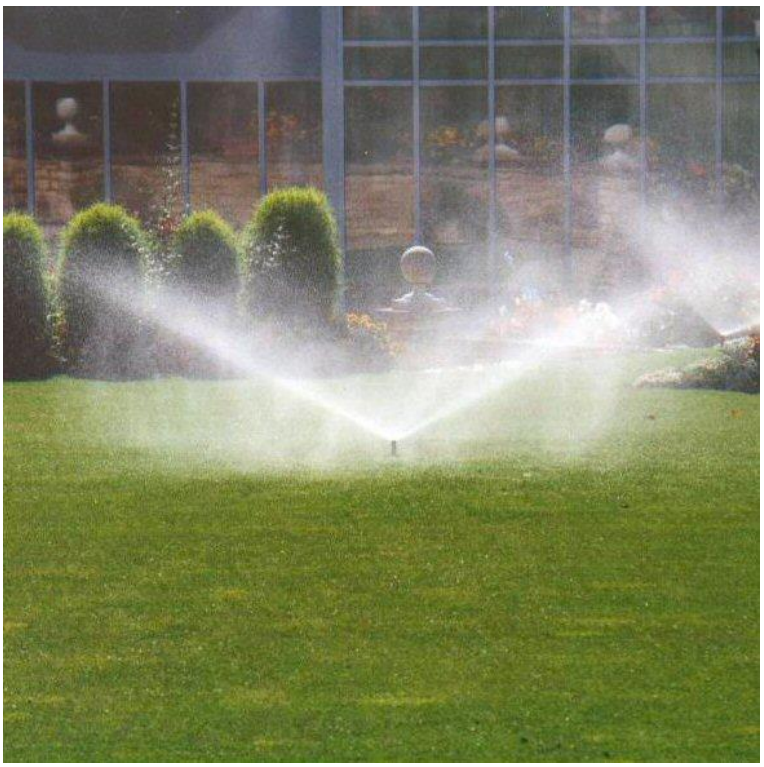
Landscape Irrigation



Access Irrigation Guide to Landscape Irrigation

Guide to Landscape Irrigation

A guide for architects and landscape designers

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Introduction

Access Irrigation has been involved with designing and installing irrigation systems for over 30 years. Many projects involve irrigation systems for new buildings, houses, car parks and town centres. In this time we have worked with many architects, landscape architects and landscapers.

As irrigation is a specialist field many architects do not have time to obtain a vast knowledge of the subject. With this in mind we felt that it would be helpful to produce a booklet aimed specifically at the needs of architects and landscape architects.

This booklet covers the general concepts of irrigation, along with information on the basics of an irrigation design and current water regulations.

As a company Access Irrigation can provide specialist advice and detailed costs for each project along with full specifications for the client. For more complex projects, Access can work as consultants to the architect, producing an overall irrigation scheme, along with tender specifications.

Once a project has been approved, Access would normally work with the main contractor to install the system. On larger projects we can provide project management services to the main contractor. On completion the system would then be demonstrated and handed over to the client.

We do hope that you will find this guide helpful. We do two further guides in this series the *'Access Irrigation Guide to Green Roof Irrigation'* and the *'Access Irrigation guide to Rainwater Harvesting'*. Either of these can be posted to you or downloaded as a PDF from our website.

If you have any comments on the guide or would like any advice on any proposed irrigation projects, please give me or any of our sales team a call.

Regards

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Irrigation - an overview

The benefits of irrigation

Irrigation has a number of benefits when considering landscape planting around a building. It ensures that the trees and shrubs will establish themselves more quickly and growth will be faster, giving a mature appearance in a much shorter time. If more mature specimens are planted these obviously encounter greater levels of stress. Regular watering ensures that the plants are much more likely to establish themselves in their new habitat.

Irrigation is also of benefit to turfed areas. A prestigious new building with brown grass surrounding it does not look very good. As well as keeping the grass green and lush even in the hottest of summers, irrigation will help keep grass in heavily used areas in good condition.

Where there is little depth of soil, such as in planters or roof terraces, then irrigation is essential. Not only is hand watering prohibitively expensive, it is never frequent enough to keep up with the evapo-transporation of the plants. Watering in these areas needs to be carried out two or even three times per day.

Not only does irrigation remove the need for costly contractors to carry out hand watering, there is none of the inconvenience of having hoses and vehicles trailing about during the day. As the irrigation system normally works at night, everything is done before staff or visitors arrive.

When the cost of hand watering is compared to the capital cost of an irrigation system, the initial costs can normally be repaid in just a couple of years. Irrigation systems are designed to evenly cover an area with water. Hand watering, by contrast can be very patchy, especially where large beds are concerned.

So in the long run not only is an irrigation system cheaper than hand watering, it also provides better establishment and better watered plants.

Irrigation system design

It is important to get advice on irrigation design early on in a project. Most reputable irrigation companies will be able to give comprehensive advice on all aspects of the irrigation scheme. Access Irrigation Ltd offer a free advice and design service to architects and landscapers. Important factors that an irrigation designer will take into account include the types of planting and the amount of soil the plants have available; the pressure and volume of the existing water supply; the level of sophistication of system required and the client's budget.

Where the control equipment is located some way from the areas to be irrigated, the architect needs to consider how the pipework will be routed. This is especially

important if the routes are through buildings. Indoors pipework is normally routed in copper pipes, with outdoor pipework in M.D.P.E. pipe. Also space needs to be allocated for water storage tanks, pumps and control equipment. On building developments where space is limited, careful design by the irrigation advisers can ensure that all of the equipment fits into a small space in a plant room.

Installing an irrigation system

Installation of an irrigation system is normally undertaken by a specialist sub-contractor or by on-site contractors with advice from the irrigation company. Work will normally proceed in two main phases commencing with the installation of the underground pipe work. At this stage the pump and control equipment would normally be installed to allow the pipes to be tested under pressure before back filling of trenches. Once the beds and soiling up has been completed the sprinklers and the drip irrigation is installed. The system would then be fully tested and commissioned.

Water delivery to the plants

The actual watering of the plants is normally achieved either by sprinklers which use spray nozzles to throw water over a relatively large area; drip systems which use a number of drip nozzles mounted into a pipe to cover an area; or individual drippers, which use individual nozzles to bring water to a single pot or hanging basket.

Generally speaking sprinkler systems consume far more water than drippers. Not only do they have greater flows and therefore need larger supply pipes and pumps, they are also more wasteful as the water droplets tend to evaporate when thrown into the air.

Sprinklers

Generally lawns are not suited to watering by drip systems, as the underground pipe runs can get damaged when carrying out maintenance such as lawn spiking. In the UK, lawn areas are normally watered using pop up sprinklers, which rise up from within the lawn when watering commences. Inside each sprinkler there is a gear drive which causes the sprinkler head to rotate back and forth. The arc of each sprinkler can be adjusted to anywhere between 40° and 360°. Once watering has finished they retract down below the turf level, making them virtually invisible. Larger models even have turf caps to make them completely invisible.

Depending on the model, each sprinkler will cover a radius between 3m and 30m. Sprinklers are spaced out to ensure a reasonable overlap between sprinklers. Windy sites need a greater overlap than sheltered positions as the wind will cause drifting.

Drip

Most modern drip systems use nozzles mounted 'in-line'. This means that the pipework is smooth, with each drip nozzle fitted inside the pipe. This has the advantage that there are no protruding parts to catch when laying the drip pipe (or be pulled of by vandals). Dripper spacings and outputs vary, however the most popular output is 1.6 L/h at 0.5m spacing.
On larger areas the trickle lines are laid out in a grid fashion, with each run 0.6m apart.

As well as being used on planted beds, lengths of drip line are often used in narrow planters to give an even distribution of water along the length.

Normally the drip lines are staked to the soil surface to prevent movement. If required they can be hidden under a mulch. Hiding the pipe away, however, can cause problems when weeding and forking as the contractor cannot see the pipe or any damage that is done. Burying the pipe underground is not recommended as root intrusion will block the nozzles. Under lawns drip pipes would also be damaged if the grass were spiked. If it is essential to bury the pipe special filters are available which add a chemical to kill any roots that intrude into the pipe.

Drip for Baskets

Drip systems use individual nozzles to bring water directly to each hanging basket or container. They are fitted with a stake to push into the compost. The emitter provides a steady dripping of water onto the compost.

Generally the pipe work down to each dripper is only 6mm in diameter, making it as unobtrusive as possible. The pipes are black coloured to resist the effects of sunlight and blend in. Light coloured or clear pipes are not recommended as they allow algae to grow inside the pipe. The slim pipe is then connected to a larger supply pipe which delivers the water to a number of drippers.

Tree watering

Trees are very thirsty, with larger trees needing several hundred litres on a hot dry day. In urban planting situations, the tree roots are severely restricted by root barriers and impervious paving. In addition, the soils the tree is planted in may be contaminated or of poor quality.

The most effective method of irrigation is dripline placed around the root zone. Pressure compensated drippers at a close spacing deliver water to each tree. Underground pipework provides water to each tree.

To encourage the root system to develop, where possible, watering is carried out periodically, with longer watering times to ensure the water penetrates deep into the root zone.

If necessary, nutrients can be fed through the system to ensure the trees remain healthy.

Points to consider for architects

When considering whether to recommend an irrigation system the following points should be taken into consideration.

i How will the planting cope in normal weather?
ii How will the planting look in a hot, dry summer?
iii How expensive will it be for the client to maintain a suitable watering regime?
iv How practical is it to water by hand?
v How expensive will it be to replace failed plants due to inadequate watering in?

Specific Irrigation Systems

Roof gardens and green roofs

Roof gardens and green roofs are becoming more and more popular. Roof gardens are especially popular on top of large office blocks in cities as they utilise previously unused space to provide a relaxing environment for staff.

With these schemes, irrigation is vital as the soil depth is very small, reducing the amount of moisture that can be held. Also the drying effect of the wind is greatly increased due to the high aspect of the location.

Supply pipework is generally laid on top of the waterproof membrane or on top of the insulation material. Extreme care needs to be taken as pipes will be more prone to damage from other contractors working in the roof. The shallow depth poses problems for lawn watering as pop-up sprinklers generally require a depth of at least 200mm. To get around this the insulation layer directly under the sprinkler can be reduced in depth to increase the available space, or the sprinklers themselves can be mounted in the gravel drainage margin, where they will not be damaged by mowers. For very small lawn areas, reduced height pop-up sprinklers can be used, as long as the grass is kept short.

Alternatively, drip lines can be laid under the soil, although these can be damaged if the lawn is spiked. The drip lines also need specially impregnated filters to prevent root intrusion.

Frost sensors can be fitted to ensure the irrigation does not come on when the roof area temperature falls to within a few degrees of freezing.

Another area of concern with roof gardens is the potential for the spread of the legionella bacterium. As the irrigation pipes are just below the surface, they can be warmed by heat rising from within the building itself, and also by the suns rays. If sprinklers are used then this water can

then be atomised.

Generally the potential problem can be eliminated, by ensuring watering is only done at night when there is no one around and including an exhaust valve at the lowest point of the pipe work. This opens when the watering cycle has finished, and drains the water from the pipe. Alternatively chemicals such as chlorine dioxide can be injected into the irrigation system to kill bacteria, or UV systems used. For more information see our guide 'Access Irrigation Guide to Green Roof Irrigation'.

Indoor atriums

Natural foliage inside a building requires a regular water and nutrient supply, as they will have no natural source of either.

Indoor planting areas are generally watered using drip irrigation lines buried under a mulch such as pea gravel. Pipe work must be brought into each planter and sealed at the point of entry to prevent water loss.

Often the supply pipes are laid under the concrete screed, so it is vital that the design ensures that there will be no fittings under the screed. An irrigation design in this case would normally bring a single pipe to each planter rather than have a number of branched pipes under the screed.

Car park watering

Large planters with trailing planting fitted to the outside of multi-storey car parks are a useful way of reducing the visual impact. The area of foliage is very high compared to the compost area, so to ensure the plants have adequate water, irrigation is needed to water the planters a number of times each day.

Supply pipe is normally clipped to the roof of the car park deck, with ducts to bring the pipes into each planter. On large car parks each side may need to be watered separately to take into account the length of time the sun is on the planters. South facing planters would require much longer watering times than North facing planting. Planted beds in surface car parks also benefit from irrigation. Trees are a popular choice in these planters, as they give height to the scheme. Again the trees can suffer considerable stress due to the inhospitable environment. A ring of drip irrigation is fitted at the base of each tree.

Town centre watering

Many town centre improvement schemes include trees, hanging baskets and planted beds. Generally a contractor is then paid to come and water the baskets every day. Not only is this very expensive, but trees that are in need of water are totally ignored.

Many planners are concerned about root intrusion into the surrounding buildings. To counteract this, trees are often planted in drainage rings or surrounded by root barriers.

This severely limits the spread of the root structure and subsequently its ability to take up water. A medium sized tree can require up to 100 litres of water per day. Without this regular supply of water the trees will look poor and eventually die.

To solve this problem StrataRoot tree watering units are fitted around the root ball. These can be installed underneath the tree grids to prevent unauthorised access. The units allow air circulation to the roots as well as water.

During the redevelopment phase of town and city centres an irrigation system can be added. By putting the trees and baskets on separate zones they can both be given adequate water supplies. A good irrigation design will ensure that all pipe work is out of sight, preventing vandalism problems. The extra capital cost is soon repaid by the savings on watering contractors.

The pump and control equipment can normally be hidden in specially constructed cabinets or built into street furniture.

Hand Watering

As an intermediate step between a fully automated irrigation system, and no watering, is a hand watering system. This incorporates a number of underground take-off points or standpipes in the landscaped area. Hoses and lances can then be connected to these for watering the area by hand.

By supplying the water via a pump, the pressure is

guaranteed regardless of the demands on the mains water system. Watering is also speeded up as the take-off points can be located at regular intervals around the areas to be watered, minimising the use of long hoses.

On some projects, such as garden centres, hand watering systems are included as well as an automated system. The automated irrigation then provides the bulk of the watering, with trained horticulturists 'topping up' as the plants require.

More unusual projects

Above are the main areas of landscape irrigation, although Access Irrigation has become involved in a number of more unusual projects, including misting of gorillas to raise the humidity in their cages, odour control systems for a large poultry farm, dust suppression on building sites and a concrete curing system, to name but a few.

Water

Water regulations

The current water regulations, The Water Supply (Water Fittings) Regulations 1999, which superseded the Water Company By-laws, put irrigation systems in the highest risk category, as there is a risk that the drip pipe work could possibly be in contact with organic products such as manure. The regulations are enforced to ensure that no contaminants are drawn back into the public mains. This 'back-siphonage' can occur if a water main ruptures, sucking water that is already in the irrigation pipes back into the public mains. If the water in the irrigation system is contaminated, this would in turn contaminate the public water main.

To prevent this from happening, water companies insist that there is a 'Type A' air gap, physically separating the irrigation water from the mains water. This air gap is achieved by bringing the mains water into a holding tank. The regulations specify a minimum gap between the outlet of the ball valve bringing the water into the tank and the maximum possible water level of the tank.

Once the water has entered the tank it is no longer considered to be mains water and is therefore not subject to all of the regulations concerning mains water supplies.

Water coming to the water tank would normally be in copper pipe or in blue MDPE water pipe. Any exposed pipe must be lagged in line with the regulations. Mains water pipe in trenches must be buried at least 750mm deep to avoid the danger of frost damage.

In some circumstances, where all of the emitters are above ground a water company may allow a mechanical Reduced Pressure Zone (RPZ) valve to be fitted. This is a very sophisticated form of check valve that is found on outdoor taps. These valves, however, have disadvantages: they are expensive; they have a high pressure drop; and they must be inspected annually by a licensed contractor.

Sources of water

For the majority of systems, irrigation water is taken directly from the public mains. However this is not the only source of irrigation water. For larger schemes, where water costs may be a factor, water can be drawn from lagoons, bore holes, wells or even from rivers. Licences are required for the extraction of large quantities of ground water.

For wells or bore holes, water can be drawn out by a submersible pump, lowered into the shaft. Although there is no need to have a storage tank, where supplies might dry up in the Summer months, a tank should be installed to allow the

use of mains water if required. The system can be designed to swap between bore hole and mains water as required.

Another source of water is rainwater harvested off roof structures. Not only is the water free, its use is unrestricted, meaning it can be used even during hosepipe bans or drought restrictions. For more information on rainwater harvesting for irrigation see the 'Access Irrigation Guide to Rainwater Harvesting'.

Water storage tanks

Water storage tanks are needed primarily to provide a 'type A' air gap in line with Water regulations. For many irrigation projects, the system can be designed to use water more slowly than it enters the tank from the public mains. In this case the tank only needs to be small.

For installations where space is a premium, pump and tank sets can be installed with the pump equipment mounted over the storage tank. The combined unit can then be fitted in an area less than $1m^3$. For very small systems, such as drippers for hanging baskets, the pump, break tank and the control equipment can be fitted into one wall mounted cabinet.

For larger systems where there are a large number of sprinklers, or where the water supply is very poor, then a larger tank is required to hold the balance of the irrigation water. Even here the tank can be kept to a reasonable size by using sensors in the tank to freeze the irrigation cycle when the water level gets low. Once the tank has refilled the irrigation cycle is recommenced.

Watering times

Watering times are normally calculated for each individual section. The length of time an area needs to be watered depends on the precipitation rate for the sprinklers and nozzles.

Normally the system will be designed so that all of the watering takes place during the night, although with very large projects some trickle watering may need to be carried out during the day. This operation of the trickle system would go unnoticed by members of the public. The whole irrigation cycle may be divided into two or more separate applications, to allow the water to be absorbed into the compost better. Typically a split watering cycle would start at 06.00 hrs and 23.00hrs.

Adding fertiliser

To feed the plants a water driven chemical injector can be added to the unit. This can either dose feed into the system whenever the system is operating, or alternatively it can be controlled by the irrigation panel to dose at regular intervals, normally once a week.

The dosage rate of the feed can be manually altered to suit different formulations of liquid feed.

Reducing scale build-up

In hard water areas, sprinklers can leave unsightly white stains, and dripper nozzles can become blocked up. In the past, the only satisfactory way of combating this is to inject nitric acid into the water supply to alter the pH of the water.

Obviously there are risks associated with the use of nitric acid, and a risk assessment has to be carried out for each project. Dosing units are available for this purpose which have a number of failsafe controls built into them. Normally a specially constructed room is required to hold the acid and the dosing equipment.

In recent years electric scale inhibitors have developed in reliability, allowing these to be used in most circumstances. These do not alter the pH of the water, but alter the molecular composition of the minerals that cause 'hardness'. This ensures that the minerals stay in suspension rather than attaching themselves to pipe and nozzle surfaces.

With electronic inhibitors, it is important to take into account the water flows and topography of the site, as well as the location of electric field and earthing straps, as these will affect the operation of the units.

Equipment

Control equipment

The system is automatically operated by an irrigation controller. The irrigation system will be divided into a number of different zones, brought on individually by solenoid valves operated by the irrigation controller.

Irrigation is traditionally done on a time basis, although most systems also have a rain sensor fitted, which record the amount of rain fall and adjust the irrigation times accordingly. For areas that will be watered even in cold weather, or are exposed to the cooling effects of the wind, a frost sensor can also be fitted to suspend operation in cold weather.

In response to the need to use water as economically as possible, the latest controllers have the ability to add an on-site weather station to the system. The controller then calculates evapo-transpiration on site and adjusts the watering times automatically, taking into account the planting type in each zone. These devices have been shown to reduce water consumption by 30%. As well as reducing water consumption, this feature also reduces the need to adjust the watering times as the season progresses.

The latest controllers coming on to the market feature remote diagnostics and programming. To reduce down time and unnecessary call outs they also feature active fault management.

Pumping equipment

Pumps are required to re-pressurise the irrigation water that is held in the water storage tank. Unlike the public mains, a pumped supply of water can be guaranteed to provide the same pressure in the system regardless of water demand.
This is important as the distance the sprinklers throw the water is determined by the pressure they operate at.

Modern electric pumps are compact and very reliable, smaller pumps are normally aligned horizontally, with larger pumps installed vertically. The pump is turned on and off by the control panel. An emergency stop switch would be located adjacent to the pump to comply with IEE regulations.

Complete pressurisation sets are also available which incorporate pump, water regulation air gap and pump starter on one single unit.

Building Management Systems

If required the irrigation system can be integrated into the B.M.S. system. Outputs can show such things as pump failure, low water level, water level overflow.

Other Sources of Information

The Water Supply (Water Fittings) Regulations 1999 HMSO, The Stationary Office, Post Cash Department, 3rd Floor, St. Crispins, Duke Street, Norwich, NR43 1PD

Water Supplies Byelaws Guide 2nd Edition White S.F. and Mays G.D. WRc plc in association with Ellis Horwood Ltd.

Water Regulations Advisory Scheme, Fern Close, Pen-y-Fan Industrial Estate, Oakdale, Gwent NPll 3EH

United Kingdom Irrigation Association, Cranfield University, Silsoe, Bedford MK45 4DT www.ukia.org **email:** enquiries@ukia.org

British Turf and Landscape Irrigation Association. A trade association for irrigation companies.

Environment Agency. A government body responsible for the allocation of extraction licenses.

Glossary

Air Gap The space between the bottom of the water inlet into a tank, and the maximum possible water level of the tank. For irrigation the air gap must be 'Type AA' or 'Type AB'. Distances for the gap are laid down by the WRc.

Ball valve A float on an arm which closes the inlet valve to the tank when the water level has risen to its desired level.

Bar A unit of pressure. 1 bar is approximately equal to l0m head or 14.5 p.s.i

Barbed fitting A plastic pipe fitting which pushes into the pipe. Barbs of the fitting prevent the pipe being pushed off the fitting by the water pressure. Only suitable for lower water pressures.

Byelaws Water company byelaws have now been superseded by the Water Supply (Water Fittings) Regulations 1999. The byelaws, however for the basis of these new regulations.

Compression fitting A pipe fitting which clamps around the pipe end and is tightened using a knurled nut. Designed for use with polythene pipes up to 12 bar pressure rating.

Controller A unit (usually electronic) which automatically operates the irrigation system, usually on a timed basis. Also known as a panel.

Decoder A computerised unit which fits on to a solenoid valve. Instead of being hard wired to the control box, all the solenoids are linked by just a 2 or 3 core cable. The controller then sends messages to each decoder telling it to turn on the valve.

Emitter Outlet through which water is designed to flow. Also known as a nozzle.

Field Capacity A measure of the soils ability to hold water. The amount of water added by the irrigation should not exceed this amount, otherwise puddling and run off will occur.

Friction loss a term used to describe the loss in pressure when water flows along a pipe. For any given flow the larger pipe the lower the friction loss.

Injector A pump, either water or electrically powered, which adds chemicals (usually fertilisers) into the water stream.

Leaky pipe The trade name for a porous pipe which can be buried underground. The emitter holes are so fine they resist the intrusion of roots. The name is often used generically to describe any type of trickle line.

Level switch A switch which is triggered by the rise or fall of the water level in the tank. This can be used to prevent the tank running dry.

Manifold A set of solenoid valves linked together, each providing water to a separate zone on the irrigation system.

M.D.P.E. pipe Medium density polyethylene - the grade of pipe used for mains water pipe and irrigation pipe. Water pipe is normally coloured blue and irrigation pipe black.

Multi-core cable A many stranded cable linking the solenoid valves to the controller. Each valve has a separate core of cable connecting it to the controller, in contrast to a decoder system.

Pop-up sprinkler A sprinkler which is buried under the turf level which rises up out of the ground to water the area. It then retracts out of the way of mowing machines.

Pressure compensated A drip nozzle designed to give a uniform output regardless of the pressure. Output will vary with pressure on non-compensated nozzles.

Pressure vessel A container holding pressurised water. By holding a reservoir of water under pressure, the number of start/stop cycles on the pump is reduced.

Pressure-stat A mechanised pressure switch which starts the pump when the pressure drops below a pre-set level.

Pump budget When the system is designed a requirement for the pump will established. This will include the maximum pressure (head) required and the maximum flow.

Pump and tank set A water storage tank and pump in one unit to save space.

R.P.Z. valve Reduced pressure zone valve. A mechanical device that can be used to replace a type A air gap in some circumstances.

Solenoid valve An electrically operated tap, which opens and closes under the control of the irrigation panel. Usually operated at 24v AC for safety.

Starter box A relay that brings the pump on, usually controlled by the irrigation panel.

Turbulent flow A design of dripper which reduces blockages in dripper nozzles. Turbulence created by the maze design of the nozzle slows the waters flow, allowing a wider, less blockage prone passageway to be used.

WRc Water research council. The body involved in specifying and approving fittings for use in the water industry.

Warning pipe An 'overflow' pipe situated below the top level of the tank or the weir. This pipe must be easily visible to show that the valve into the tank is leaking.

Weir A large overflow put into a tank to comply with the water regulations. See also warning pipe

Zone Sections that the irrigation system is divided into. Systems are zones to account for different watering requirements, and also to reduce the size of the pump and pipework by reducing the amount of water used at any one time.