



CODE OF STANDARDS AND NORMS FOR LANDSCAPE IRRIGATION

FIRST EDITION
September 2021
Copyright reserved

PREFACE

The Landscape Irrigation Association of South Africa (LIA) was formed as the Turf Irrigation Association on 1986 to promote the professional standing of the South African Turf Irrigation Industry.

For many years, whilst the industry was in the embryo stage, concern arose over quality of design and installation and, on drawing up the Constitution, emphasis was placed on recommended standards.

The Code of Standards of the LIA were drawn up from a pooling of experience gained from many years in the industry and reliable technical sources. They are formulated as a safeguard to ensure efficient and trouble-free systems. The inclusion of each item has been carefully assessed and only used where it has been proved that its exclusion in the past has resulted in a drop in quality.

The LIA and SABI have merged into a single entity under the SABI name, to represent the whole irrigation industry in South Africa.

This document concentrates on the minimum standards and norms and supplements, and should be read in conjunction with the Landscape Irrigation Design Guidelines (September 2021). Information for this document was drawn from the Code of Standards of the LIA (Jan 2009), the SABI Norms (2017) and the Landscape Irrigation Best Management Practices of the Irrigation Association and American Society of Irrigation Consultants. The SANS Standards 1200L for Medium Pressure Pipelines and SANS Standards 1200LB for Bedding (Pipes), were also consulted.

It is appreciated that with the advancement in technology and the appearance of new innovative equipment, additions and amendments will be needed and, when indicated, revised editions of these Standards will be issued.

An important aspect in the industry is that all participants use a universal technology - both written and verbal and to this end, a complete set of terms in common practice in the irrigation field together with their accepted abbreviations has been included.

Contents

1.	IMPLEMENTATION OF STANDARDS	1
1.1	NEW INSTALLATIONS.....	1
1.2	EXISTING INSTALLATIONS.....	1
1.3	APPROVED VARIATIONS	1
1.4	DISPUTES	1
1.5	INSTALLATION PROCEDURE.....	1
2.	TERMINOLOGY.....	2
2.1	HYDRAULIC DATA	2
2.2	SYSTEM DATA	3
2.3	DIMENSIONAL DATA.....	3
3.	TECHNICAL DATA.....	5
3.1	CONVERSION TABLES.....	5
3.2	FORMULAE.....	6
4.	DESIGN PARAMETERS.....	7
4.1	SYSTEM CAPACITY	7
4.2	IRRIGATION DURATION	7
4.3	SYSTEM APPLICATION RATES AND OPERATING PRESSURES.....	7
4.4	OVER AND UNDER WATERING	7
4.5	MAINLINE PRESSURE RATING.....	8
4.6	LOCAL AUTHORITY REGULATIONS.....	8
4.7	DOCUMENTATION.....	8
4.8	INFORMATION FOR CLIENT	8
4.9	IRRIGATION SCHEDULE.....	8
5.	PIPEWORK.....	8
5.1	TRENCHES.....	8
5.1.2	ADVERSE CONDITIONS	9
5.1.3	BACKFILLING	9
5.2	PIPING & FITTINGS.....	9
5.2.1	SABS PIPING.....	9
5.2.2	PIPE FITTINGS	9
5.2.3	OPERATING PRESSURE	9
5.2.4	THRUST BLOCKS.....	9
5.2.5	EXPANSION JOINTS.....	9
5.2.6	SOIL CORROSION	9
5.2.7	PIPE SIZING	10
5.2.8	PIPE PRESSURE RATING	10
5.2.9	PIPE SPECIFICATIONS.....	10
5.2.10	PVC PIPE INSTALLATION	10
6.	SPRINKLERS.....	Error! Bookmark not defined.
6.1	INSTALLATION OF SPRAY EMITTERS.....	11
6.2	SPACING.....	11
6.3	SPRAYLINES.....	11
6.4	LANDSCAPE DRIP SYSTEMS.....	11
7.	VALVES.....	Error! Bookmark not defined.
8.	PUMPS AND MOTORS	Error! Bookmark not defined.
8.1	INSTALLATION REQUIREMENTS.....	12
8.2	WATER SUPPLY	13
8.3	WATER STRAINING AND FILTRATION	13
9.	ELECTRICAL.....	14
10.	WARRANTY	Error! Bookmark not defined.
11.	DOCUMENTATION AND HANDOVER.....	Error! Bookmark not defined.
11.1	AS-BUILT DRAWING.....	16
11.2	HANDOVER DOCUMENTS AND REQUIREMENTS.....	16

1. IMPLEMENTATION OF STANDARDS

Members of the SABI are required to ensure that all installations and services are carried out in accordance with these standards, subject to the following provisos.

1.1 *New installations*

These standards shall be deemed to apply as the minimum requirements, unless approved variations have been agreed to in advance, in writing, by all parties concerned.

1.2 *Existing installations*

Installations prior to **September 2021** may remain as installed if not under dispute. Should any repairs or extensions take place, this work shall be deemed to be done in accordance with these standards, unless approved variations have been agreed to in advance, in writing, by all parties concerned.

1.3 *Approved variations*

Where compliance of these standards is impractical, any variations shall be agreed to in writing, by all parties concerned.

1.4 *Disputes*

In the event of a dispute where agreement is not possible between parties concerned, it is agreed to accept the findings of an arbitration committee appointed by SABI who will assess the problem on a facts found basis, with no redress whatsoever, financial or otherwise to SABI.

1.5 *Installation procedure*

Installations undertaken by SABI members shall be of the highest standards and shall comply with the standards of SABI

2. TERMINOLOGY

2.1 *Hydraulic data*

Volume

Amount of water in a container or that required by plants, expressed as:

ℓ = Litres

m³ = Cubic Metre

Mass

Weight of the volume of water in a container, expressed as:

Kg = Kilogram

Flow

Amount of water passing through a pipeline, sprinkler or emitter, expressed as:

ℓ / s = Litre per second

ℓ / min = Litre per minute

ℓ / h = Litre per hour

m³ / h = Cubic metre per hour

Velocity

Rate of water passing through a pipeline, expressed as:

m / se = Metre per second

Pressure

Amount of energy exerted by water in a container, pipeline or sprinkler, expressed in:

Bar = Bar

M = Metre

kPa = kilopascals

Static pressure

Pressure under no flow or static conditions. (Pressure for maximum pressure rating of equipment).

Working pressure

Pressure under dynamic conditions. (Pressure available to operate irrigation equipment).

Surge pressure and water hammer

Additional pressure caused by the change in velocity due to start-up and shut-down of pumps, rapid valve opening and closing, and column separation and collapse.

Friction

Resistance caused by flow in pipeline, fittings, valves, sprinklers etc., expressed as:

m

kPa

bar

2.2 **System data**

Gross Water Application (GA)

Total depth of water applied to planted areas by an irrigation system per cycle expressed as mm

Gross rate of precipitation or application (GAR)

The rate at which water is applied by an irrigation system without evaporation losses, expressed as:
mm / hr = Millimetres per hour

Nett rate of precipitation or application (NAR)

The rate at which water is applied by an irrigation system after evaporation losses, expressed as:
mm / hr = Millimetres per hour

Co-efficient of Uniformity

The uniformity of a sprinkler water distribution, expressed as:
% CU = Percent Co-efficient of Uniformity

Scheduling co-efficient

% SC = Additional time needed to compensate for the deficiencies in the CU.

Absorbed power (P2)

The power required by pump to deliver a required flow rate and pressure at the corresponding efficiency, expressed as:

kW = Kilowatt

Input power (P1)

The energy required by an electric motor or engine to drive a pump taking the efficiency of the drive unit into account, expressed as kW

Electricity

A source of energy associated with power, expressed as:

V = Volts

W = Watts

A = Amps

VDC = Volts direct current

VAC = Volts alternating current

50 Hz = 50 Cycle

1 PH = Single Phase

3 PH = Three Phase

PF = Power Factor

2.3 **Dimensional data**

Measurement

Distance, size of plans, pipes, valves, spacing of sprinklers and emitters, expressed as:

M = Metre

Mm = Millimetre

Area

The size of land, expressed as:

m² = Square metre

ha = Hectare

Sprinkler spacing

The distance between sprinklers or emitters and rows, expressed as:

$L_e \times L_d = \text{Sprinkler Spacing} \times \text{Row Spacing (in metres)}$

3. TECHNICAL DATA

3.1 Conversion tables

VOLUME

GALL	US GALL	ft ³	LITRE	m ³
1	1,2	0,161	4,546	0,005
0,833	1	0,134	3,785	0,004
6,229	7,481	1	28,317	0,028
0,220	0,264	0,035	1	0,001
219,97	264,17	35,315	1000	1

AREA

ACRE	MORGEN	HECTARE
1	0,472	0,4047
2,117	1	0,8565
2,471,	1,167	1
1 ACRE	1 MORGEN	1 HECTARE
43560ft ²	92196ft ²	10 000m ²

MEASUREMENT

INCH	FEET	YRDS	mm	cm	METRE
1	0,0833	0,0278	25,4	2,54	0,0254
12	1	0,3333	304,8	30,48	0,3048
0,03937	3	1	914,4	91,44	0,9144
0,0907	0,0033	0,0011	1	0,10	0,001
39,37	0,033	0,011	10	1	0,01
	3,281	1,094	1000	100	1

VELOCITY

ft / sec	m / sec
1	0,3048
3,281	1

PRESSURE

ft HEAD	PSI	m HEAD	KPA	BAR	kg / cm ²
---------	-----	--------	-----	-----	----------------------

1	0,434	0,305	2,992	0,030	0,031
2,310	1	0,704	6,895	0,069	0,070
3,281	1,422	1	9,805	0,098	1,000
0,335	0,145	0,102	1	0,010	0,0102
33,461	14,504	10,192	100	1	1,0192
32,809	14,223	10,010	98,067	0,981	1

POWER

HP	Kw
1	Kw
1	0,746
1,341	1

FLOW

gpm	US gpm	gph	US gph	m ³ / h	ℓ / s	ℓ / m	ℓ / h
1	1,2	60	72	0,273	0,076	4,546	272,8
0,833	1	50	60	0,227	0,063	3,785	227,0
0,017	0,2	1	1,2	0,005	0,0013	0,076	4,546
0,014	0,017	0,833	1	0,004	0,0011	0,063	3,788
3,67	4,4	220	264	1	0,278	16,67	1000
13,2	15,85	792	950,3	3,6	1	60	3600
0,22	0,264	13,2	15,84	0,06	0,017	1	60
0,0037	0,0044	0,222	0,264	0,001	0,0003	0,017	1

FRACTIONS & DECIMALS

inch	mm	inch	mm	inch	mm	inch	mm
1/64	0,016	17/64	0,266	33/64	0,556	49/64	0,766
0,397		6,747		13,097		19,447	
1/32	0,031	9/32	0,281	17/32	0,531	25/32	0,781
0,974		7,144		13,493		19,843	
3/64	0,047	19/64	0,297	35/64	0,547	51/64	0,797

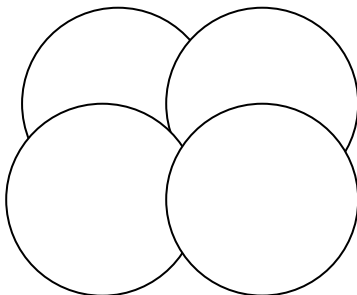
1,191		7,541		13,890		20,240	
1/16	0,063	5/16	0,313	9/16	0,563	13/16	0,813
1,587		7,937		14,287		20,637	
5/64	0,078	21/64	0,328	37/64	0,578	53/64	0,828
1,984		8,334		14,684		21,034	
3/32	0,094	11/32	0,344	19/32	0,594	27/32	0,844
2,381		8,731		15,081		21,431	
7/64	0,109	23/64	0,359	39/64	0,609	55/64	0,859
2,778		9,128		15,478		21,828	
1/8	0,125	3/8	0,375	5/8	0,625	7/8	0,875
3,175		9,525		15,875		22,225	
9/64	0,141	25/64	0,391	41/64	0,641	57/64	0,891
3,572		9,922		16,272		22,622	
5/32	0,156	13/32	0,406	21/32	0,656	29/32	0,906
3,969		10,319		16,668		23,108	
11/64	0,172	27/64	0,422	43/64	0,672	59/64	0,922
4,366		10,715		17,065		23,415	
3/16	0,188	7/16	0,438	11/16	0,688	15/16	0,938
4,762		11,112		17,462		23,812	
13/64	0,203	29/64	0,453	45/64	0,703	61/64	0,953
5,159		11,509		17,859		24,209	
7/32	0,219	15/32	0,469	23/32	0,719	31/32	0,969
5,556		11,906		18,256		24,606	
15/64	0,234	31/64	0,484	47/64	0,734	63/64	0,984
5,953		12,303		18,653		25,003	
1/4	0,250	1/2	0,500	3/4	0,750	1	1,000
6,350		12,700		19,050		25,400	

3.2 *Formulae*

3.2.1 Rate of precipitation (gross)

$$\text{mm/h} = \ell / \text{hr} / (L_e \text{ (m)} \times L_d \text{ (m)})$$

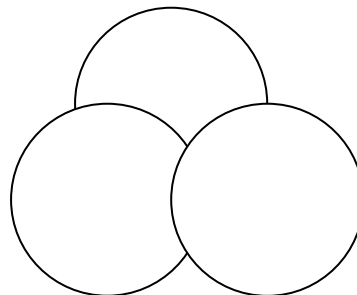
SQUARE + RECTANGULAR



$$\frac{\ell / \text{hr}}{\text{-----}} = \text{mm/hr}$$

S x S

TRIANGULAR



$$\frac{\ell / \text{hr}}{\text{-----}} = \text{mm/hr}$$

S x S x 0,866

3.2.2 Absorbed power

$$\text{kW} = \frac{10 \times \text{mh} \times \text{m}^3/\text{hr}}{\text{pump efficiency (fraction)} \times 3600}$$

3.2.3 Electricity

1 PHASE

$$V = \frac{W}{A}$$

$$W = V \times A$$

3 PHASE

$$V = \frac{W}{A \times 1.73 \times \text{PF}}$$

$$W = V \times A \times 1.73 \times \text{PF}$$

4. **DESIGN PARAMETERS**

4.1 ***System capacity***

A system shall be capable of a gross application per week (system capacity) to suit the peak water demand of the planted material and ground condition, and this gross application shall be clearly stated in millimetres per week and also the total time in hours per week required for it's achievement. Waterwise hydro zoning according to plant water requirements, should be considered when designing an irrigation system.

4.2 ***Irrigation duration***

The duration of a watering cycle shall be clearly stated for each station giving the time in minutes per station it shall run, the precipitation which shall result in millimetres, and the number of times the cycle should operate per day and be repeated in a week.

4.3 ***System application rates and operating pressures***

Sprinklers having dissimilar rates of precipitation and operating pressures shall not be included in the same station.

4.4 ***Over and under watering***

The size and location of a sprayline shall where ever possible ensure watering compatibility with the area concerned, so as to avoid heavy rates of precipitation on steep slopes which could cause erosion, or very light waterings in hot and sandy soil situations where little water reaches the plants.

4.5 ***Mainline pressure rating***

When the water supply is from a municipal feed, the piping connecting from this feed to the sprinkler valves shall be of a class specified by the municipal authority or, if not specified, of a class in excess of the highest closed valve pressure.

4.6 ***Local authority regulations***

Rules and regulations as laid down by local authorities must apply.

4.7 ***Documentation***

The SABI Member shall be required to supply the following information to the client along with his design:

- Specifications of the of irrigation equipment he proposes.
- The type and specification of the piping and fittings he proposes.
- The total operating time per week (or month or year) of the system.
- The total weekly (or monthly or annual) water usage of the system.

4.8 ***Information for client***

The SABI member shall supply, on request from the client, all other relevant information contained in this section.

4.9 ***Irrigation schedule***

The SABI member shall, on supply or installation of the designed system, supply the client with an operation schedule detailing the gross precipitation rates, volumes and scheduled operating times of each irrigation zone.

5. **PIPEWORK**

5.1 ***Trenches***

5.1.1 **Soil cover**

All piping shall be installed such that they have a minimum soil cover of at least the following below the finished grade:

- Laterals 450mm
- Mainlines smaller than 75mm 500mm
- Mainlines 75mm and larger 900mm

5.1.2 Adverse conditions

If rock or other adverse conditions preclude the installation at the prescribed depth the client's permission must be obtained for burial at a shallower depth and adequate protection shall be given.

5.1.3 Backfilling

Trenches shall be backfilled with selected stone-free material so as to not to cause damage to the pipes and cabling. The area shall be compacted to match the texture of surrounding soil to prevent subsidence.

5.2 ***Piping and fittings***

5.2.1 SABS Piping

Only SABS or SANS piping and fittings with a guaranteed pressure rating, where they are available, shall be used.

5.2.2 Pipe fittings

Piping shall be compatible with fittings.

5.2.3 Operating pressure

Piping shall not at any time under working conditions be subjected to pressures in excess of the pressure rating.

5.2.4 Thrust blocks

Adequate thrust blocks shall be cast at all bends, reducers, valves, tees and end caps or at any other unsupported point on PVC pipelines.

5.2.5 Expansion joints

Expansion joints shall be installed at intervals as recommended by pipe manufacturer.

5.2.6 Soil corrosion

Only piping and fittings made from a material suitable to site soil conditions shall be used. (pH etc).

5.2.7 Pipe sizing

Irrigation mainline pipes shall be of an adequate size to ensure that water velocities are kept below 1.0 m/sec. Spray line pipes shall be sized to ensure that water velocities are kept below 1.5 m/sec. Pump suction pipe velocities shall not exceed 1.3m/s. Pump discharge and valve cluster velocities shall not exceed 2.5m/s or as specified by the manufacturers of pump station accessories such as hydraulic valves, non-return valves, flow meters and manual valves.

5.2.8 Pipe pressure rating

All piping directly coupled to Municipal Mains should be of type and pressure rating approved by the local authority.

5.2.9 Pipe specifications

The client shall be made aware of the different pipe specifications available.

5.2.10 PVC pipe installation

PVC pipes may not be installed aboveground unless they are coated for protection against ultra violet light where necessary.

6. **SPRINKLERS**

6.1 ***Installation of spray emitters***

- 6.1.1 The sprinklers shall be selected to operate only within the manufacturer's pressure range.
- 6.1.2 Only sprinklers having a compatible rate of precipitation shall and operating pressure be used on the same spray line.
- 6.1.3 Pop-up sprinklers shall be installed on adjustable swing joint risers or flexible swing arms to allow for adjustment.
- 6.1.4 Shrub sprinklers shall be mounted on rigid risers of either galvanised steel or ultra violet resistant plastic. Pop-ups shall not be placed on top of fixed risers.
- 6.1.5 Shrub risers shall be positioned such, as to not create a hazard or be prone to damage. In particular, risers shall not be used on kerb edges where they are liable to be damaged by parked car overhangs. For this application suitably sized tall pop-ups should be used.
- 6.1.6 Specify pop-up heights of the sprinklers to clear interference from vegetation.
- 6.1.7 Design system to target each planting area with no overspray of impervious surfaces, wetting of structures or adjacent planting areas. Prevent runoff of water from the site.
- 6.1.8 Position sprinklers a minimum of 50 mm from hard surface edges but farther than 50 mm where possible to minimize overspray, back-splash or wind drift.
- 6.1.9 Sprinklers without low head drainage valves shall be surrounded with adequate drainage material.

6.2 ***Spacing***

- 6.2.1 In the case of square and rectangular spacing of sprinklers, the distance between sprinklers shall not exceed 50% of the diameter of coverage (head to head coverage). In triangular pattern, the spacing shall not exceed 55%.
- 6.2.2 Spacing should be derated according to prevailing wind conditions.

6.3 ***Spraylines***

- 6.3.1 Spraylines shall be sized to ensure that the pressure variance within the zone does not exceed 10%.

6.4 ***Landscape drip systems***

Only Dripline or drippers from an approved manufacturer with guaranteed pressure rating and performance specifications shall be used.

- 6.4.2 All drip irrigation systems shall be fitted with pressure regulation devices.

- 6.4.3 All drip irrigation water shall be adequately filtered. The filtration grade should be 130 micron for drippers with a flow rate >1l/h and 100micron with a flow rate less than 1l/h.
- 6.4.4 Drip systems shall be installed in such a way as to prevent plant roots from growing into and blocking the dripper orifices and to prevent dirt from being drawn into the dripline from the surrounding soil.
- 6.4.5 Drip systems shall be installed to suit soil characteristics.
- 6.4.6 Driplines shall be fitted with vacuum-breaker valves at all high points where static height variances occur. The vacuum-breaker valves should be adequately sized to ensure that vacuum conditions do not occur in the pipelines

7. **VALVES**

- 7.1 No solenoid valve or valve-in-head sprinkler shall be subjected to a pressure in excess of the manufacturers' specification.
- 7.2 All underground valves shall be installed in valve boxes. All valves shall be accessible and serviceable within the valve box. Each valve cluster should be equipped with an isolation valve for ease of maintenance.
- 7.3 Pressure reducing valves shall be installed where excessive line pressures occur.
- 7.4 All systems connected to a potable water system shall be fitted with an easily accessible isolating valve close to the point of source.
- 7.5 Sufficient isolating valves and scour valves where necessary shall be fitted to permit maintenance of the control valves without having to drain the whole system.
- 7.6 Air release valves shall be fitted to all systems where air accumulation could occur.

8. **PUMPS AND MOTORS**

8.1 ***Installation requirements***

- 8.1.1 Pumps shall be selected to provide a capacity of 10% in excess of the design flow and 5% in excess of the design pressure, and be able to cope with the additional friction and pressure involved in this increase. Selections must be within the manufacturers recommended operating limits.
- 8.1.2 Motors shall be protected with an approved starter with over loads set to trip at 5% above full load current.
- 8.1.3 Accessible break joints in the form of unions or flanges shall be fitted on both suction and delivery pipes.
- 8.1.4 Isolating valves shall be fitted on a pump suction and delivery pipe.

- 8.1.5 All pumps set above a water source shall have a foot valve installed on the suction line and be fitted with a priming device.
- 8.1.6 All positive displacement pumps shall be fitted with a pressure relief valve, of adequate size, between the pump and the delivery isolating valve.
- 8.1.7 All borehole pump installations are to conform with the specifications as laid down by the Borehole Water Association.
- 8.1.8 All pumps must be fitted with adequate protection devices to prevent dry running. Motors must be fitted with adequate protection against overloading and, phase failure and phase reversal, for three phase installations.

8.2 Water supply

- 8.2.1 It is the responsibility of the designer or contractor to establish that the water quality is suitable for the system.
- 8.2.2 The capacity of storage tanks or reservoirs shall be adequate for at least one complete irrigation cycle.
- 8.2.3 No cross-connection between potable and non-potable water supplies are permitted.

8.3 Water straining and filtration

- 8.3.1 A strainer shall be fitted to suction intakes where the ingress of dirt may be possible and sized to prevent blocking of pump components.
- 8.3.2 Where fine nozzles are being used and water condition warrants, a cleanable filter of adequate size shall be installed on the mainline inlet of a system. Care must be taken not to exceed the rated pressure of the filter. The recommended grade of the filter may be selected from the following:
 - a) Sprinklers 300-400micron.
 - b) Micro-Sprayers 200micron.
 - c) Drippers 130micron (>1l/h) and 100micron (<1l/h).

8.3.3 The mesh to micron relationship for commonly used screens is:

Mesh	Microns
10	2000
20	840
30	590
40	420
50	300
60	250
100	150
150	113

200	75
300	50

9. ELECTRICAL

Note that all electrical installations must be signed off by a qualified and registered electrician who can issue a Certificate of Compliance (COC). This does not apply to plug and play installations and 24VAC control wiring.

- 9.1 All electrical work is to comply with local municipal codes.
- 9.2 All underground control wires shall be insulated copper conductors and SANS-listed for direct burial.
- 9.3 All cable joints shall be waterproof and secure (e.g. crimp ferrules with suitable grease or neutral cure silicon) and should be appropriate for the size of cable. All cable joints (splices) shall be made in easily accessible junction boxes (valve boxes), preferably in flower beds, and shall be indicated on the as-built plan. The valve boxes should be installed to protrude 50mm above the ground level, unless they are in lawn areas, for easy location during fault finding. The cables shall be extended by 500mm for ease of fault finding.
- 9.4 Control wires must be installed to allow for expansion and contraction using snaking and loops along the route and, expansion coils at connections and at the solenoid valves.
- 9.5 A spare wire shall be installed throughout the system to assist with fault finding.
- 9.6 Control cable selections shall ensure that the voltage available at a solenoid shall not be less than 90% of the solenoid rating. A minimum cable size of 1.0 mm² is required. As a guide for control wiring to power solenoids the following applies:
 - 1.0mm² up to 150m
 - 1.5mm² up to 250m
 - 2.5mm² up to 400m
- 9.7 All low voltage control cables shall be buried with soil cover not less than 400 mm to minimise damage and, preferably, where possible, in the same trenches as the pipework so as to present no extra hazard. If control cables run in a separate trench they shall be encased in a conduit.
- 9.8 All available cable colours from the electrical supplier should be used for ease of fault finding and maintenance.
- 9.9 Where cable runs under paving, it is to be sleeved. Expansion joints shall not be positioned in the sleeves under paving.
- 9.10 Irrigation controllers shall be installed according to the manufacturer's recommendations. If they are not weatherproof, they shall either be sited indoors or in a weatherproof casing.
- 9.11 Special consideration shall be given to the protection of all electronic controllers. Adequate lightning and earthing protection shall be installed (earth spikes and surge arrestors).

10. **WARRANTY**

- 10.1 The terms and conditions of the warranty or guarantee shall be clearly stated and shall not be for less than 12 months from the date of hand over of the completed plant - or in the case of large systems, for each section, from the date of hand over of the section.
- 10.2 Warranties and / or guarantees on materials of irrigation equipment from suppliers shall be passed on to the client and shall be clearly stated.
- 10.3 It is recommended that, for the client's safety, adequate safeguards in the form of insurance in respect of public liability, product liability and all forms of indemnity be taken out, these all being commensurate with the magnitude of the involved contract.

11. DOCUMENTATION AND HANDOVER

11.1 *As-build drawing*

The client shall be provided with As-built drawings to scale containing:

- a) The position of sprinklers;
- b) The position of spray line piping with colour coding of individual stations or zones;
- c) The position of control wiring with colour coding;
- d) The position and class of the main line clearly distinguishable from the spray line piping;
- e) The position of all isolation valves;
- f) The position of all zone valves and control or master valves;
- g) The position of pumps and boreholes as well as their switchgear;
- h) The position of storage tanks;
- i) The position of control cable junction boxes;
- j) The position of power source(s), isolation switches and circuit breakers;
- k) The position of power cables;
- l) The positions of rain and soil sensors if applicable;
- m) A legend or key listing all symbols used in the drawing

It would be preferable to provide a separate as-built automation plan indicating all electrical installations.

11.2 *Handover documents and requirements*

The client shall be provided with a handover manual containing:

- Operating schedule programmes including zone precipitation rates, irrigation frequency and run times of all stations per season;
- Specifications of all equipment used;
- System operating and maintenance instructions;
- Warranty and guarantee terms and conditions;
- Contractor's contact name and telephone numbers;
- Date of installation.

11.3 The contractor shall keep record of the following:

- Operating schedule with recommended run times for each station;
- Date of installation, commissioning and handover;
- Copies of all as-built plans and documentation handed to the client.