MINIMUM
IRRIGATION
DESIGN
INSTALLATION and MAINTENANCE
STANDARDS

for

GENERAL IRRIGATION PROJECTS & IRRIGATION MAINTENANCE

at

THE UNIVERSITY OF SYDNEY

08/2016

THE UNIVERSITY OF SYDNEY

1. Introduction

These minimum standards are to form part of any project brief issued by The University of Sydney which:

- May contain an irrigation design or maintenance component, or
- for any irrigation system to be developed by the private sector or
- as part of any design and construct building project and or
- any landscape project for hand over to, and ongoing or future management by, The University of Sydney.

Consultants, Developers and Contractors are reminded of the necessity to comply with the requirements for National Plumbing code and also all plumbing requirements described in Australian Standard AS 3500, and any other requirements for irrigation systems that may be issued from time to time by The University of Sydney and or as part of any DA approved by local council that may relate or pertain to any specific or general project requirement. In other words this document is to serve as a minimum standard for general University projects and which may be overruled by other issued documentation which may give rise to a higher standard or on any specific project where the University may require greater standards for a specific irrigation requirement. This document may also be over ruled from time to time to a higher standard by any another authority having jurisdiction or other specific project outcome requirements.

2. Common Related codes of practice and minimum standards

i. Industry standards- *but not limited to*.

AS/NZS 1477 PVC Pipes and Fittings for Pressure Applications, Standards Australia.

AS 2698.1 Plastics Pipes and Fittings for Irrigation and Rural Applications – Polyethylene Micro-irrigation Pipe, Standards Australia.

AS 2698.3 Plastics Pipes and Fittings for Irrigation and Rural Applications – Mechanical Joint Fittings for use with Polyethylene Micro-Irrigation Pipes, Standards Australia.

AS/NZS 2845.1 Water Supply - Backflow prevention devices - Materials, design and performance requirements, Standards Australia.

AS.NZS 3500.1.2 National Plumbing and Drainage Code, Standards Australia.

AS/NZS 4130 Polyethylene (PE) Pipes for Pressure Applications, Standards Australia.

3. Types of systems

This section will nominate the types of systems and water supply or resources to be used and categorised as Low or High Volume Systems. If more than one type of system is required within a project, the boundaries of the separate sub-systems are to be described and clearly defined on all submitted and or accompanying shop or design drawings for approval by the University.

“Low volume” (dripper or mini and micro spray systems) should generally only be used in locked courtyards and other areas where general students or the public do not generally have access after hours, and may include narrow and remote access median strips or small gardens or very narrow or small and isolated turf areas where approval may from time to time be granted. When used all lateral pipe work is to be pegged and laid below mulches or ground level for protection and is to be non visual.

Generally preference is for “High volume” pop up shrub bubblers, pop up spray sprinklers, or gear driven rotor type pop up sprinkler systems in both turf and garden areas.

Opportunities for use of second class water, (supplies other than the potable supply) should be considered where it may be an advantage and feasible to do so. From time to time and on specific occasions the University may require a system to be run from second class water. If a second class water is used, a dual system may be required to enable the University an option for using potable water when and if required.

Developers and or contractors are required to seek clarification from the University for each system set up on second class water supplies and shall provide appropriate backflow prevention, storage and pumping facilities to enable seamless change over to the potable water supply in such an event. Where such systems are to be installed the University is to be fully notified in advanced and shall retain the right to request alterations and additions at the developer’s cost in order that the system shall meet the University's needs.

Irrigation of landscapes is a major consumer of the University’s reticulated potable water supply and the University is seeking to be proactive in reducing potable water used for open space amenity. All systems are therefore to incorporate “local” system flow meters to measure and record flow with the use of a pulse meter which will need to be connected to a local ‘field’ controller and then in turn report to the University’s “central irrigation control” system. The pulse flow meter is to be installed from a single point source for each system or section of a system. In addition each system will require control equipment compatible with the University’s Central computerised Control System.

All new systems are to be handed over to the University for management and control and must be approved and accepted by the University in writing upon handover.

i. First class water (potable water source)

Many of the current irrigation systems are supplied from the University of Sydney’s potable (First Class) water supply. Where potable water is to be the *ONLY* water source, provide backflow prevention at a single “irrigation point of connection” to the potable water supply main to protect the water supply from contamination and fit a pulse water meter linked to a local Controller System and then the local controller linked to the University’s Central Irrigation Control System.

ii. Second class water (recycled or harvested water resource)

Second class (non potable) water to be used where feasible in place of potable water. The supply is to be reliable and fit for purpose. Where supplies may not be 100% reliable they shall be augmented by a potable supply which shall include suitable storage tanks and pumping arrangement for the irrigation to be feed from either supply including fitting of a Reduced Pressure Zone Device or other type of approved back flow prevention device and or a suitable protected and vandal proof physical air gap above a storage tank, whichever meets code and Sydney Water approval. Any and all types of backflow prevention shall be secure in a vandal proof lockable cage.

Second class water supplies may include storm water harvested supply, treated effluent or other University supply other than potable water.

If not adequately designed, the use of second class water may fail. All systems shall therefore have suitable filtration designed and installed at the site prior to a system supply pulse water meter as a point of flow reference and input to the central control system. The filtration may vary depending on the water source and designed to meet expected worst case water quality.

All filtration shall incorporate auto backwash and shall be oversized by a factor of a minimum 2x the nominal peak flow of a system. e.g if a system has a peak station flow rate of 200lt/min the filtration shall allow for a minimum of 400lt/min and any backwash demand shall be allowed for in the pump design in addition to any system flow.

A sustaining valve may be used where appropriate.

Filtration systems are to backwash on time control basis *and* pressure differential as back up to time.

In all cases where the use of second class water is possible, discussions with the University are to be arranged before starting design work to seek the University's approval and any detailed requirements that may be required in addition to this document. The project designers may then review the latest developments in the area of second class water and make application for changes or alterations to the University. The University shall however have the final say of any system specific requirements and, for maintenance purposes, may require specific products to also be used within any specific system. Current preferred filtration should be from 'Filtaworx' or "Amiad" stainless steel suction scanner filtration range. Pumps to be either Lowara or Grundfos fitted with variable frequency drives and remote control touch screen panels with remote "ap" access via data sim card.

If treated effluent water is being used, pipes, sprinklers, valves and valve boxes with lilac coloured striping, caps, covers or markings are to be used. Lilac identification may also be used for water collected from other harvest methods.

Where second class water is used, signage is to be installed at all major entry points to the given area to advise the users/public that the irrigation system is not from a potable supply and is "not fit for drinking" and which may also be unsuitable for direct human contact. All second class water supplies shall include fortnightly testing over an initial 3 month period to validate the supply as being 'fit for purpose'. Fit for purpose shall mean suitable for spray irrigation and contact after four hours with approved reduction log E.coli level, TDS & Turbitity levels so as not to be harmful to human health.

iii. High volume

The range of irrigation systems which fall within this category include the following:

- automatically controlled pop-up sprinkler systems.
- manually controlled pop-up systems
- quick coupling valve systems
- automatic or manual shrub bubbler and spray systems.

  NOTE: Each and all of the above systems shall be fitted with an irrigation pulse flow meter at each water supply or "point of connection" and in the case of automatic systems shall allow for connection through a local field controller to the University's Central Irrigation Control System. Application maybe made for exemption on a specific case by case basis where the area is remote and isolated, eg. smaller than 500m² or for temporary establishment purposes only.

iv. Low volume

The range of irrigation systems that fall within this category include any area where specific establishment of landscape request is made and the system may be either:

- automatically controlled drip and or micro spray systems
- manually controlled drip and or micro spray systems.
- Other fixed impact type plastic sprinklers on risers for landscape establishment only

Note that low volume irrigation systems generally have a relatively short operational life and should only be used where initial establishment is the major objective. In low volume systems, 'turbulent flow' type pressure compensating internal emitters are to be used on dripper systems for up to 3 years. Automatic systems with the University's approval may be local stand-alone systems, and Hunter controllers are to be use with University approval.

4. Minimum standards for high volume sprinkler systems

i. Controllers.

Local "field controllers" are to be installed each with a 'local' flow meters, rain sensor and communication to the Central Irrigation Control System for each water supply as a "local system". For Irrigation systems that are to be handed onto the University for future maintenance and control, other temporary controllers may be installed during landscape maintenance periods, however they are to be replaced in full working order with an approved field controller compatible with Central Irrigation Control System prior to the Universities operational acceptance. Station count shall be minimum 8 stations with at least 2 spare stations available.

ii. Solenoid Valves.

For maintenance purposes the University has preferred brands of Solenoid valves. 25mm, 40mm and 50mm valves which may be either Hunter ICV or Toro P220 valves.

Solenoid Valves 80mm and over would be rare and require special University approval. Bermad or similar would be a suitable selection.

All solenoid valves are to include a pressure regulation device to set the operating pressure at each station solenoid valve.

All solenoid valves are to be fitted with a preceding service ball valve in full stainless steel or stainless steel and bronze construction. They shall be not be a reduced bore pattern and they shall be rated to a minimum working pressure of PN16.

Lever handles are to be used for all valves and shall be located parallel and alongside the incoming pipe work toward the solenoid valve when in the on position and vertical when in the off position.

All solenoid valves watering large open turf areas or on any sporting fields are to be located to the perimeter of the area and for sporting surfaces shall be a minimum of 2m off to the side or beyond the ends of sporting or such surfaces, ie valves are not to be on a sporting surface or in the middle of large open turf areas.

iii. Sprinklers.

For service and maintenance purposes the University has preferred brands of sprinklers. Pop up spray Sprinklers with Radius to:

- <4.8m shall be Toro 570 or Hunter Pro Spray and pressures are to be between 180kPa and 280kPa regulated at the solenoid valve.
- <8m with multi jet low precipitation shall be Hunter with MP rotator nozzles and pressures are to be between 180kPa and 280kPa regulated at the solenoid valve.
- 6 to 13m radius Gear driven sprinklers shall be Hunter I20 Stainless Steel riser 5 year warranty and shall use matched precipitation nozzles. Pressures are to be between 300kPa and 400kPa regulated at the solenoid valve.
- 12 to 19m Gear Driven sprinklers shall be either Hunter I25 (stainless steel), Rainbird 8005 SS (stainless steel). Pressures are to be between 400kPa and 480kPa at the last sprinkler and regulated at the solenoid valve.

Gear driven sprinklers used on open major recreational areas and all sporting fields shall be Rain Bird 8005 SS or with permission Hunter I40 sprinklers may be considered. Where couch grasses are used Toro 640 sprinklers are also considered an approved sprinkler.

All sprinklers are to be installed as per the manufacturer's recommendations and shall be installed truly vertical on a "swing arm assembly" not smaller than the inlet thread of the sprinkler. The swing arm shall be no greater than 30° to the horizontal.

All sprinkler designs to be matched precipitation and shall provide an average DU of greater than 80%. Generally sprinklers are not to be spaced further apart than 90% of the radius of throw of the selected sprinkler. Computer generated sprinkler performance is to be conducted on all designs of oval systems and large open spaces and reserves. Small turf and garden systems do not require CAD performance data.

Sprinkler placement and design shall consider topography and other site conditions and shall not operate sprinklers across different areas, slopes or micro climates on a single station. when this can be avoided

Sprinkler pressure variation or any station from last to first sprinkler shall generally be kept to 5% up to a maximum of 10%.

Sprinklers adjacent to footpaths, kerbs, gardens, building etc or mowing strips shall be located a minimum 100mm and maximum 150 mm away from the edge to permit the use of mechanised edging equipment without damage to sprinklers.

iv. General Turf and Garden Areas.

Systems shall be fully automatic pop-up sprinklers for high use turf areas. Pop up spray sprinklers should be provided for formal shrub bed and garden areas that are not directly and adequately covered by the turf sprinklers. Part circle sprinkler to be used and are to be directed away from all, boundaries, kerbs, major pathways, roads and carparks, buildings, any playground equipment, picnic shelters etc. Large area gear driven sprinklers are to be avoided immediately adjacent to or within 6m of large trees, light poles, bins, seat, retaining walls or other site obstructions. Sprinkler types/models are not to be mixed on a single station. Sprinkler brands are generally not to be mixed on a given system. Shrub beds, formal gardens, grassed areas and embankments are to be treated as a separate entity when designing irrigation systems.

v. Other Major Recreational Open Space and Sporting Fields

In addition to the requirements above, fully automatic pop-up sprinklers for all active open space training and or sporting turf areas shall include quick coupling valve systems as appropriate. Eg. Turf cricket wicket, large trees or shrubs in carparks that may require additional or supplementary watering to the automatic irrigation system.

vi. Car parks and Median Strips

Systems in carparks and immediately surrounding carparks shall be automatically controlled low volume systems with full pressure regulation and which shall also include Quick coupling valves which are to be provided at 25-50 metre spacing to facilitate establishment of plant material. Where there is a risk of damage by cars to quick coupling valves, protection should be provided.

Quick coupling valves should not be installed in car overhang areas and the irrigation system must be capable of being used at all times, even when the car park is full.

5. System capacity

Prior to the design of the system the designer should ascertain, the maximum and minimum pressure likely to be encountered and maximum permitted draw-off from and the size of the permissible point of off-take from the supply point.

If insufficient supply is found to exist this should be brought to the attention of the University's Grounds Unit Manager before progressing with any detailed design and or installation. All potable water supply systems shall be fully pressure and flow tested after the point of connection with backflow fitted before further works are undertaken.

The University does not guarantee that the flow, pressure or water quality will remain constant or consistent from day to day. It is therefore essential that the system be designed with an expectation that pressure and flow will may and shall not exceed greater than 75% of current flow or pressure capacity when tested on any given potable supply.

All irrigation feeder mains should be designed so that the velocity does not exceed 1.2m/sec for pipes equal to or larger than NB100, and 1.5m/sec for pipes less than NB100. All branch lines or laterals to which sprinklers or emitters are to be connected should be designed so that the maximum head loss over the length of the pipe or lateral from first to last sprinkler does not generally exceed 5% up to a maximum of 10%. Designs are to take into account ALL the system losses to the last sprinkler on the farthest and or highest point of the system.

Friction loss shall be no greater than 35kpa through any valve. The maximum velocity in lateral pipes should never exceed 2.5 metres per sec.

6. Operating times, Peak Application and Precipitation Rates

The following draw-off rates and operating times are based on the University's current requirements

i. Automatic systems for irrigation

The design requirements for automatic systems are:

- Systems are to be able to apply a peak summer demand of a nominal average of 25mm/week to the area being irrigated.
- The system shall be able to apply the above demand in 4 watering events or less, or over 4 evenings. That is, shall be able to apply a minimum of 6.25mm per irrigation event or evening watering period.

- The system shall generally apply the irrigation within the hours of 10pm and finish each irrigation cycle before 6.00am the following morning.
- Application rates of a given set of sprinklers are generally not to exceed 12mm/hr. (small area pop up sprays exempt). The system shall be programmed for "cycle and soak" where application rates exceed soil infiltration rates.
- Generally systems for large areas will require a minimum of 2.8lt/sec/ha at the required system pressure to meet the above criteria. Where pressure or flow from the water source cannot exceed or meet this target storage tanks and pumps will need to be considered in the system design and designed to meet the requirements of the whole system.

7. Other Materials

i. Pipes and fittings

Mainlines: (All pipes upstream of solenoid valves)

Generally pipes on irrigation system mainlines are to be Black MDPE PE100 poly with lilac stripe when from a known non potable (second class) water source or plain black when from a potable source (1st Class). BLUE or Black with Blue stripes is NOT ACCEPTABLE, to avoid conflict with potable supplies that could be run on the site in this material.

ALL irrigation mainlines are to include in the final 200mm of cover an irrigation ID tape warning of "Irrigation Main Below. The ID tape shall include a trace wire.

Pipes shall be Minimum PN12.5 or SDR13.6 or when from a pump source where the pump curve at shut off head is higher than 120mhd pipes may need to be of a higher class.

Mainline pipes are to be sized so as not to exceed velocities as previously stated.

MDPE shall have electrofusion or butt weld jointing of minimum PN12.5 for all fittings 90mm and over. 75mm and less maybe either electrofusion or mechanical joint.

uPVC or MPVC may be used for long straight lines and or water transfer but which shall not generally be mixed with MDPE without first seeking written approval of the University for specific reasons or cost savings. Where PVC pipe is approved and used RRJ pipe and (DICL) fittings are to be used. SWJ fitting are NOT to be used on any pipes above 50mm. Solvent weld fittings maybe used with permission of lines on 50mm or less.

If effluent water is being used, the pipe used shall be marked with continuous purple coloured stripes and then also have a continuous purple id tape attached in addition to denote effluent use.

The designer/contractor shall consider the need for concrete anchor/thrust blocks regardless of pipe being used and these shall be installed as required.

Mainline fittings to isolation valves shall be flanged where valves are 80mm sluice valves and above and insulated stainless steel backing rings, bolts, nuts and grease is to be used. Screwed mechanical fittings maybe used to ball valves 80mm and below.

Lateral Pipes: - (Pipes downstream of solenoid valves)

Low volume systems may used a low class MDPE. SWJ uPVC or where suitable LDPE for water delivery to the emitter or outlets. Fittings are to be the best of their kind and new and shall be installed in accordance with manufacturers' recommendations. Fittings and pipe should be supplied

by the same supplier and shall be fully compatible. Where barbed fittings are used a retaining clip is also to be used.

On high volume systems, the University has a preference for lateral pipes to be MDPE. They are to be either MDPE minimum PN10 or PN12.5 to be used as appropriate or available. uPVC may also be used however it shall generally only be used on smaller and "tighter" systems where many fittings are required in short distances. uPVC pipe shall be minimum Class 12 for 25 and 20mm and minimum class 9 for 32mm and above. Final design plans are to show the materials and sizes of all finished work.

Mechanical or solvent weld joints are to be used as appropriate. Fittings and pipe work are to be fully compatible.

Saddles maybe used on mainlines, but only for QCV or solenoid valve off takes or, lateral pipes for sprinkler off takes and minor branch lines. All saddles when used shall utilize either electrofusion or shall incorporate stainless steel nuts and bolts. Mild steel, Gal Steel, Zinc or zinc plated nuts and bolts are NOT TO BE USED.

All and any threads to be used on valves and fittings to sprinklers etc shall be BSP. All other connections to be flanged or shall incorporate a mechanical joint PE fitting, electrofusion, butt welding, RRJ spigot and socket or SWJ as necessary. No NPT or other thread or thread adaptors are to be used within the system.

ii. Location and Depth of Pipes

Mainline pipes are not to travel under or through the middle of sporting surfaces or oval but are to deviate around ovals and the like with an offset of a minimum of 3 meters to enable all solenoid valve to be located off sporting surfaces also.

All mainline pipes 100mm uPVC or 125MDPE and larger shall be surrounded by a minimum of 75 mm thickness of coarse washed fill sand. All Mainline pipes shall be laid with 450 mm minimum final cover and a maximum final cover of 900 mm.

An ID tape with trace wire shall be placed at a depth of 200 mm over all mains. One end of the trace wire shall terminate in the pulse flow meter pit.

In low volume systems, the end of buried polyethylene pipe shall be marked and fitted with a valve to enable flushing. Polyethylene pipe under mulch should be pegged down with 3 mm wire stakes at least 400 mm long and bent into a V shape and placed at each 2m intervals AND at each fitting where there is a change of direction.

Changes in direction and joints in any pipes, shall not be made under paved surfaces unless absolutely necessary. Preference in all cases is to join, elbow or tee before or after such areas and not under where a failure of a fitting can turn into a very costly and messy repair.

All systems including low volume systems are to be flushed out once pipe is laid and before sprinklers or emitters are attached and ends sealed.

Sleeves shall be installed wherever irrigation pipes and a separate sleeve for where control wires cross under footpaths, roadways, car parks or any other paved area.

Sleeves shall be a minimum of 50 mm for wires and 2 x the diameter of the irrigation pipe up to 100mm and then a minimum of 150mm larger for pipes over 110mm, than the outside diameter of the pipe they intend to carry. All sleeves should be heavy duty storm water or poly conduit.

iii. Valve boxes, Isolation Valves and Locations

All automatic solenoid valves, isolation service valves, flow meters etc shall be located in Commercial grade “lip or lay over” style lockable poly, or precast concrete and hinged, reinforced, lockable, checker plate or similar type of approved valve box.

The valve boxes on sporting fields and large open grass or garden areas shall be installed and located 2m off any formal playing surfaces.

They shall be neat and flush square with any nearby path or kerb and located flush with the ground surface. Where possible they shall be located in the edge of mulched or garden areas. In all cases they should be placed out of any potential traffic (pedestrian and/or any service vehicle) access or corridors and as inconspicuous as reasonable to avoid damage and any potential acts of vandalism.

Valve boxes should be supported so that any minor subsidence will not cause the valve box to rest on any pipes. All valve boxes are to incorporate a precast concrete or poly paving slab base, laid on a compacted level sand or gravel base and to be wrapped in builders plastic or geofabric to prevent the ingress of soil. The plastic to contain small slits to ensure excess water can drain away.

Isolation valves:

Isolation service valves on mainlines of 100mm or larger shall be water supply type flanged resilient seat sluice valves with a hex head and shall be supplied with one service key handle for each size valve. 80mm valves may also be either flanged resilient sluice valves or may be full bore stainless steel and bronze lever handle ball valves. All service valves 50mm and less shall be stainless steel, lever handle, full bore, ball valves. Cast or pressed steel valves with steel or zinc nuts and handles will be rejected.

8. Automatic Controllers, Wiring and Locations

i. Controller types and locations.

All systems to be handed over to the University for ongoing operation and management are to be fitted with local or “field” control hardware compatible with the University’s Central Irrigation Control System. The local hardware may vary from site to site and assistance from manufacturer is to be sought for each particular site requirements. Generally power supply, communications, antenna will be required with appropriate number of inputs and outputs as necessary for the system. The developer or contractor may install and operate their own control system up until hand over to the University but at which time a unit compatible with the Central Irrigation Control System will be required to be installed and linked to the system with local pulse water meter and rain sensor. The University shall be responsible for final data entry and communication with the central however the contractor/developer shall supply all necessary local controller components and install them ready for linking to the Central.

The location of local controllers should be unobtrusive yet easily accessible for maintenance and operation and provide communication via radio link or GPRS (Data Sim) to the central. Where possible the operator should also be able to see as much of the watered area as possible from the local controller location. Sprinklers are not to spray the operator or the controller cabinet.

The local controller should wherever possible, be incorporated into the wall of a building or immediately adjacent. External access is essential. In open areas where no buildings exist, the controller should be located off the ground at chest height or approx 1.2m to the base of the unit on a sturdy steel post in a vandal proof powder coated steel ventilated cabinet. Alternative is to use a freestanding cabinet or pedestal. Under no circumstances shall the local controller be mounted below 900mm and is never to be located in the ground.

A mains voltage twin 240v power point shall be provided in all housings.

Where freestanding or on a post a 1000 mm wide concrete apron shall be placed at the front of the local irrigation controller housings and minimum 300mm to the rear and sides.

Where the local controller is mounted on a wall, the housing should be an electrical switch box with the following specifications:

- minimum internal dimensions of 600 mm high, 600 mm wide and 300 mm deep or larger as necessary for the particular site and field hardware requirements.
- powder coated and the colour should be Woodland grey unless otherwise specified
- Lockwood type 201 cylinder lock easily convertible to a master key system
- door hinged sideways
- double side and rear walls (20 mm brackets to back and side walls)

ii. Wiring

All wiring shall be in accordance with the relevant Australian Standard for extra low voltage wire.

Generally active cables shall be minimum 1.00mm² high density polyethylene coating, double insulated multicore control cable shall be used for runs not exceeding 300m and 1.5mm² for wire runs not exceeding 800m. It is of particular importance to check each brand of valve for electricity draw off at the solenoid and increase the wire size to match. A separate twin core 1.5mm² or 2.5mm² cable shall be used for common runs and shall be sized based on length of run, coil draw and number of coils to be operated at any given time.

All wire shall be run in continuous lengths from controller to valve and is to be conduited in a light duty conduit when laid with an irrigation pipe. All cable jointing shall be contained in waterproof joins such as geltite or DBY and or DBYR joiners. Soldering and heat shrink may also be suitable where carried out by approved and trained persons and where the joint is not subject to flooding at any time. All joins are to be water proofed. All joints shall be in a valve box.

Adequate wire (minimum 1000mm) shall be left at valves during installation to enable future replacement of valves without the need for excessive jointing of wires.

Wires shall be laid in light duty conduit below or beside the pipe system in a common trench along with the pipes.

Wires not in pipe trenches should be in suitably sized orange heavy duty electrical conduit.

9. Special requirements for second class water systems

i. Pumps

Pump design is specific per project. Generally pumps are to be either submersible bore hole type when in a bore, or laid horizontally in a shroud in a tank. Where pumps are to be surface mounted multistage pumps with VFD control on each and every pump is to be supplied for additional pump control and electrical efficiency.

Pump systems are to be either Lowara or Grundfos.

Bore pumps and end suction style pumps generally shall only be used for constant flow and pressure for such duties as water transfer.

Pump, pump manifolds etc and pump control are to be supplied as a “turn key” system from the one manufacturer or supplier. Specific base plates, rails and mounting maybe locally manufactured. Pumps systems shall allow for an additional 20% capacity of flow over the peak design of the system. Pump systems shall allow for all system losses in the design, including suction lift capability and static elevation, all pipe filter, meters, valves and sprinkler head requirements. Shop drawing of final pump selection is to be submitted to the University for approval however final pump selection duty, pressure and brand is entirely the responsibility of the contractor regardless of the University’s approval. In other words if a pump selection underperforms the University, even though they may have approved the shop drawing and pump type and brand, is not responsible for the final pump system performance. Where a pump system under-performs, the contractor shall be fully responsible for all costs associated with any required change or upgrade of the pumping system and not just the pump replacement which may extend to replacement of pipe work valves meters filters and upgrading of power supplies.

Pump controls should offer the following minimum protection:

- dry running
- heat overload
- locked rotor
- broken water seal
- multiple start.

The following devices will also be required

- overload current device with automatic and manual reset
- flow switch and or low pressure protection
- thermal overload device
- multiple start protection
- thermal transformer protection with automatic reset
- water level sensor and or low level protection
- lockout circuit with indicator lights and reset
- circuit breakers instead of fuses
- pump confirm running switch to send signal to irrigation controller
- phase failure switch
- pump cycle adjustable from 0 to 15 minutes
- lightning and surge protection for all electrical components.
- Touch screen remote operation panel ad SMS alarm
- Remote access app and data sim access and full operation with access to cancel and reset alarms etc

To achieve even wear on multiple pump systems, on start up the pump to start first should alternate (that is, start 1 pump A, start 2 pump B). In the event of one pump failing the controls should

automatically switch to the other pump and send an alarm to the Universities Irrigation Maintenance Contractor via SMS.

A manually operated switch is also required so that either pump may be switched on. This switch should override the automatic control.

Surface mounted pumps to be housed in a robust ventilated and vandal proof pump house. Allow to supply shop drawings for the University approval. Bore hole pumps to be installed as necessary for vandalism protection and efficiency motor cooling for example within a shroud as necessary.

Where the pumps and controls are to be housed in a pump house, a structured pump house large enough for service personnel to walk into and service all the equipment within it is required. The housing will need to be well lit, vandal proof and have well drained floors. All the pump controls and the irrigation controller should be housed in a weather proof box in the pump house with easy access for operation and maintenance.

ii. Filters

High quality automatic electric auto back wash filter/s disc or screen (Arkal SpinKlin, Filtomat or Filta-worx or other approved equivalent) is required to be installed downstream of the pump in a suitable housing or pit. The automatic filter shall have the following features:

- 120 or 80 mesh filter depending on whether high or low volumes system is empolyed
- flushing according to time and also pressure differential
- flushings counter
- information on filter condition (filtering, flushing, malfunction)
- pumps must shut down immediately if a malfunction occurs and send a signal to the irrigation controller
- suction scanner (driven by an electric motor) to remove any debris from the filter.

Manual isolation service valves before and after the filter with pressure gauges also before and after the filter.

All flushing water is to be returned to the source water preferably downstream from the original source. Filters/strainers are also required on the intake to all pump suctions and in any wet well arrangement. All filters should be sized 20% larger than the expected maximum flow rate.

iii. Sustaining valves and solenoid valves from Second Class water.

A pressure sustaining valve is required downstream of the filters unless it can be justified this shall not be required at any time. Automatic solenoid valves should be of a type specifically designed for dirty water. That is dirty water pre-screens and or “scrubber” valves are to be used.

iv. Water meter

A water meter must be installed with easy access, on the outlet side of the pump system. These requirements include:

- Ultra-Sonic meters for all meters 40mm and above
- certification from the manufacturer or their agent that the meter is within +/- 5 per cent accuracy
- installation according to manufacturer’s instructions

- in addition, installation to include a length of straight, unobstructed (no valves or filters) pipe on the inlet side of the meter which is at least 10 times the pipe diameter and a length of straight unobstructed pipe on the outlet side of the meter which is at least five times the pipe diameter.
- meter able to record to a level that far exceeds expected use in any one year with no reset facility for the total
- meter's unit of measurement sensitive enough to identify 2 per cent of the expected annual water use
- meter cannot be made to record in reverse.
- Meter to have a pulse output and compatible with and connected to the central irrigation control system operated by the University.
- Generally Ultra-Sonic meters with liquid crystal display and instant actual digital flow reader fitted and 15year display battery life.

10. Documentation

i. Shop drawings

When a project is being designed and tendered directly for and to the University as a "Design and Construct" project a scale schematic drawing of the proposed system along with a description of the system and a fully costed price is to be submitted. The plan is to show the brand spacing and location of all sprinklers, valves and proposed pipe routes. It shall include water source point of connection with any pumps meters and special valves filters etc. The proposed controller location and equipment is also to be shown on the plan. Plans that are designed by Industry certified designers and supported with sprinkler performance modelling will be viewed favourably by the University when reviewing tenders and company presentations.

All drawings to be on a series of A1 sized pages and still legible if reduced to A3. Colour is preferred.

The design plan for high volume irrigation systems should also show the following:

- system layout at an appropriate scale to fill a single sheet with a bar scale included
- point of connection and pulse meter meter pit
- sprinklers used in design, nozzle size and spacing
- controller type and number of stations
- size, type and location of valves
- pressure proposed at each solenoid valve
- operating pressure, discharge rates of sprinklers and maximum draw-off intended
- number of hours of watering per week needed to apply the required precipitation (no programming schedule is required)
- location of conduits.

The design plan for low volume irrigation should also show the following:

- location of any in ground boxes
- location and type of controller
- filter type and mesh size
- type of pressure regulator and pressure proposed
- number, type and total station flow rate (litres per hour) of emitters
- location of all polythene pipe ends and how they are marked
- emitter spacing
- location of conduits.

Documentation for second class water systems and or, where potable water supplies are in adequate and thus storage tanks and pumps are required, may also need to include pump details including type, manufacturer, warranty, dimensions and output. Drawings should include pumps, controls, filters and valves. A list of spare parts and any special tools required for regular service and maintenance of the pumping system is also required. Thus allowance should be made to include:

- make and size of pumps
- make and size of filters
- make, type and other relevant information on controls
- diagrams of electrical circuits
- filters and pipe layout including valves
- instruction on how to switch from second class to potable water.

ii. Work as executed documents

The developer /contractor will be required to ensure that “Work as Executed” documents are available at handover to the University and they are to show all the details as stated above in section 10 i, including type and class of pipe and all final pipe routes and locations. All pipe routes and valve locations are to be surveyed using as a minimum sub-meter accurate GPS. Buried valve locations are to show triangular measurements. Work as Executed drawings are to also include brand names, type, model and performance specifications for the equipment installed on the project. A draft document plan is to be submitted for comment and/or approval.

To assist with maintenance allow to supply a schedule of required maintenance timetable and brief description of maintenance required.

Final approved A1 plans and documentation shall be copied three times and supplied to the University in 3 separate hard cover A4 binders with the project name and or area on the front. A brief statement of system description including the contractor responsible for the work. A copy of plans in .dwg and .pdf format to be supplied on disc and 2 reduced A3 size laminated sets of plans are also to be included and handed over to the University before final payment or acceptance of the works will be made or undertaken by the University.