Hydraulic Services Design Standard

MACQUARIE University

DOCUMENT HISTORY

Revision No.	Date	No. of Pages	Comment
V1.0	Aug 2015	27	For Review
V1.1	**Dec 2015**	**27**	**For Circulation**

CIRCULATION APPROVAL

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1. PURPOSE

This Hydraulic services standard sets out Macquarie University's minimum requirements for the design, construction and maintenance of Hydraulic systems. The objective of this standard is to provide guidance and minimum standards of compliance to ensure that systems are designed, constructed, commissioned, and maintained to achieve energy and water efficiency, fitness for purpose, quality and durability, design performance in operation, maintainability and safety for access and operation, low environmental impact, and low life cycle cost.

Applicable requirements documented in Work Health and Safety legislation, Disability Discrimination legislation, State Environmental Planning legislation, Commonwealth and State legislation, Natural Construction Codes (NCC), Macquarie University Design Guides and Australian Standards (AS) are the minimum and mandatory compliance requirements. British Standards shall be used where no Australian Standard exists.

Reference is also made to CIBSE commissioning codes, ASHRAE and their associated standards and references.

Where any ambiguity exists between this standard and the aforementioned mandatory requirements then:

a. The highest performance requirements must apply
b. Applicable requirements must follow this order of precedence
    i. Work Health and Safety legislation
    ii. Disability Discrimination legislation
    iii. State Environmental Planning and Assessment legislation
    iv. All other Commonwealth and State legislation
    v. This Standard and Macquarie University Design Guides
    vi. NCC and BCA
    vii. AS/NZS

2. SCOPE

These Standards describe the minimum, requirements for the design, construction and maintenance of all hydraulic services throughout all buildings owned, operated and managed by Macquarie University Property.

The Standard applies to planners, project managers, consultants, contractors, sub-contractors, tenants, managing agents and University staff involved in the design, construction, commissioning and maintenance of existing, new and proposed University buildings and facilities.

The Hydraulic Services Standard provides:

- A reference document to enable consistency with the design and engineering objectives;
- Guidance on design considerations;
- Details of the minimum performance requirements;
- Details of the minimum quality requirements;
- Guidance in regards to provisions for maintenance and access;
- Commissioning requirements for acceptance by the University.

3. GLOSSARY OF TERMS

Unless the context otherwise requires, the following definitions apply:

AS	Australian Standard
BCA	Building Code of Australia
BMCS	Building Management Control System
Consultant	The design consultant/engineer
D&C	Design and Construct
FIP	Fire Indicator Panel
HDG	Hot Dip Galvanised
HLI	High Level Interface
LCD/LED	Liquid Crystal Display/Light Emitting Diode
MSDS	Material safety data sheets
MUP	Macquarie University Property
NATA	National Association of Testing Authorities
NCC	National Construction Code
ODP	Ozone Depletion Potential
O&M	Operations and Maintenance
PC	Practical Completion
RPZD	Reduced Pressure Zone Device
VOC	Volatile organic compound
VSD	Variable Speed Drive
WHS	Work Health and Safety

4. AUTHORITIES & RESPONSIBILITIES

This standard is owned by MUP. MUP is responsible for maintaining the standard and keeping it up to date. Always check to see if there has been an update to this standard before committing to its use for any particular project. It is the responsibility of the user to ensure they are using the latest version.

5. TECHNICAL REQUIREMENTS

5.1. INTRODUCTION

The aim of this manual is to assist consultants, Project managers, D&C Contractors and Builders. Generally, the relevant Australian standards are to be complied with unless the University requires that a higher standard be met. Variations from the standard are to be approved by MUP. For the avoidance of doubt the Hydraulic system of a University building may include structural/building elements, or any other trade works other than the hydraulic trade which are contingent on the functioning of the hydraulic system. (Eg. Building Trade – Gutters, plant enclosures, etc). In some cases components of the Hydraulic system will be installed or are to be installed in other buildings. In these cases the word building in this document is to be interpreted as inclusive of these structures, annexes and components.

It should also be noted that the University is a long term owner of the property and so appropriate considerations are to be made in terms of quality of installation, efficiency in operation, ease of maintenance and safety, long term reliability, and flexibility for change of use (where feasible).

The Technical Services Manager shall be consulted if any confusion arises before applying this Standard Guide. Approved variations must always be in writing or they will not be accepted.

5.2. STANDARDS

The design of hydraulic systems shall be in accordance with all relevant authority requirements and standards including but not limited to;

NCCA	The National Construction Code incorporating the Building Code of Australia and The Plumbing Code of Australia
AS 2243	Safety in Laboratories
CIBSE	Commissioning Codes A, B, C, M, R, and W.
AS/ NZS 3500	National Plumbing and Drainage Code – All Parts
AS 5601	Gas Installations

5.3. DESIGN AND DOCUMENTATION

5.3.1. DESIGN APPROACH

The University expects consultants and designers to provide designs that meet the project brief. The following are priorities that consultants and designers must be aware of and consider in their design:

a. A consultant's return brief shall be provided for approval that confirms all aspects of the project brief, design allowances, building fabric, usage and operating conditions, environmental criteria, design approach and options to be considered as part of the concept design process;
b. Provide environmental conditions that meet the project brief;
c. Take a long term balanced view of capital costs, energy costs, maintenance costs and longevity of equipment;
d. As educational and research progresses at rapid rates, usage of buildings and areas within a building can change a number of times within its life. Where possible, systems must be designed to be adaptable for fit out alterations, change of use, extension & expansion;
e. Accessibility, ease of operation, and ease of maintenance;
f. Control systems shall be designed with simplicity and reliability in mind. Often controls are made overly complicated which can lead to issues in commissioning, multiple points of failure and an overly onerous maintenance burden;
g. Allowance for adequate space for installation and maintenance of plant, whether it be in designated plant rooms, ceiling spaces or otherwise. Lack of space is not considered an acceptable excuse for

poor access provisions. Where insufficient space has been provided due to factors beyond the consultant's control, it shall be notified in writing to MUP for instructions to be made;

h. Provision of FIXED access platforms, walkways, stairs and ladders in accordance with AS.1657 to allow service/maintenance access to all items of equipment in ceiling spaces, roof spaces and on roofs;
i. Roof access ways exposed to the elements shall be aluminium alloy 6063 -T6 Temper, engineered to support the heaviest piece of installed equipment including service loads, and attached to roof decking with approved weatherproof fixings isolating the access way from the roof material;
j. Walkways are to be provided in roof spaces, protected from the weather and shall be integrated with ductwork, pipework and conduit layouts at the design stage so that all serviceable items of equipment can be accessed from the fixed walkway;

5.3.2. DESIGN INPUTS AND PROCESS

The University expects consultants and designers to proactively inform, advise and contribute to the design process. In particular the following aspects:

a. Planning and architecture – Provide advice on the appropriate location of plant rooms and reticulation strategy to assist in both the planning of the building and the facilitation of better maintenance in the future. Such advice must be provided in the early stage of the design and planning process so that this can be taken into consideration by the architect.

5.3.3. ENGINEERING FUNCTIONS REQUIRED FROM DESIGN CONSULTANTS

The university expects consultants and designers to be fully qualified, experienced and capable of carrying out all engineering design, calculations, equipment selection, construction quality checks, overview and verification of commissioning.

5.3.4. EQUIPMENT SELECTION AND SIZING

In selecting equipment, the consultant shall select products of proven and reliable quality, with reputable support and after sales service. A design basis shall be nominated in the design documentation, with any alternatives to be of an equivalent standard and requiring the approval of MUP and the consultant prior to tender acceptance.

The following general points apply to equipment sizing:

a. Hot water plants must be sized and configured to handle peak load in an energy efficient manner across the entire load profile. This requires consideration of available waste or renewable heat sources, energy source, appropriate heating units, storage unit type and capacity.;
b. Pumps must be selected in their stable range and high efficiency points of the pump curves. For variable flow applications, ensure that the entire flow range is stable;
c. Products which are closed systems and proprietary in nature, thus locking the University into exclusive dependence of one manufacturer must be avoided and only used if there are no other options.

5.3.5. MINIMUM ENERGY EFFICIENCY AND HEAT RECOVERY REQUIREMENTS

a. In terms of efficiency, plant shall be selected to achieve at least the greater of the NCC/BCA Part J requirements and the criteria nominated below. Where the efficiencies nominated below cannot be achieved, it should be highlighted to MUP for approval along with the reasons why it cannot be achieved.

Item	*Efficiency*
Pumps	60%
Gas Fired Hot Water Heaters	85%

5.3.6. EXISTING SITE CONDITIONS

It is the consultant's obligation to obtain all relevant existing site services information at the commencement of design.

An audit of the University's piped water, stormwater, sanitary drainage and gas services including pipe sizes, capacities and pressures is available from the Office of Facilities Management.

Information regarding the detention capacities of Mars Creek and College Creek is also available.

Sydney Water Sewer Mains

The Mars Creek and South Creek and Waterloo Road (Housing) sewer mains are Sydney Water owned and maintained assets, all other inground sanitary drainage pipework was laid and is maintained by the University.

Stormwater

All Stormwater main services in existence within the campus were laid and are maintained by the University.

Water Supply

From City Supply within the University site and metered at Balaclava Road and Culloden Road entrances.

Maximum and minimum water pressures at water main connections are 705 kPa and 430 kPa respectively at an AHD ground level of 75m.

The maximum static water pressure in each building shall not exceed 500kPa for any non fire fighting service.

Pressure reduction valves are to be used to control maximum water pressures.

Fire fighting flows available shall be confirmed by the Sydney Water Corporation and calculated from the University's connection to the 300mm diameter water main in Balaclava Road.

Each new building is to have its own University meter.

Gas Supply

Medium pressure Natural Gas is reticulated at 100 kPa throughout the University from a Master Meter and Regulator set located near the intersection of Herring and Waterloo Roads.

Site mains capacity is to be assessed from outlet of Master Meter giving consideration to existing mains sizes and connected loads.

Each new building is to have its own private sub-meter.

5.3.7. FUTURE ALLOWANCE

The provision of spare capacity for future additions must be considered for all projects and confirmed at the design briefing stage. In making such allowances careful analysis of the options of increased plant size versus provisions for expansion, efficiency and performance at part load conditions, infrastructure sizing, reticulation system sizing, etc must all be considered.

5.3.8. OTHER DESIGN REQUIREMENTS

a. Redundancy to an agreed standard (e.g. N+1, etc.) must be incorporated into the design for critical environments such as animal houses, special laboratories, clean rooms, constant temperature environments, museums or the like.
b. Designers and installers shall demonstrate that provisions for safe and adequate access for maintenance and commissioning of plant and equipment has been made to an appropriate level of detail in accordance with the stage of the design. This shall include compliance with the current statutory requirements and any specific requirements of the project. Access to plant in need of regular maintenance should be readily available without the need for specialised plant such as scissor lifts, cherry pickers or the like.

c. The design of hydraulic services systems shall include provisions to ensure the system can be fully commissioned. The standard of compliance shall be in accordance with the CIBSE commissioning codes and respective reference documents.

5.4. HYDRAULIC SYSTEMS AND TECHNICAL COMPONENTS

The following sections contain technical requirements on equipment, materials and installations. Consultants and designers are required to adhere to these. In the preparation of consultants' specifications, they are required to ensure that those project specifications do not contain any conflicting requirements or information with this document, unless approved by MUP.LABELS AND MARKING

5.5. SANITARY PLUMBING AND DRAINAGE SYSTEMS

5.5.1. GENERAL

Inground

All in ground sanitary drainage shall be of minimum nominal diameter size of 100mm.

Marker tape shall be applied 300mm above all inground pipework. Traceable marking tape shall also be applied to all inground non metallic pipework.

Inground sanitary drainage shall be bedded and supported with 10 mm aggregate.

Inspection openings are to be provided;

a. At the connection to the University or Authorities main sewer
b. On all WC branch lines
c. At intervals of not more than 30 metres on main lines.
d. Inspection openings shall also be located at the base of all stack risers, and shall be incorporated with an expansion joint (expansion gate fitting preferred).
e. As close as practical outside the building on each branch line
f. At junctions and all changes of direction
g. Encase top of riser shafts in 100mm thick x 100mm deep concrete surround and finish shaft with screw down gas tight brass cover engraved with "S"

Consult with the geotechnical engineer to determine whether additional inground support or provision for movement and expansion is required for inground drainage.

Ensure that the hydraulic specification states a requirement for protection to pipework below slabs on grade during concrete pours. A video of all drainage pipework under floor slabs is to be provided following completion of slab pours.

Above Ground

All pipework must be concealed where possible in accessible ducts and ceiling spaces. Where piping is concealed adequate access for maintenance and inspection is to be provided. Provide clearouts at every branch connection, immediately before entry to stack and at the upstream end. Locate clearouts in ablutions floors with screwed chromed brass caps set at finished floor level.

Inspection openings share to be located at the base of all stack risers, and shall be incorporated with an expansion gate fitting.

Acoustic insulation shall be installed on pipe work traversing through office areas, classrooms, lecture theatres and living areas in accommodation buildings.

5.5.2. VENTS

Air Admittance Vents (AAV's) are acceptable however must be installed in a readily accessible position for inspection and maintenance

5.5.3. FIXTURE TRAPS

New fixtures are to feature chrome plated solid brass bottle traps where exposed. Concealed fixture traps are to be UPVC. Provide screwed connections to trap connection to waste pipes to facilitate disconnection.

5.5.4. FLOOR WASTES

Floor wastes are to be chrome plated brass screw in type with 100mm diameter and feature puddle flange and epoxy grouted into penetration.

Penetrations for floor wastes in suspended concrete slabs are to be cored after the slab is cast at the lowest point of the area to be drained.

5.5.5. LABORATORIES

Open Floor Wastes are not permitted in laboratories.

All laboratories are to be plumbed with HDPE drainage pipework regardless of proposed use, to allow for future flexibility.

5.5.6. WASTEWATER DRAINAGE PIPE SCHEDULE

System	*Location*	*Nominal Size DN (mm)*	*Acceptable Pipe Materials*	*Class*	*Jointing*
Sanitary drainage	Inground	100 – 225	PVC "Best Practice Certified"	SN8	Solvent welded or Rubber Ring Joint
Sanitary drainage	Above Ground (internal)	100 – 150	PVC "Best Practice Certified"	DWV	Solvent welded
Sanitary vent	Inground and above ground	50 - 150	PVC "Best Practice Certified"	SN8	Solvent welded
Trade waste drainage	Inground	100 – 225	HDPE	SDR26	Electrofusion / Rubber Ring Joint
Trade waste drainage	Above Ground (internal)	100 – 150	HDPE	SDR26	Electrofusion
Trade waste vent	Inground and above ground	50 - 100	HDPE	SDR26	Electrofusion

5.5.7. TUNDISH SCHEDULE

Location / Application	*Acceptable Selections*	*Considerations*
Exposed / minor Discharge	Equal to Opie Manufacturing WMT Series FMT Seies	Selection to suit flow discharge and application
Recessed in wall cavity / minor discharge	Equal to Opie Manufacturing TURE Series	Selection to suit flow discharge and application Consider acoustic implication of tundish location.
Plantroom	Copper	To suit flow discharge
A/C Condensate	Waterless Hepvo	Acceptable only for airconditioning condensate where conventional tundish is impractical. Ensure waterless trap is accessible

5.5.8. PIPE PENETRATION SCHEDULE

Penetration	*Treatment*	*Specification*
Vertical penetration through slab	Cast in fire collar	Fire collar to match FRL of slab being penetrated, and have necessary approvals in accordance with the Building Code of Australia, AS1530.4 and AS4072.1
Horizontal penetration through fire compartment	Retro fit fire collar each side of fire wall	Fire collar to match FRL of wall being penetrated, and have necessary approvals in accordance with the Building Code of Australia, AS1530.4 and AS4072.1
Penetration through external wall below ground	Waterproof penetration	Coordinate waterproofing details with architect to MQU approval

5.5.9. ACOUSTIC TREATMENT SCHEDULE

Type or location	*Material*	*Sheathing material*
Horizontal and vertical sanitary and trade waste drainage pipe work traversing through office areas, classrooms, lecture theatres and living areas in accommodation buildings	Equal to Thermotec Acoustic "Nu-Wrap 5" 5kg/m² loaded polymer barrier over 25mm nominal thickness convoluted polyurethane foam	The outer skin of the loaded polymer will be faced with a heavy duty reinforced aluminium foil, tested to achieve a fire performance of "four zeros" to AS1530.part 3

5.5.10. INSPECTION CHAMBER AND COVER SCHEDULE

Location	*Chamber*	*Cover*
In road ways, loading docks, footpaths etc. subject to vehicle traffic	Precast modular circular concrete chamber Equal to Rocla 'Sewer Access System'	Class D bolt down
In external paved landscaped areas	Precast modular circular concrete chamber Equal to Rocla 'Sewer Access System'	Class B bolt down Recessed cover to match surrounding floor finish where applicable

Note: All access chambers to be epoxy lined to 1m above pipe invert levels. Provide full length galvanised steel ladders and intermediate landings for the access chambers as required

5.5.11. TRADE WASTE PRE TREATMENT DEVICES

Trade waste source	*Pre Treatment Device*	*Capacity*	*Comments*
Laboratory Drainage	Dilution Pit	5 litres per fixture discharging to dilution pit	Sydney Water Approved. Inground polythene pit with Class D Lid
Laboratory Drainage	PH Correction	As required with consideration to laboratory use.	To suit application
Plaster rooms	Plaster Trap	50 Litre	Sydney Water Approved. Under sink type, stainless steel construction.
Food Preparation	Grease Arrestor	As per Sydney Water guidelines	Sydney Water Approved Polythene or concrete construction inground Stainless steel or polythene construction above ground Provide hot and cold wash down taps adjacent grease arrestor

5.6. STORMWATER DRAINAGE AND COLLECTION

5.6.1. GENERAL

Design Considerations

Stromwater drainage systems are to be designed to the following criteria;

Box Gutters, overflows and associated downpipes;	ARI 100 , 5 minute intensity
Eaves gutters, podiums and associated downpipes;	ARI 20, 5 minute intensity
Inground stormwater reticulation;	ARI 20, 5 minute intensity

Overflow from roofs shall be directed away from pedestrian thoroughfares.

The hydraulic designer is to document flow rates and pipe capacities in design documentation.

Clean catchment rainwater is to be harvested for toilet flushing and landscape irrigation to new buildings.

Inground

All in ground stormwater drainage shall be of minimum nominal diameter size of 100mm.

All changes of direction 225mm and above are to be via a pit.

Marker tape shall be applied 300mm above all inground pipework. Traceable marking tape shall also be applied to all inground non metallic pipework.

Inground stormwater drainage shall be bedded and supported with 10 mm aggregate.

Inspection openings are to be provided;

Consult with the geotechnical engineer to determine whether additional inground support or provision for movement and expansion is required for inground drainage.

Stormwater discharge to existing campus infrastructure is to consider existing site Water Sensitive Urban Design strategies. Additional WSUD is to be incorporated as required to achieve water runoff quality targets.

Above Ground

All pipework must be concealed where possible in accessible ducts and ceiling spaces. Where piping is concealed adequate access for maintenance and inspection is to be provided.

Provide clearouts at the base of all downpipes, or terminate the downpipe above an open grated drain.

Acoustic insulation shall be installed on stormwater pipe work traversing through office areas, classrooms, lecture theatres and living areas in accommodation buildings.

5.6.2. ROOF GUTTERS

Box gutter linings are to be constructed of 0.55mm 304 grade stainless steel.

Eaves gutters are to be of half round powder coated aluminium or Colorbond coated zincalume steel of approved profile.

Roof gutters are to be designed and constructed to feature external overflows discharging outside the building in the event of a blockage in either the downpipe(s) or the gutter itself. Gutters and downpipes are to be constructed to ensure ease of cleaning and freedom from blockage by leaves, hail, etc. Box gutters are to be no less than 450mm (w) x 150mm (d) laid to 1% fall.

5.6.3. RAINWATER HARVESTING TANK

Rainwater harvesting tanks are to be designed to HB 230.

Tanks can be below or above ground. All tanks are to feature 2 (two) access hatches and maintenance access in compliance with AS 2865 and AS1657.

The rainwater tank shall be constructed with all inlets, outlets, interconnections, overflows and access lids including concrete anchoring of the base of the tank to manufacturer's recommendations.

The size of the tank shall be determined with consideration to catchment area, reuse demand and WSUD requirements in conjunction with MUP.

First Flush Device

All pre-treated roof water shall discharge into the rainwater harvesting tank via a below ground silt and sediment trap.

5.6.4. STORMWATER DRAINAGE PIPE SCHEDULE

System	*Location*	*Nominal Size DN (mm)*	*Pipe Material*	*Class*	*Jointing*
Stormwater	Above Ground (internal)	100 – 300	PVC "Best Practice Certified"	SN8	Solvent welded
Stormwater downpipes	Above ground exposed	*Refer to architectural finishes schedule*			
Stormwater	Inground	100 – 300	PVC "Best Practice Certified"	SN8	Solvent Welded / Rubber Ring Joint
Sub Soil	Inground	100	Slotted PVC "Best Practice Certified"	SN8	Solvent Welded / Rubber Ring Joint

5.6.5. STORMWATER SUMP SCHEDULE

Location	*Chamber*	*Cover (grated)*
Landscape / podium areas	Precast modular square concrete chamber	Equal to ACO Heel guard Anti-slip 'S' stainless steel 316 (mechanically stamped) grated cover Class B
Back of house areas	Precast modular square concrete chamber	Grated heavy duty Class D

5.6.6. INSPECTION CHAMBER AND COVER SCHEDULE

Location	*Chamber*	*Cover*
In road ways, loading docks, footpaths etc. subject to vehicle traffic	Precast modular circular concrete chamber Equal to Rocla 'CPO Stormwater Pits	Class D bolt down
In external paved landscaped areas	Precast modular circular concrete chamber Equal to Rocla 'Sewer Access System'	Class B bolt down

5.6.7. RAINWATER OUTLET AND TRENCH DRAIN SCHEDULE

Application	*Type*
Podium and balcony RWO's	Stainless steel grate and membrane, cast iron assembly, integral puddle flange with weep holes Equal to SPS
Grated trench drain	Stainless Steel 316 Aniti-slip 'S' (mechanically stamped). Outlet with sediment basket at 4m centres Equal to ACO Heelguard

5.7. WATER SUPPLY SYSTEMS

5.7.1. GENERAL

Design Considerations

Water supply systems are to be designed to the following criteria;

Minimum water supply pressure to any fixture is to be 200 kPa

Mains pressure supply is preferred over pumped supply. Where booster pumps are required variable speed multi stage pumps are to be specified.

Pumps are to be in minimum triplex arrangement with duty/duty/standby operation.

Maximum hot water dead leg is 6m.

Clearly state on design documentation whether pipe sizes specified are Internal Diameter (ID) or Outside Diameter (OD)

Inground

Marker tape shall be applied 300mm above all inground pipework. Traceable marking tape shall also be applied to all inground non metallic pipework.

Marker plates are to be provided at ground level for main inground water reticulation.

Consult with the geotechnical engineer to determine inground soil conditions.

Above Ground

All pipework must be concealed where possible in accessible ducts and ceiling spaces. Where piping is concealed adequate access for maintenance and inspection is to be provided.

5.7.2. HOSE COCKS

Specify external hose cocks at 60 metre intervals maximum, for landscape watering. Specify standpipes to be provided with 20 mm NB screw-nosed brass hose taps, mounted with screwed flanges on external walls or columns at 400 mm above finished ground or paving level. Each hose cock is to be installed with an isolating stop cock.

5.7.3. WATER HEATERS

Water heaters are to utilise waste heat where practical from mechanical or power generation plants.

Solar preheat is to be considered and included where practical.

5.7.4. WATER METERS

Water meters shall be provided to measure water usage at each building. Water meters shall include a pulse lead type attachment to allow for connection to the campus Building Management Systems. Meters shall be located in visible and accessible locations to allow for manual meter reading and building water isolation. Sub meters are to be installed for all major building plant, including, but not limited to:

a. Cooling towers
b. Domestic and heating hot water plants
c. Laboratory potable and non-potable water
d. Potable water supplies used for irrigation

Water meters shall generally be of the following type and standard:

Location	*Size*	*Type*	*Monitoring requirement*
External Building Supply	Equivalent to the nominal size of connecting pipe 50mm – 150mm	Equal to Elster	Pulse output to BMS
Internal	Meter size to be equivalent to the nominal size of connecting pipe 15mm – 40mm	Positive displacement type Equal to Elster	Pulse output to BMS

5.7.5. PIPING SYSTEM SCHEDULE

Type	*Nominal size (DN)*	*Acceptable Materials*	*Jointing method*
Inground	65 mm – 150 mm	PVC-M PN16 Equal to Iplex Blue Rhino PE100 SDR11 (PN16) Pressure Pipe	Rubber ring joint Electro fusion Coupling
Potable Cold Water Above Ground	25mm – 150mm	Copper type B	Silver brazed
Potable Cold Water Rough-in	15mm – 20mm	Cross-linked high-density polyethylene (PE-Xa) PN16 equal to Rehau	Dezincification resistant brass (DZR) compression sleeve fittings
Rainwater reticulation Above Ground	25mm – 150mm	Green coloured Copper type B	Silver brazed
Rainwater Reuse water rough-in	15mm – 20mm	Green coloured Cross-linked high-density polyethylene (PE-Xa) PN16 equal to Rehau	Dezincification resistant brass (DZR) compression sleeve fittings
Non potable water Above Ground	25mm – 100mm	Lilac coloured Copper type B	Silver brazed

Non potable water Rough In	15mm – 20mm	Lilac coloured cross-linked high-density polyethylene (PE-Xa) PN16 equal to Rehau	Dezincification resistant brass (DZR) compression sleeve fittings
Hot water Above Ground	25mm – 100mm	Copper type B with thermal lagging	Silver brazed
Hot and Warm water Rough In	15mm – 20mm	Lagged Cross-linked high-density polyethylene (PE-Xa) PN16 equal to Rehau	Dezincification resistant brass (DZR) compression sleeve fittings

5.7.6. PIPING INSULATION AND SHEATHING SCHEDULE

Type or location	*Material*	*Sheathing material*
Piped Services and control wiring positioned externally subject to bird and/or rodent attack.	As required by the type of service	Metal sheathing Piped services and control wiring positioned externally subject to bird and/or rodent attack.
Hot water flow and return pipe Branches from flow and return to room served by branch	Thermotec 4-Zero or equal 25mm closed cell polyethylene foam min density 50 kg/m	Factory applied aluminium foil sheathing
Rough in hot and warm water within wall cavity	nil	nil

5.7.7. VALVE SCHEDULE

All valves are to be watermark approved

Type	*Nominal size*	*Description*
Isolation valve - External	80mm – 150mm	Sluice valve EDPM encapsulated Ductile or cast Iron with stainless steel stem Valves in the ground must be provided with valve pits, adequately sized for easy removal and servicing of valves. Wherever possible, non-return and building isolation valves must be located within the building readily accessible from outside.
Isolation valve – Internal	15mm – 50mm	Brass or stainless steel ball valve. Chrome plated where exposed
Isolation Valve - Internal	65mm – 300mm	Gate valve or Resilient seated geared Butterfly valve
Reduced pressure zone device (RPZD)	15-50mm	Stainless steel or Brass Body
Reduced pressure zone device (RPZD)	65 – 150mm	Ductile iron body coated to AS4158
Inwall recessed Backflow prevention valve box	To suit installation and no of valves	Lockable stainless steel box with full stainless steel front panel

Hose Tap	20mm	Polished brass hose tap, securely fixed to wall or structure. Each hose tap fitted with an approved loose jumper stop valve (immediately upstream) and RMC Watts vacuum breaker model No BHCV50.
Thermostatic mixing valve (TMV)		Enware Aquablend Series
Hot water return thermostatic balancing valve		Equal to TA Therm HT '52-721-20' thermostatic circulation valve with thermometer
Hot water air valve	15mm	Provide at the upper-most point on each hot water flow and return riser. Bronze body, brass float with stainless steel disc

5.7.8. WATER METER SCHEDULE

Location	*Size*	*Type*	*Monitoring requirement*
External potable	Equivalent to the nominal size of connecting pipe	To suit application	Pulse output to BMS
Internal potable cold water	15mm – 40mm Meter size to be equivalent to the nominal size of connecting pipe	Positive displacement type equal to "Elster V 100 series"	Pulse output to BMS
Internal non potable cold water	Equivalent to the nominal size of connecting pipe	Lilac coloured Positive displacement type equal to "Elster V 100 series"	Pulse output to BMS

5.8. NATURAL GAS

5.8.1. GENERAL

All Natural gas services shall be designed and installed in accordance with AS 5601 and the local gas authority gas fitting rules.

Marker tape shall be applied 300mm above all inground pipework. Tracable marking tape shall also be applied to all inground non metallic pipework.

All internally positioned heaters and cookers must be flued to the outside of building.

Cook tops in Student Housing and kitchenettes are to be electric.

Clearly state on design documentation whether pipe sizes specified are Internal Diameter (ID) or Outside Diameter (OD)

5.8.2. GAS ISOLATION

Minimum compliance requirements of this design standard are specified in Attachment 1.

Project managers, consultants, contractors, commissioning agents and facilities maintenance personnel must ensure compliance with these requirements is achieved.

Consultants and designers must include check sheets for each system component detailing each item that needs to be checked, tested and verified during the installation process in project specifications. Such check sheets must be completed and verified by the project consultant/designer, including the identification of any defects and the closing out of such defects.

Formal sign-off from the issuer of the standard or their delegated authority is required for acceptance of any non-compliances and departures from this standard's requirements.

External

Provide appropriately signed external shut off valve for each building. Isolation points are not to interfere with services isolation of adjacent buildings

Internal

Valves shall be located in a prominent position as close as practicable to the room entrance with appropriate labelling and access.

5.8.3. GAS SUPPLY METERING

Each new building is to feature a sub-meter assembly complete with data logger and connection to the site wide BMS System.

Additionally gas sub meter assemblies are to be provided to all major plant items, kitchens and laboratories.

5.8.4. LABORATORY SUPPLY

Provide isolation valves for all gas supplies to laboratories spaces. Isolation points are to be located at the entry to the laboratory and be clearly labelled.

Each laboratory gas outlet/turret must be installed with flashback arrestors.

5.8.5. GAS PIPELINE SCHEDULE

Location	*Acceptable Pipe Material*	*Requirements*
Inground	Polyethylene Copper Type A Nylon	Tracable marking tape shall be applied to non metallic pipework. Marker tape shall be applied 300mm above all inground pipework
Above ground & Inside Building	Copper – Type A or B	Copper – Alloy Brazing Capillary fitting to AS5601

5.8.6. GAS VALVE AND FITTING SCHEDULE

All gas valves to be AGA approved

Type	*Description*	*Comments*
Isolation valve – External	One piece, anti static, flanged, stainless steel, ball valve rated to 100 kPa. Equal to Pentair	N/A
Isolation valve – Internal	One piece, nickel plated brass, ¼ turn ball valve, (lockable). Equal to Pentair	N/A
Lab gas outlets	Equal to Enware LC series gas turrets.	N/A
Safety Shutoff Valve	Equal to System Control Engineering System 3.	Provide appropriate signage and reset procedure instructions at valve.

5.8.7. GAS METER AND REGULATOR SCHEDULE

Meter is to be located upstream of the regulator where practical.

Provide pressure test points either side of regulators.

Regulator vents shall terminate external to buildings and be fitted with insect gauze.

Location	*Pressure Reduction*	*Type*	*Comments*
Main Pressure reduction station	100 (TBC) kPa – 5 kPa	Parallel paired OPSO regulator and valve train with rotary gas meters equal to Elster Instromet	Pulse output to BMS. Locate regulator externally
Internal	5 kPa – 2.75 kPa	Single low pressure regulator & meter set	Pulse output to BMS

5.9. SANITARYWARE AND TAPWARE

Refer to ***Component Specifications – Sanitary Fixtures*** for specification of the following;

- Urinals
- Hand Basins
- WC Suites
- Cleaners Sinks
- Stainless Steel Sinks
- Accessible Fixtures and Fittings
- Flushing Mechanisms
- Boiling / Chilled Water Units

All Sanitary Fixtures are to be rated based on the Water Efficiency Labelling and Standards (WELS) Scheme and as prescribed in AS6400.

Minimum Star rating based on Table 3.1 of AS 6400

5.10. PAINTING

All exposed hydraulic services shall be painted in accordance with the Macquarie University approved paint colours as noted below:

Pipework – Gloss Enamel Solvent based

Type of Pipe	*Std Colour AS 2700*	*British Std BS381C*	*Dulux*
Gases- Town gas, Flue gas	Biscuit – X42 Sand - Y44 Straw – Y 24	Light Beige – No. 366	Cream G2
Sanitary and Trade Waste Drains and Vents	Black – N61	-	Black
Fire Services	Signal Red – R13	Red – No. 537	
Cold Water	Emerald Green		
Hot Water	Green		
Downpipes (internal)	Green		
Electric Power	Orange – X15	Orange – no. 557	
Dangerous Materials	Golden Yellow – Y14	Golden Yellow – No. 356 with black markings	

5.11. SERVICE ACCESS/ SAFETY REQUIREMENTS

5.11.1. GENERAL

The following are the University access & service requirements;

a) Position all equipment and arrange access provisions at equipment, to optimise future maintenance and repairs.

b) Equipment must not be located in ceiling spaces above labs, animal houses and critical environments. Plant will only be accepted in ceiling spaces within office buildings.

c) The University will not accept plant within tight spaces. Plant that is located in ceiling space must have free and easy access. This includes the ability to service the system without reaching around or over columns, beams, cable trays, pipework, light and ductwork.

d) All motors are to be provided with isolators within 1 meter distance from motor

e) A plus 20% additional dimension access allowance is to be provided above the manufacturers access requirement for equipment.

f) Plant located above 3m height will have permanent stair/ladder access provisions with permanent workable platform.

g) Trip hazards to be identified and painted yellow with black strip.

h) Electrical Hazards must be identified and labelled appropriately

i) Yellow walkways to be painted around all plant areas in plant rooms

j) Chemical Hazards to be labelled and yellow safe clearance lines to be painted on the floor. Also appropriate paperwork ie MSDS to be presented onsite.

k) Confined spaces to be noted and appropriate signage applied

l) Fixed switchable lights are to be provided in AHU chambers

m) Access to plant and equipment must comply with all WHS regulations.

5.12. REDUNDANT EQUIPMENT

All redundant hydraulic services and associated services (plant, power, controls, water, drainage, etc) must be removed as part of the project. Penetrations are to be filled to the appropriate fire resistance level (FRL) and building surfaces and finishes must be made good.

5.13. PRODUCT SUPPORT/ EXPERIENCE REQUIREMENTS

All products must be supported locally and internationally by factory trained service networks.

Equipment and associated accessories shall be specified as products that have been established manufacturing reliability and proven installation history in Australia.
Proven installation history includes products installed and operated for over 8 years and operational costs and detailed life cycle reports can be provided.

All spare parts must be available ex-stock factory for a period of 10 years from purchase date .

All spare parts must be readily available as spares with minimum ordering and delivery times.

5.14. COMMISSIONING

Macquarie University requires a comprehensive plan demonstrating how hydraulic services systems are to be inspected, tested and commissioned in order to achieve the project design objectives.

The Contractor shall provide Inspection & Test Plans (ITP's) for all major items of equipment and systems to be installed as part of their works, including but not limited to:

- Pipework for all systems including pressure testing and flushing
- Valves and fittings
- Pumps
- Hot water plant
- Pits
- Trade waste treatment apparatus
- Electrical
- Controls
- All equipment to be installed

In addition to the above, the contractor shall also submit a commissioning methodology statement outlining how the systems will be commissioned, requirements and preconditions for commissioning, and pre-typed commissioning sheets for systems such as:

- Drainage
- Water
- Gas
- Controls – functional testing

The above documents shall form a testing and commissioning plan that will be developed by the contractor in conjunction with the shop drawings and be submitted for approval to MUP prior to commencement of construction.

6. QUALITY CONTROL

6.1. DESIGN STANDARD COMPLIANCE

Compliance with requirements of this standard must be checked throughout the design, construction and commissioning phases of project by:

a) The MUP Technical Services Representative

b) The MUP Project Manager

Competent MUP representatives must check compliance with this standard during design reviews and formal site inspections.

Any non-compliances with requirements of this standard must be documented by the consultant and contractor (as applicable) and brought to the attention of the MUP Project manager and/or client's representative. Project Managers must maintain a register of non-conformances and manage close out of outstanding non-conformances.

Contractors and their consultants issued with non-conformances must take appropriate corrective or preventive actions. Proposed corrective or preventive actions and close out of non-conformances must first be formally approved by issuer of the standard or their delegate.

6.2. DESIGN STANDARD CERTIFICATION

Consultants must certify compliance to the design standard by completing and submitting a letter of certification to the MUP Project Manager at each of the following project phases:

a) Design and Documentation

b) Tender

c) Construction

Notwithstanding MUP internal quality control process, contractors and their consultants must implement their own robust quality assurances and control procedures to ensure compliance with the requirement of this standard.

ATTACHMENT 1 DESIGN STANDARD COMPLIANCE CHECKLIST

Key Standard Requirements	***Project Phase***	***Compliant***	***Non-Compliance / Departure Description***	***Non-Compliance Approved***	***Comments***
	☒Design & Documentation ☒Tender ☒Construction ☒DLP	☐Yes ☐No		☐Yes ☐No ..... Approver Signature	
	☒Design & Documentation ☒Tender ☒Construction ☒DLP	☐Yes ☐No		☐Yes ☐No ..... Approver Signature	
	☒Design & Documentation ☒Tender ☒Construction ☒DLP	☐Yes ☐No		☐Yes ☐No ..... Approver Signature	

Key Standard Requirements	***Project Phase***	***Compliant***	***Non-Compliance / Departure Description***	***Non-Compliance Approved***	***Comments***
	☒Design & Documentation ☒Tender ☒Construction ☒DLP	☐Yes ☐No		☐Yes ☐No ..... Approver Signature	
	☒Design & Documentation ☒Tender ☒Construction ☒DLP	☐Yes ☐No		☐Yes ☐No ..... Approver Signature	
	☒Design & Documentation ☒Tender ☒Construction ☒DLP	☐Yes ☐No		☐Yes ☐No ..... Approver Signature	

ATTACHMENT 2 DEEMED-TO-COMPLY SWITCHBOARD MANUFACTURERS

Approved switchboard manufacturers:

1. Gosford Electrical Manufacturing
2. SMB Harwal
3. KE Brown
4. Relec Switchboards
5. Southern Cross Switchboards

ATTACHMENT 3 DEEMED-TO-COMPLY SWITCHBOARD METERS AND GATEWAYS

The following meters are deemed to comply. An alternate equivalent meter can be used with the approval from MU PROPERTY.

Meter	***Manufacturer***
Nemo 96HD	IME
PM750	Merlin Gerin
Diris A40/A41	Socomec

The following gateways are deemed-to-comply. An alternate equivalent meter can be used with the approval from the Sustainability & Engineering Team within MU PROPERTY.

Meter	***Manufacturer***