of the available head capacity (leaving limited capacity for static lift)
- Pumps supplied are often of insufficient capacity to uniformly irrigate correctly sized irrigation areas (based on appropriate DIR for soil type and/or water and nutrient balances), even when divided into a number of smaller sections or zones

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Pump Selection

- Uneven effluent distribution is a significant contributor to poor AWTS performance, or failure
- Irrigation area sizing requirements may create need for a bigger pump than typically supplied
- A one size fits all approach to pumps is not practical
- Pump should be selected to meet the specific requirements of each site

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Filtration

- Critically important
- Protects irrigation system from blockages
- Mesh filters low cost
- Disk filters higher performance



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Filtration

- Filtration of effluent is essential for effective irrigation
- Cylindrical mesh filters are usually sufficient for surface irrigation systems (typically 150 mesh, 100 micron rated filters)
- Disc filters better protect subsurface irrigation systems
- Need regular cleaning as part of each service
- If filter clogs frequently, need to investigate and solve treatment system problem

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Flushing

- Again, critically important
- Scours potential blockages
- Can return flush line to treatment system, or field flush to soak away (gravel pit)
- Flush valves can be automatic or manual
- Automatic flush flushes ~4 litres on start-up


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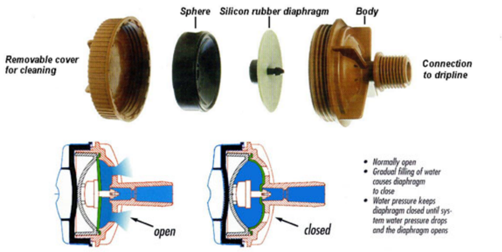
Automatic Flush Valve

- Netafim Automatic Flushing Valve



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Flushing Velocity

- Flushing velocity can be calculated using the continuity equation (part of hydraulic design)
- Must be sufficient to entrain air and sediment in lines and prevent build-up of slimes
- Dirtier water requires higher velocities
- Typically >0.8m/sec required for effluent
- Some driplines rated >0.3m/sec

Distribution System

- Mainline to field
- Indexing / sequencing valve
- Manifold
- Laterals
- Drippers or sprinklers
- Air valve / vacuum valve
- Dripper line non-leakage (DNL) valves
- Flush valve / Field flush / Flush return line

Mainlines, Submains, Manifolds

- Typically 25mm ID or larger diameter LDPE or PVC lilac piping
- Manifold and laterals should be buried
- Older systems may sit on ground surface
- Most Councils now require burial
- Surface exposure increases potential for damage (e.g. mowers, animals) and degradation (e.g. exposure to UV)


Mainlines, Submains, Manifolds

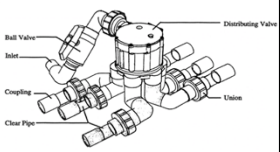
Pipe selection is part of hydraulic design. Need to consider:

- Energy losses in pipe. Refer to manufacturer's charts or calculate
- Pressure rating - AS/NZS requires pipes to be rated at 150% of the shut off head (of the pump)
- Appropriate wall thickness and depth of burial to protect pipe
- Consider cost, including fittings

Indexing / Sequencing Valves

- Used to automate and sequentially deliver doses to each zone (zones generally <400m^2)
- Improves hydraulic performance of the irrigation field and reduces demand on pump



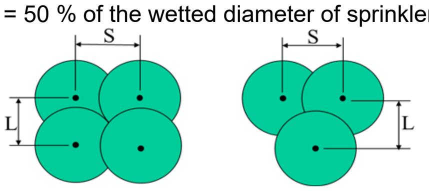



Surface Irrigation

- Only suitable for slopes <10%
- Secondary treatment and disinfection required
- Wide variety of spray heads (rotary, impact, spray nozzles, drippers) and risers (fixed, spike, pop-up)
- There are only a limited range of spray heads specifically designed for domestic effluent irrigation (larger orifices), but many for clean water (smaller orifices, which readily block)
- Sprays must not generate runoff or aerosols and should have a throw and plume height suited to the site

Sprinkler Layout and Recommended Overlap

Average conditions:
S = L = 60% of the wetted diameter of sprinkler
Windy or exposed conditions:
S = L = 50 % of the wetted diameter of sprinkler



Surface Irrigation

- Inappropriate where rainfall > evaporation and soils are saturated for extensive periods of time
- May result in uneven distribution

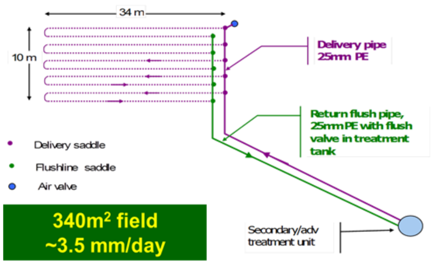
Subsurface Irrigation

- Subsurface drip irrigation is the industry standard
- Significant public health and environmental advantages over surface spray irrigation
- Involves pressure dosing of 13mm ID pipe fitted with turbulent flow or pressure compensating emitters, laid along the contour
- Built-in or dosed protection against root intrusion and biofilm development (copper oxide/Trifluralin)
- Typically lilac (purple) pipe

Subsurface Irrigation

- Places effluent directly in the root zone and prevents surface runoff during rainfall
- Allows more use of and ease of maintenance of an irrigation area
- Careful hydraulic design, layout and installation is essential (effluent filtration, line flushing, vacuum release valves, correct spacing of laterals / emitters etc.) is required; though this is often not undertaken

SSI Setup for 1,200L/day System on Category 4 Soil



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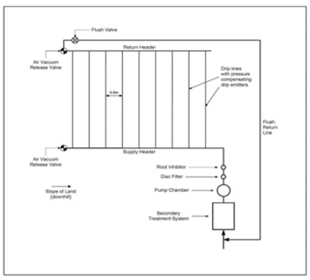
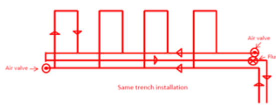
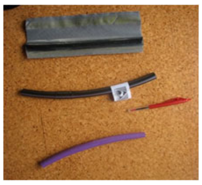
Subsurface Irrigation System Layout



Revised Figure M1
Page 167
AS/NZS1547:2012 to ensure even pressure in lines for effective distribution and flushing



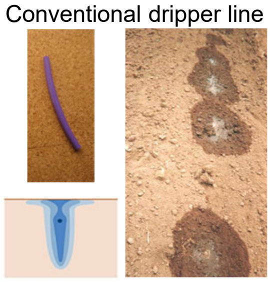
Pressure Compensating Dripper Line

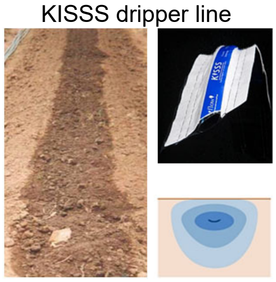


Source: CIVCON

Dripper Line Selection

Conventional dripper line KISSS dripper line

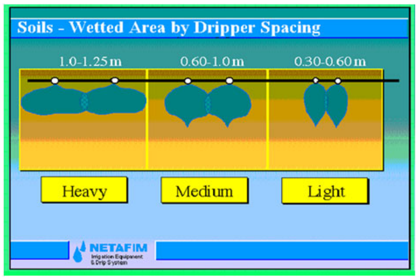




Dripper Laterals

- Typically buried at 100-150mm depth
- May be placed on surface beneath mulch
- Commonly pressure compensating (PC) and anti-siphon (AS) for sloping sites, or may be
- Non-pressure compensating for flat sites
- Laterals commonly spaced 0.6-1.0m apart depending on soil texture
- Space laterals more widely at bottom of slope
- Maximum 100m dripper line run length

Dripper Spacing



Source: Netafim

Pressure Compensation

- Flowrate from the drippers remains constant for varying in-line pressures. Why is this important?

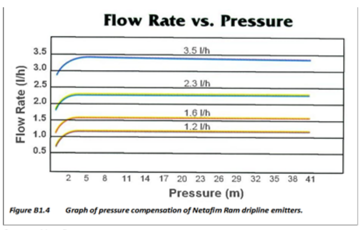
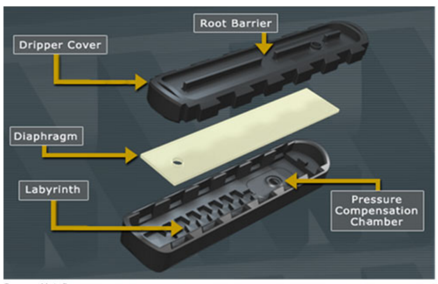


Figure 81.4 Graph of pressure compensation of Netafim Ram dripline emitters.

Source: Netafim

Pressure Compensating Emitters (PCDE)



Source: Netafim

Operating Pressure and Flowrate

- Typical operating pressures - 5 to 40m.head
- Typical flowrate - 1.5 to 4.0L/hr per dripper (some brands specify flowrate per m)
- What factors should be considered when selecting emitter pressure and flowrate?

Dripper Line (Tube) Non-leakage Valve (DNL/TNL)

- Shuts off flow through the valve when line pressure drops below 2, 4 or 6m.head
- Opens and allows flow when the line pressure exceeds 8, 12 or 16m.head

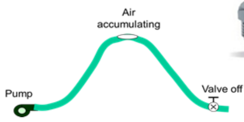
Model	Shut-off pressure (m) **	Minimum Operating Pressure (m) **	Max. working Pressure (m)	Recommended Flow rate range (l/hr)
RED	2.0m *(2.0m)*	8.0m *(4.0m)*	40m	0-1,000
BLACK	4.0m *(4.0m)*	12.0m *(7.0m)*	40m	0-1,000
BROWN	6.0m *(8.0m)*	16.0m *(11.0m)*	40m	0-1,000

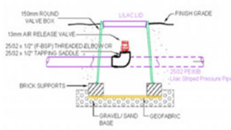
DNL/TNL Valve

- Holds pressure in the irrigation lines and keeps them filled
- Irrigation system full at the beginning of each irrigation cycle
- Ensures the system reaches operating pressure in the minimum time
- Prevents draining of the system to the lowest point
- Results in more uniform distribution of effluent

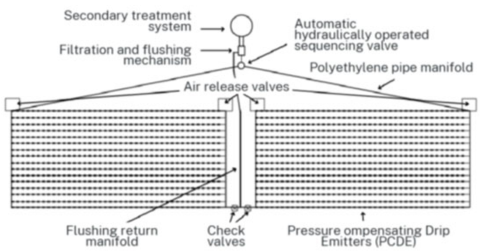
Airlocks / Air (Release) Valve

- Air release valves installed at high points to evacuate air from the laterals during system start-up
- Prevents a vacuum from occurring after pump turns off, avoiding debris intrusion into the drippers





Subsurface Irrigation System Schematic



(Source: DPHI 2025)

Installation – Critical Phase

- Clear and detailed specifications
- Competent and experienced installers
- Follow manufacturers instructions / manuals
- Pipe installation to AS/NZS standards
- May need to rotary hoe or improve ground
- Protect against future damage
- Divert run-on stormwater
- Erect warning signs (min. 2)
- Fence off
- Observe OH&S requirements
- Make good

Commissioning

- Check pumps and aerators
- Fill pump well with clean water
- Pressure test all pipelines
- Check for leaks
- Check flush lines
- Check alarm system
- System should be inspected by regulator at this stage, not before or after

Management of Irrigation Systems

- No household fittings or end of pipe discharge
- Do not irrigate low growing crops which are not cooked before eating
- Avoid compaction by vehicular and animal traffic
- Keep clear of sensitive receptors such as;
  - Clotheslines
  - Swimming pools
  - Barbeques
  - Children's play equipment
  - Open windows etc.

Operation, Maintenance and Servicing Manuals

1. For home owner
2. For servicing agent:
   - Flushing – automated/manual
   - Regular monitoring and cleaning of filter(s)
   - Check for blockages, leaks and surface ponding
   - Monitor desludging requirements
   - Power outage procedures
   - Record keeping:
     - File as-built plans
     - Record location of pipelines
     - Record failures and problems
     - Service report to Council and copy to owner

Summary

Design requires understanding of:

- Site specific details (soils, slope, flood and / or frost risk, landscape requirements, local regulations etc.)
- Nature of effluent being handled
- Equipment performance and interaction of components
- Clear understanding of required outcomes
- Careful hydraulic design required to match components and ensure even distribution