THE UNIVERSITY OF SYDNEY

Hydraulic Services Standard

Design, Engineering, Planning & Sustainability

University Infrastructure

Document Edition Control

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Author(s):	Chris Hipsley

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Contents

1 Purpose

The UI Hydraulic Services Standard sets out the University of Sydney's minimum requirements for the design, construction and maintenance of plumbing, drainage, stormwater, water and gas services. It ensures new and refurbished systems are energy efficient, fit-for-purpose, made from durable good-quality materials, contain no or minimal environmentally harmful substances, and are cost efficient to operate and maintain.

Applicable requirements documented in Workplace Health and Safety legislation, Disability Discrimination legislation, State Environmental Planning legislation, Commonwealth and State legislation, National Construction Codes (NCC), the Building Code of Australia (BCA) and Australian and New Zealand Standards (AS/NZS) are the minimum and mandatory compliance requirements.

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:
    1. Workplace Health and Safety legislation.
    2. Safety in Design Legislation.
    3. Disability Discrimination legislation.
    4. State Environmental Planning and Assessment legislation.
    5. All other Commonwealth and State legislation.
    6. NCC, BCA and PCA.
    7. AS/NZS.
    8. This standard and other University of Sydney standards.

Use versions of all references current at the time of project certification. Where references are changed during the course of a project, provide an impact statement and request confirmation to implement.

2 Scope

This standard describes minimum requirements for design, purchase, construction, and operation and maintenance of electrical services plant, equipment and infrastructure for buildings and spaces owned, operated, maintained and/or managed by the University of Sydney. It applies to:

a. New building construction;
b. Refurbishment projects for University-owned spaces;
c. Refurbishments of spaces that form part of a broader medium-term (less than five years); program/plan of progressive upgrades to a University-owned building;
d. Refurbishment projects for long-term University-leased spaces;
e. Facilities maintenance services.

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

The standard provides:
a. A reference document to enable consistency with the design and engineering objectives
b. Details of the minimum performance requirements for Planning, Architectural Design and maintenance.
c. Support of the University Vision for the built environment and best practice.

The Standard addresses key objectives:

a. Quality design which responds, enhances and complements the environment.
b. Appreciation of the heritage context and cultural history of the campuses.
c. Value for money in all aspects of the project.
d. The design of low maintenance buildings and environments.
e. Longevity of construction approach to design.
f. Standardization of key flashing and ancillary details.
g. Flexible design, to future proof building usage for expansion or adaption to new uses.
h. Safety in design.

All hydraulic systems products and services provided or specified by designers, consultants, staff and contractors must conform to this standard.

Where specific applications are not explicitly covered, or ambiguity exists, the intent of the design standard must be satisfied. In such cases a return design brief must be provided for review and approval by the issuer of this standard or their appointed delegate who must have relevant technical competence in the subject matter. Additional more stringent requirements may apply on a project-specific basis dependent upon risk management and insurance requirements.

3 Glossary of Terms

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
AUMS	Advanced Utilities Monitoring System
BCA	Building Code of Australia
BFPD	Backflow Prevention Device
BMCS	Building Management & Control System
CCTV	Closed circuit television
COS	Central Operations Services
DI	De-Ionised
DICL	Ductile Iron Cement Lined
DPI	Department of Primary Industries
EPA	NSW Environmental Protection Authority
EP&AR	Environmental Planning & Assessment Regulation
HWU	Hot Water Unit
NCC	National Construction Code
PCA	Plumbing Code of Australia
PC	Practical Completion
PC1	Physical Containment Level 1
PC2	Physical Containment Level 2
PC3	Physical Containment Level 3
PC4	Physical Containment Level 4
PUG	Project User Group or Project Working Group

RAG	Registered Air Gap
RO	Reverse Osmosis
RPZD	Reduced Pressure Zone Device
TMV	Thermostatic Mixing Valve
USYD	University of Sydney
UI	University Infrastructure
WELS	Water Efficiency Labelling and Standards
WHS	Work Health & Safety
WSUD	Water Sensitive Urban Design

4 Roles and Responsibilities

This standard is issued by UI. It is approved and signed off by the Chief University Infrastructure Officer. UI is responsible for maintaining the standard and keeping it up-to-date.

5 Existing Buildings

The design for projects within existing buildings must be assessed on a case by case basis and developed in conjunction with this standard. The project scope will drive the design requirements.

Any items not included in the scope must not be priced into the overall project to achieve the following aim; To reduce the need to value engineer any services.

New projects within existing buildings must assess what the expectation of the refurbishment will be. This will enable the right outcome for the given project.

These specific requirements must be included in the scope of works specification for design and construction of hydraulic services:

Obtain the Gate Paper from the Project Manager and understand the scope of works in relation to the space and fit out requirements. Understand the expectation from the end user.

5.1 Reuse of Equipment

Reuse existing services where identified in the Gateway Paper scope of works and the approved Return Brief.

Equipment must be suitable for the intended new purpose and life expectancy of the works, comply with current codes and achieve energy targets.

Equipment must be cleaned, have consumables replaced, tested, relabeled and re-commissioned.

Remove redundant pipework, equipment and wiring, including inaccessible ceiling spaces, and make good exposed surfaces before commencing the installation of new services.

Remove redundant underground services unless otherwise approved by the project superintendent.

6 Technical Requirements

6.1 Introduction

The Hydraulic Systems of a University building will include surrounding structures and annex buildings. 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 must be interpreted as inclusive of these structures, annexes and components.

6.2 Design and Documentation

6.2.1 Design Approach

The University expects consultants and designers to provide designs that meet the project briefs. The following are priorities that consultants and designers must consider in their designs:

a. Take a long term balanced view of capital costs, energy costs, water efficiency, maintenance costs and longevity.
b. As educational and research both progress at rapid rates, usage of buildings and areas within buildings are subject to multiple changes within the life of the building, systems must be designed to be adaptable for such changes.
c. Ensure that plant and equipment are designed with access and visual impact taken into consideration.

It is the designers and the installing contractor's obligation to document and install systems, equipment and materials that are "fit for purpose" from both a WH&S and operational perspective. Any disputes in regard to the interpretation of this clause shall be referred to NSW Fair Trading and/or the UI Project Manager for a final determination.

6.2.2 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. Building Physics - provide advice to the project team, including other design team members that would improve the inherent building performance, which may lead to reductions in both capital and energy costs. This may initially take the form of simple advice relating to existing infrastructure capacity and location, which may affect the siting of the building, and subsequently backed up by modelling or similar methods. The process may take a number of iterative steps. The consultant or designer is expected to advice, contribute and if necessary, lead such processes.
b. 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 stages of the design and planning process so that this is taken into consideration for the architect's design and to be incorporated into his planning. Late advice will lead to poor location of plant and lack of maintenance access, thus a building of poor quality that will suffer from either poor or lack of maintenance and high owning costs to the University.
c. The University of Sydney – provide advice on the availability of options, assist in assessing the advantages and disadvantages, provide analysis of life cycle costs and life expectancies, offer recommendations and assist in making decisions.

6.2.3 Engineering Process

The University expects consultants and contractors to be fully qualified, experienced and capable of carrying out all engineering design, calculations, equipment selection and construction quality checks.

As part of the design development, the University expects consultants and designers to select proven and reliable hydraulic system.

6.2.4 Equipment Selection and Sizing

In selecting equipment, the University expects consultants and contractors to select products of proven and reliable quality, with reputable support and after sales service.

Products which are of 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.

The provision of 20% spare capacity for future use must be provided when designing and sizing all hydraulic services infrastructure, pipework and equipment. In making such considerations careful analysis of spare capacity against the application of diversity and balance must be considered.

6.3 Design and Construct Contract

6.3.1 General

This section outlines the extent of the services to be provided by the contractor under a Design and Construct contract.

The contractor shall be fully responsible for the complete design of the hydraulic services installations, including the selection, sizes and quantity of equipment, and shall provide calculations and drawings and other documentation as necessary to demonstrate conformance with the design parameters, industry practice, UI requirements, codes, regulations and standards. This includes all calculations required to confirm that existing infrastructure is sufficient to supply the proposed systems and equipment installed under the project.

The contractor shall allow to fully co-ordinate the documentation with the Architect, Structural Engineer and all other services consultants / contractors.

6.3.2 New Buildings

As a minimum, the hydraulic services provided in University buildings must be designed and installed in accordance with the minimum legislative requirements incorporating all Statutory Regulations, Australian Standards, Local Council, Fire & Rescue NSW, Work Health & Safety (WHS) and WorkCover requirements.

Each building must be equipped with the appropriate hydraulic services, all designed and installed in accordance with the requirements of the NCC.

6.3.3 Refurbishments

The requirements for the refurbishment of existing hydraulic services within existing buildings will often be the same as for new buildings.

Whilst every endeavor is made to comply with current NCC regulations during refurbishments and upgrades, it is unlikely that the full extent of the building regulations can always be met.

Within any building proposed for refurbishment, the Standard of Performance for all existing hydraulic services measures must be reviewed by the consultant/contractor for compliance with the current NCC and Australian Standard requirements. The details of this review together with a proposed hydraulic services measures upgrade strategy must be submitted to UI for approval during the initial design development.

6.3.4 Calculations

As part of the contractor's design, it is expected that the following design calculations as a minimum are produced for review by UI for approval prior to finalising design:

a. Cold water supply calculations for potable, non-potable, fire and rainwater reuse, inclusive of mechanical services and irrigation water supply requirements. For new buildings and major refurbishments, this shall include water balance calculations for the purpose of sizing rainwater harvesting storage tanks.
b. Hot water supply calculations.
c. Sanitary plumbing and drainage calculations.
d. Stormwater drainage calculations, inclusive of roof and in ground drainage, overflows, rainwater harvesting, on site detention, permitted site discharge and water quality.
e. Sub-soil drainage calculations.
f. Gas supply calculations.
g. Equipment selections based on the overall capacities calculated.
h. RO water plant and pipe sizing, including design diversity & system daily average demand.
i. Pipe sizing calculations.
j. All other calculations necessary to illustrate equipment reticulation and components have been selected fully in accordance with the project requirements and this specification.

6.3.5 Drawings and Documentation

The contractor shall provide design, construction and as-built drawings, which may be either design drawings produced by the contractor or shop drawings produced by equipment manufacturers.

For each service, present on the schematic layout for that service, a "Basis of Design" summary. The summary shall identify how the system works, basis of design, any departures form Australian or University standards and all substantial information are required to review the adequacy of the design intent. The basis of design is to include pressure and flow information from the Sydney Water Pressure inquiry or the on-site fire flow test results.

It shall be maintained up to date using Revision Numbering throughout the checking and review process.

The contractor is responsible for producing all design and as-built documentation, including, but not limited to:
a. Concept Design documentation (as required).
b. Detailed Design documentation, including:
c. Layout drawings.
d. Details.
e. Schematics, including a Basis of Design Statement for each service.
f. Design certification.
g. Equipment details.
h. Testing / commissioning procedures.
i. Workshop drawings, including:
j. Drawings for the purpose of system manufacture.
k. As Built drawings, including:
l. Detailed drawings demonstrating the as installed system.

m. Operations and Maintenance manuals.
n. Training manuals.

6.3.6 Technical Submittals

Technical submittals shall be provided with the full technical and spatial requirements of each proposed plant item. The technical submissions shall include, where applicable, but not be limited to:

a. Certified shop drawings of each item complete with sectional weights and point loads.
b. Certified noise levels from each plant item.
c. Electrical requirements including starting current, running current, operational voltage, power consumption, recommended protection devices, wiring diagrams, connection and terminals details. Also detail of how cables are terminated to the plant item and earthing requirements shall be provided.
d. Pump Curves as applicable.
e. Recommended spares schedules and projected future availability (to ensure that redundant components are not used).
f. Requirements for specialist tools to maintain the plant item.
g. Maintenance zones and requirements including weights of any replaceable components.
h. Manufacturer's recommendations for installation including ventilation and thermal requirements.
i. Confirmation of product lifespan assuming maintained to manufacturers recommendations.
j. Where equipment model numbers / references are stated these are indicative only and the Contractor MUST ensure the selected plant fully complies with the standard.

6.4 Cold Water Services

6.4.1 General

The water supply network serving the University of Sydney is a complex arrangement of Sydney Water owned infrastructure and University owned infrastructure. During the design development phase of the project the consultant/contractor must determine the water supply demand requirements for the project and determine if the existing infrastructure is capable of meeting the project requirements.
The consultant/contractor must allow to investigate and obtain all available details of the existing infrastructure, including the location and survey of underground services, as required. Where existing information required for the design development is not available, the project team must arrange further investigative works.

Pressure/flow enquiries must be submitted to Sydney Water, as required for the project, and all fees and charges applicable for this information must be allowed for. Where the water supply asset is owned by the University of Sydney, network diagrams must be requested from UI and testing of the water supply to obtain available pressure /flow details must be arranged by the project team.

Where new connections to the existing water supply infrastructure are required, the consultant/contractor must provide an application for connection to either Sydney Water or UI, dependent upon which party owns the asset.

6.4.2 Design and Installation Criteria

The following general design and installation criteria for cold water services must be adopted by the consultant/contractor for all projects.

Item	Cold Water Services Criteria

Water Main Connections & Valve Pits	a. Provide an underground valve at each connection point to Sydney Water and University water supply mains. b. Provide underground valves on University ring mains at not greater than 100m spacing's to allow shutdown of sections of the ring main. c. Valve must be oriented in the direction of flow. d. For all underground valves, provide a 300mmm square cast iron surface box with hinged cover permanently marked "SV" or "Water" set flush with the adjacent ground surfaces. e. Surface boxes must be concreted to a 150mm pipe riser extending from the valve and housing the valve extension spindle. f. Surface boxes installed in soft landscaping must be provided with a concrete minimum 150mm surround. g. All in ground valves must be anti-clockwise closing. h. All new building connections to the University or Sydney Water supply must incorporate a dedicated pressure transducer on the suction side of the pumps, connected to the BMCS system.
Isolation Points	a. Provide individual water service isolation valves where each water service enters a building. b. Isolation valves and connecting pipework must be arranged so as not to interfere with services isolation of the adjacent buildings. c. Storz connection point and isolation valve must be provided in a discrete location, immediately downstream of all building isolation points to allow for temporary hose connections to provide water to the building in the event of emergency water supply network shutdowns. The size of the temporary connection point shall be equal to incoming supply size for the building. d. Isolation valves must be provided on each floor immediately adjacent to each water supply riser connection point on each floor. e. Provide isolating valves for all laboratories, on the wall adjacent to the main entry door. Valves are to be housed inside a stainless steel wall box mounted no higher than 1500mm above the floor. The stainless steel box is to be installed complete with an appropriately sized drain outlet and is to be key locked with a 003 Key. f. Isolation valves must be installed upstream of each group of hot and cold water fixtures located within an individual room. g. All water service isolation valves must be located in positions not easily accessible to the general public, but easily accessible for maintenance purposes, i.e., located in a locked service cabinet at maximum height of 1500mm above floor level. h. Access to all isolation valves must be clearly identified with traffolyte signage, or approved equivalent.
Water Filtration – Incoming Supply	a. Provide dual automatic backwash filters with stainless steel screens to all main incoming supplies. b. Automatic backwash cleaning to be provided by set timer and pressure differential control. c. Manual backwash facility to be provided at filter. d. No interruption to water supply to occur during backwash cycle. e. Filtration on incoming supply to be not greater than 100 microns. f. Install a by-pass pipework arrangement around the dual filter assembly. g. Monitored by BMCS. h. Water filtration units must be JUDO or approved equivalent.
Water Tanks	a. Potable and non-potable water tanks must be 316 stainless steel (external to the building) and 304 stainless steel (internal to the building) modular panel type tanks, externally bolted. b. Panel tanks must be installed on 600mm raised supporting beams allowing access to visually inspect the underside of the base of the tank.

	c. A minimum clear distance of 500mm around each wall of the panel tank must be provided to allowance maintenance and inspection of the tank walls. d. Access ladders and lockable access covers to allow internal tank inspection and cleaning must be provided. e. Tank water level indicators must be installed. f. Tank filling valves must be Philmac servo type or approved equal. g. Bladder or liner tanks will not be accepted. h. Poly tanks (UV Stabilised) are acceptable for rural applications.
Operating Pressure	a. 350-500 kPa (for non-firefighting service). b. Pressure reduction must be used to control maximum water pressures.
Hot & Cold Water/ Pipeline Velocity	a. Maximum 1.5 m/s.
PH Correction	a. Maintain pH between 6.5 and 7.5 where pH is required to be controlled.
Reticulated DI and RO Water Filtration and Quality	a. PUGs must specify the quality and quantity of DI and RO water where required for laboratory usage. b. Proposed DI and RO water supply equipment must be submitted to UI for approval complete with manufacturer's maintenance requirements and budget costing over the life cycle of the equipment. c. DI and RO pipe systems must be provided with valving to allow individual floors to be shutdown without affecting the entire building. d. Pipework dead legs on DI and RO pipe systems will not be accepted. e. RO plant waste water discharge shall be piped to the rainwater reuse tank where possible. f. Where buildings are specifically designed to house wet laboratories, a centralised RO/pure water system shall be designed and installed as follows: g. The water purification plant shall be a Merc Millipore or approved equal, complete with backflow prevention as required, water sub-meter, sand/carbon filtration, UV disinfection and cartridge micro-filtration prior to the RO process. h. RO plant shall be sized to be 80% efficient and able to produce one day's Average Day Demand of RO water in 8 hours Average Day Demand and the required minimum water resistivity shall be determined from the PUG. i. Type 1 (Ultrapure grade) is required for specific users, and only provided as a "point of use" treatment. These units shall be strictly limited in numbers due to the cost of maintaining such equipment. It is suggested that one unit per building level would be sufficient, with all operation and maintenance requirements provided by the user to ensure quality water to the users' satisfaction. j. Type 2 (analytical grade) reticulated RO water shall be a to ISO3696 (Water for Analytical Laboratory Use), requiring de-ionising using ion exchange prior to product storage. k. Pure water produced by the RO plant shall be stored in a single translucent polypropylene tank with capacity for a minimum of 8 hours' use. l. To maintain quality product, the main distribution system shall be a "flow and return" system with UV disinfection controlled by the duty and standby circulation pumps. Pumps shall be sized to circulate total storage every 4 hours. Duty and standby functions shall alternate each 24 hours. m. Off-takes from the ring (flow & return) main shall be made at one only point for each laboratory, with a supply emergency isolation valve located within the laboratory service valve compartment. Install pipework so that all horizontal pipelines slope towards outlet points to ensure service can be completely drained.

	n. The wastewater from the RO plant shall be captured and directed to building rainwater harvesting system for re-use.
Reticulated DI and RO Water Filtration and Quality (Cont'd)	a. Pipes and fittings used in the installation shall be selected from the following and as specified under materials section. All pipe and fitting must be the same material as the pipework: b. Reverse Osmosis - Beta Polypropylene Homopolymer pipe & fitting (PP-H) c. Ultra-High Purity Water - Polyvinylidenfluoride pipe & fitting (PVDF) d. Ultra-High Purity Water valves to be George Fisher SYGEF Plus 3-way diaphragm valve type 519 with butt fusion spigots and connector or other approved equal as confirmed on site with client. Piping from wall to fume cupboard inlet to be piped using matching tube hose connection not through flexible braided hose. e. Reverse Osmosis valve to be PROGEF Standard Diaphragm valve DIASTAR TenPlus FC (Fail safe to close) with butt fusion spigots SDR11 metric (In line branch valve with take-off from recirculated loop). Spigots and connector to suit hose connector to dishwasher. f. Immediately after the satisfactory completion of the system's hydraulic pressure tests the contractor shall flush out, remove all foreign matter and clean the system. The system shall be thoroughly flushed out with clean water. Whenever possible the flushing medium shall be fed into the system at high points and flushed out at low points on the system via suitably sized valve or plugged wash-out points. g. The whole flushing procedure shall be carried out to the satisfaction of the suppliers of the water generating plant. h. Thoroughly flush the entire system with domestic cold water to remove all matter from the pipe and equipment. A second flush shall be carried out using a mild caustic soda hydroxide to further cleanse the piping. Allow to circulate the water for a period of one hour before removing flush water. A third flush shall be carried out using water with 50 ppm of chlorine which shall be circulated for fifteen minutes. i. The fourth flush will be carried out using the reverse osmosis grade water, after which the system shall be left fully charged with reverse osmosis grade water, remove all possible air from the system and the system shall thereafter be maintained full at all times. The contractor shall carefully monitor these operations to ensure the existing system is not contaminated. All components of the system are to be included in the flushing process. j. Flushing shall be witnessed and certified by the Superintendent and a copy of these records shall be provided as proof of commissioning.
Backflow Prevention Devices	a. Each individual University site/building must be deemed a separate property for the purposes of containment protection and must be installed with individual dual backflow prevention devices at the main water supply connection point to each site/building, in order to achieve building containment and to ensure that annual testing does not interrupt the water supply to the site/building being served by the device. b. Containment protection for all University buildings must be deemed high hazard. c. Zone and individual protection devices must be installed within each building to suit the relevant hazards contained. d. Zone containment for all wet laboratories, animal houses, green houses and areas with similar use, must be deemed high hazard. e. All backflow prevention devices must be located a maximum height of 1500mm above floor level.

External Fire Hydrants	a. Connected to external water supply infrastructure only via a branch line. b. If connected downstream of a building Brigade Booster Connection be provided with signage indicating "Attack Hydrant". c. Water supply to each external hydrant must be provided with sluice valve installed in-ground complete with cast iron box and hinged cover permanently marked "SV" or "Water" to indicate water service. d. Must be a twin hydrant arrangement. e. For more information refer to the UI Essential Fire Safety Measures Standard.
Boiling/Chilled Water Units	a. Filtered boiling and chilled water units must be provided in all designated tea making areas. b. Boiling and chilled water taps must be installed in the sink with the boiling/chilled water unit installed in an accessible position in a cupboard directly below the sink. c. Consideration should be made in regard to the location of the Font Tap to achieve DDA access where possible.
Hose Taps	a. Brass hose taps with a 20mm screwed outlet must be installed for cleaning purposes in open courtyards, balconies, external dining and entertaining areas. b. All plantrooms, chiller and cooling towers and accessible roof areas must be provided with brass hose taps with a 20mm screwed outlet to allow hose down and cleaning floors, roofs and gutters. c. All roofs where solar panels or glass skylights are installed, provide a brass hose taps with a 20mm screwed outlet (installed at 30m centres) to allow hose down and cleaning. d. Each bathroom must be provided with a chrome plated hose tap with a 15mm screwed outlet to allow placement of a cleaner's bucket underneath (min 450mm above from FFL). A floor waste must be located directly below outlet of this tap where possible. e. Vacuum break devices must be installed to hose taps in zone protected areas and those installed in external areas. f. Quarter turn taps are not permitted to be installed. g. All hose taps must be provided with vandal proof spindles. h. Backflow prevention must be installed on hose taps installed in hazardous environments as necessary to comply with AS3500 and Sydney Water requirements.
Safety Showers / Eye Wash	a. All wet laboratories must be provided with emergency safety showers and eye wash facilities with a 32mm minimum potable cold water supply as per manufacturer's instructions. b. Each safety shower/eye wash facility must be provided with an independent isolation valve. c. All eyewash stations must be connected to the sanitary plumbing system. Floor wastes shall not be provided for safety showers. d. For labs proposed to install a safety station consisting of combined Safety shower, eye wash and handwash basin, please refer to the University of Sydney Typical Safety Station detail. e. For more information refer to the Laboratory Design Standard AS2982.
Urinals and Cisterns	a. Flushing requirements for all urinals must be inline type with urine sensing flush control mechanism, or similar, for best practice water conservation. b. For all new and refurbished bathrooms, water supply pipework must be installed to facilitate the potential for future rainwater re-use and /or centralised grey water reticulation systems. c. This requires pipework serving urinal and cistern flushing systems to be installed independently of pipework serving hand basins, showers and other general drinking and potable water fixtures.

	d. In new buildings where rainwater re-use and/or grey water system is not proposed, this pipework must be installed throughout the facility and fed from the main hydraulic services plantroom containing metering, backflow prevention and/or pumping equipment for the potable water supply to the building. e. A pulse water meter must be installed on the urinal/cistern water supply pipework at the main connection point to the potable cold water supply. f. In existing buildings, where this pipework is installed for future connection to a rainwater re-use and/or grey water system, the separated water supply pipework must be installed with a separate isolation valve provided on each floor immediately adjacent to each water supply riser connection point. g. Pipework installed to meet these requirements must be provided with approved identification to indicate recycled water.
Building Management Control System (BMCS)	The following water supply equipment must be connected and monitored by the BMCS in real time: a. All water supply pumps and VSDs (potable/non-potable/rainwater re-use/hot water recirculating, etc) – run/fault alarms b. All tanks (potable/non-potable/rainwater re-use) – high and low level alarms c. Hot water plant – temperature/fault alarms d. Rainwater re-use water treatment plant and equipment including UV filtration e. Automatic backwash filters
Advanced Utilities Monitoring System (AUMS)	All new water meters installed shall be connected and monitored by the AUMS to log and display water consumption details in maximum 15 minute intervals.
Lab Process Water	Where process water is required in laboratories for cooling of equipment, the supply must meet the requirements of the Sustainability Framework.
Water Stations	For new buildings and buildings undergoing significant refurbishment, water stations must be installed to meet the requirements of the Sustainability Framework

6.4.3 Water Segregation and Backflow Prevention

Existing buildings may contain a variety of water services, including potable, non-potable, de-ionised, reverse osmosis and rainwater re-use systems. The consultant/contractor is responsible for ensuring that the correct supply is provided to each fitting and fixture and to ensure that water supplies remain totally segregated.

Water segregation comprising separate potable and non-potable, cold and hot water supplies, must be provided within the following areas:

a. Wet Laboratories - all types and ratings.
b. Animal Houses.

All non-potable supplies including pipework and tapware must be clearly identified using standard pipe marking labels and tapware signage.

The following design and installation criteria for water segregation must be applied to all projects involving laboratories and animal houses:

Item	**Water Segregation Criteria**

Non-Potable Water Supply	a. Non-potable water supplies for all laboratory buildings must generally be designed as centralised systems serving the entire building. b. For new laboratory buildings, provision of a centralised non-potable water supply via a registered break tank must be installed. c. Non-potable mains pressure supplies will not be accepted. d. In existing buildings containing laboratories, the consultant/contractor must connect to the existing non-potable water supply serving the building.
Laboratory Water Supply (PC1, PC2, PC3 & PC4)	a. Separate supplies for potable cold water, potable hot water, non-potable cold water and non-potable hot water must be provided to each laboratory. b. Each supply must be provided with accessible isolation valves located outside of the laboratory facility to allow individual shutdown of each supply.
Laboratory Backflow Protection (PC2, PC3 & PC4) (High Hazard)	a. Each individual laboratory rated as PC2 and above must be provided with 4 off individual RPZDs serving potable cold water, potable hot water, non-potable cold water & non-potable hot water. b. RPZDs must be installed in a stainless steel cabinet located outside of the PC rated area to enable servicing without entering the laboratory facility. c. The door to the cabinet containing the RPZDs must be fitted with a hinged and lockable with 003 key glass or perspex viewing panel. d. The cabinet must be provided with a 50mm diameter drain at the base of the enclosure. e. Pipework supplying each device must be labelled pipe markers indicating water service type, f. The cabinet must be provided with a traffolyte label indicating the lab name and room number(s) that the devices are protecting.
Laboratory Hand Basin (High Hazard)	a. Supplied with potable cold water only unless required by Laboratory Design Standard AS2982 and potable warm water (hand washing).
Laboratory Benches (High Hazard)	a. Supplied with non-potable cold only unless required by Laboratory Design Standard AS2982 and/or specialised lab processes (laboratory work and equipment).
Emergency Shower/Eye Wash Facilities	a. Supplied with potable cold water.
Animal Houses (High Hazard)	a. Animal drinking water shall be a dedicated potable cold water supply (High Hazard). b. Supplied with separate non-potable hot and non-potable cold water supplies. c. Separate potable cold water shall be supplied for hand washing.

6.4.4 Water Metering

Each building must be provided with its own Sydney Water meter and/or University owned sub-meter assembly. All main meters must be rated at 100 litres per pulse (unless specifically noted otherwise) for revenue billing in commercial applications in addition to being suitable for monitoring of complex distribution water supply networks.

All meter and sub-meter assemblies installed must be “smart meter” type with multiple pulsed outputs for increased real time data to provide water management information. These meter assemblies must be compatible for connection to the AUMS via a set of voltage free contacts.

Meters must be suitable for measuring bulk flows of cold water, hot water and rainwater, dependent upon usage, and must be installed with an in-line strainer to protect the rotor.

All sub-meter assemblies must be rated at 10 litres per pulse (unless specifically noted otherwise) and be installed within the building to measure water supplies for the following systems/areas:

a. Mechanical HVAC plant (including evaporative Condensers, heating boilers, etc).
b. Mechanical Cooling Towers – meters rated at 10 litres/pulse.
c. Steam Boilers.
d. Centralised Potable Hot Water Systems.
e. Centralised Non-Potable Water Systems.
f. Rainwater Reuse Systems – meters rated at 100 litres/pulse.
g. Backup Potable Supply to Rainwater Reuse System – meters rated at 100 litres/pulse.
h. Irrigation Systems – meters rated at 100 litres/pulse.
i. Spaces proposed for tenancy leasing agreements.
j. Any equipment that utilises more than 50kL of water a month – meters rated at 100 litres/pulse.

Where meter assemblies are connected directly to the Sydney Water network, the contractor must make application to and pay for all fees for Sydney Water to supply a new meter assembly.

Water meters must be installed in fully accessible positions to allow for easy reading and servicing. Individual isolation valves must be provided for each water meter assembly.

The consultant/contractor must coordinate the location, meter type and data output with other building services consultants/contractors to ensure the installed meters are fully compatible with the AUMS and adequate communication network connection points have been provided.

The University utilises the services of an energy advisor to manage changes to utility metering and accounts at The University. The energy advisor must be made aware of any changes to utility metering or accounts. This includes requests for new meters, transfer of accounts, or disconnection of existing meters. It is the project team's responsibility to ensure that the correct documentation is provided to the energy advisor within the timeframes stipulated. The process for requesting changes to utility metering or accounts is outlined at **http://sydney.edu.au/about-us/working-with-us/contractors.html**.

All water meters and sub-meters must be connected to the AUMS. Allowance for modifications to, AUMS programming, including meter hierarchy must be included for all new meters and sub-meters. For further information refer to the UI AUMS Standard.

6.4.5 Equipment and Materials

All materials supplied and installed must be approved by the local authority have the respective Australian Standard's mark and manufacturer's SAA licence number.

All materials must be first quality and the best of their respective kinds. Second quality or inferior materials must be rejected. All costs associated with replacement of rejected materials must be the contractor's responsibility.

The following materials must be specified and installed.

Item	**Cold Water Services Equipment & Materials**
Pipework Above Ground	a. Copper Type B in accordance with AS 1432 (pipe) AS 3688 (fittings). b. Stainless Steel 316 min 2mm in accordance with ASTM A269-02a / BS EN 10312. c. High density cross-linked polyethylene (PEX) pipe on branch pipework to bathroom and kitchen fixtures downstream of branch isolation valves supplying the fixtures.

	d. Pipework crimping is not allowed. Termination of all pipework must be made using pipework fittings and end caps. e. The use of alternative non-metallic water supply pipes in above ground locations will not be accepted without prior approval from UI.
Pipework Below Ground	a. The UI Permit to Dig Form (UI-ENG-F003) must be submitted and approved by UI prior to installing or repairing any pipework located below ground. b. Ductile Iron Cement Lined (DICL) with minimum pressure class PN35 in accordance with AS 2280, for pipes greater than 100mm diameter. c. Copper Type B in accordance with AS 1432 (pipe) AS 3688 (fittings), for pipes equal to or less than 100mm diameter. d. PE Pressure Pipe with minimum pressure class PN16 and compound PE100, in accordance with AS 4130, for pipes greater than 100mm diameter. e. All pipes shall be installed at a minimum of 600mm cover, shallower cover will not be accepted without prior approval from UI. f. All metallic pipes installed underground must be installed in polyethylene green sleeve protection bag. g. Underground pipe warning tape and trace wire must be installed 150mm above all underground pipes for the full length of the pipe. h. Warning tape is to be made of durable plastic with a minimum width of 300mm and colour to match AS1345. i. Line marking identification plates must be installed at pipework changes in direction and at 50m intervals. Identification plates shall indicate the service type, flow direction, depth and diameter. Identification plates shall be brass, epoxy resin screw set flush with the surrounding surface. For services in soft landscaping a concrete fixing block must be provided. j. The use of alternative non-metallic pipe in underground locations will not be accepted without prior approval from UI.
Copper Tube Joints	a. Silver soldered joints for all pipe sizes. b. Viega Propress and Connex-Banniger B-Press compression fittings for copper pipe sizes equal to or less than 65mm diameter using specialised pressing tools in accordance with the manufacturer's instructions and warranty requirements, for above ground applications only. c. 15% silver solder. d. Minimum 6mm lapped joints. e. Joints must be made from preformed copper tees. Site or factory fabricated copper tee joints are not permitted. f. The use of alternative compression press fittings will not be accepted without prior approval from UI.
Ductile Iron Cement Lined Pipe/Joints	a. Ductile Iron Cement Lined pipework installed below ground must be spigot and socket connections with rubber ring joints. b. DICL may be installed where the pipework exits and enters below ground. Flanged connections and joints must be provided on all DICL pipe installed above ground. c. Anchored in accordance with local authority and manufacturer's instructions. d. All DICL fittings must be cement lined /FBE coated. e. Gibault joints must be long sleeve with stainless steel rods, nuts and washers.
Stainless Steel Pipe Joints	a. Butt jointed, TIG welded and passivated after welding.
Cross-linked Polyethylene (PEX) Pipe/Joints	a. The use of PEX pipe is only approved for 15-25mm sizes (equivalent to the internal bore of copper tube).

	b. Use of PEX pipe as risers pipework, main horizontal feeds and plantroom areas, is not permitted. c. Pipes must be jointed using brass compression fittings and specialised tools in accordance with the manufacturer's instructions. d. PEX pipe colours shall match the water service type, i.e., cold water – platinum, hot/warm water – red, rainwater – green, recycled water – lilac. e. PEX pipe to be REHAU or approved equivalent.
PE Pipe/Joints	a. PE pipe joints shall be formed by butt or electro fusion welding. b. PE fittings with minimum pressure class PN16 in accordance with AS4129 must only be used. c. Installers performing welding of PE pipe need to demonstrate experience and training with the weld type proposed d. Automated welding machines that provide a report of all performed welds shall only be used and copies of each weld must be provided as part of the project deliverables. e. Pipe marking colour to match service type, i.e. potable water – blue, fire services – red, rainwater – green, recycled water – lilac. f. All PE pressure pipe must be submitted for UI approval with full details of proposed installation, including size, location, depth, jointing method, excavation and backfilling or alternative installation details.
Unions	a. Bronze heavy pattern three piece bull nose taper type. b. Where a tap connector type union is used it must be either type silver soldered to the piece or a loose nut used in conjunction with a stop formed tube.
Valves Above Ground	a. 25mm or less – brass or chrome plated stop valve. b. 50mm or less – non-rising spindle pattern, with clockwise closing, screwed type with a union fitted to the outlet side. c. 80mm or less – bronze flanged. d. 100mm or greater – flanged cast iron with bronze trim except where installed for hot water reticulation in which case the valve construction must be flanged bronze. e. Must be located in easily accessible positions for ease of maintenance at a maximum height of 1500mm above the floor. f. Lever operated ball or butterfly valves shall not be used without written UI approval.
Valves Below Ground	a. 100mm diameter and greater must be gate valves. b. Flanged body ends, bolted cover and fusion bonded epoxy coated internally and externally. c. Resilient seated. d. Non-rising spindle pattern. e. Class 16, working pressure 1600kpa. f. Fitted with key cap. g. Anti-clockwise closing. h. Provided with a surface box. i. Manufactured in accordance with AS 2638.1-2002.
Reduced Pressure Zone Device (RPZD) Valves	a. Devices must be installed complete with unions and inlet strainers of appropriate size. Unions shall be fitted on the inlet & outlet sides of device/s so that water supply can be isolated facilitating easy removal of device/s. b. Devices must be supported so that inlet & outlet pipe work is not supporting devices. c. Backflow devices requiring a drain line must be provided with a 50mm minimum connected drain line. d. Up to and including 50mm diameter must be screwed type. e. Greater than 50mm diameter must be flanged type. f. All RPZDs to be traffolyte labelled indicating the area they serve.

	g. RPZD Valves to be Pentair Valvecheq Figure RP-03, Conbraco Apollo Series 4A-200 or Zurn Wilkins Model 375.
Double Check Valves	a. Fire services water supplies must be provided with a double check valve with a check bypass water meter prior to the booster valve assembly. b. Double check valves must be Pentair Valvecheq Figure DCDA03 or Conbraco Apollo DCV.
Cold Water Pump Sets	a. High efficiency pumps with variable speed drives. b. A minimum dual pump system arrangement must be installed with a duty and standby and auto changeover every 12 hours. c. Certified for potable water use to AS4020. d. Supplied by a pump manufacturer as a complete packaged system mounted on a base with manifold, valves and control panel. e. Pump control panels shall provide auto/off/manual switches for each pump and a main isolation switch for the controller with traffolyte labelling indicating electrical supply details. f. Pump controllers shall provide indicator lights for each pump indicating power on, pump run, pump fail. g. Pressure gauges to be installed on the inlet and outlet of each pump. h. Enable removal of one pump while the other is in operation. i. Monitored by BMCS. j. All cold water pump sets must be Grundfos type, or approved equivalent. k. All VSD drives shall be Grundfos or Hydrovar manufacture.
Flexible Connections	a. Braided stainless steel bellow type not less than 4 pipe diameters long. b. Installed on all pump suction and discharge connections. c. Maximum deflection on each flexible connection must not exceed 5 degrees.
Basin and Sink Connections	a. Mini cistern cocks and chrome plated cover plates for both hot and cold connections must be located at the wall under each fixture. b. Exposed pipework must be chrome plated. c. Braided stainless steel flexible hoses must be used only when the hose is concealed in joinery or the like and where 100mm floor wastes are provided (so, if they fail, no real damage is created). Where they are used, they shall be of the correct type to prevent straining, kinking, twisting or stresses on the connections. They shall be the correct length to match the installation requirements. d. Braided flexible hoses shall NOT be joined to another braided flexible hose under any circumstance.

6.5 Hot Water Services

6.5.1 General

The consultant/contractor must ensure the most efficient hot water supply is designed and installed to suit the building operations and demand. Gas boosted solar hot water systems must be installed where sufficient northern roof solar access is available. Where solar access is not achievable, mains pressure gas fired hot water systems must be installed. Heat recovery from the mechanical plant must be considered wherever possible. Life cycle analysis and costing must be performed to determine the most viable hot water supply for each project. Heat pump systems and electric hot water units must only be used where the above listed options are not viable. These types of systems must be submitted to UI for approval.

Centralised recirculating hot water installations must be installed to ensure continuity of hot water supply temperatures at each outlet. Systems must be designed with multiple units to ensure efficiency and system redundancy is maintained. A minimum of 20% spare capacity above the maximum hot water demand must be provided for all hot water installations.

Recirculating pumps must be thermostatically controlled to limit unnecessary operation. Duty and standby hot water pumps must be installed to allow system redundancy. Balancing valves must be installed on the hot water return circuit to control the hot water return temperature to a minimum of 60^{0}C.

All hot water installations must comply with the energy efficiency measures listed in the National Construction Code and to suit the requirements of the University of Sydney Sustainability Framework document and must incorporate adequate controls to avoid the likelihood of the growth of legionella bacteria.

Hot water system calculations must be provided (at the 70% design approval stage) for approval to confirm the design assumptions used in calculating the hot water plant capacity and recovery rate. Energy calculations shall also be included in the assessment of the hot water plant to ensure the most efficient system is selected.

Heat and energy loss must be minimised by installing adequate insulation on all hot water supply pipework and by locating hot water units in the vicinity of areas with the greatest demand.

All hot water units and storage tanks must be installed at floor level in accessible locations with sufficient space to enable maintenance and/or removal and replacement of each individual unit.

Copper safe trays complete with drainage pipework must be installed under all hot water units. Overflow/relief valves to must discharge to tundishes connected directly to a drainage connection point, not to the copper safe tray.

6.5.2 Design and Installation Criteria

The following general design and installation criteria for domestic hot water services must be adopted by the consultant/contractor for all projects.

Item	**Hot Water Services Criteria**
Potable Hot Water Delivery Temperatures	a. Minimum 65^{0}C storage at hot water plant. b. Minimum 60^{0}C return water temperature. c. 42^{0}C to accessible bathrooms & shower amenities. d. 45^{0}C to staff bathrooms, hand wash basins & shower amenities. e. 50^{0}C to student accommodation amenities, kitchens and kitchenettes. f. 50^{0}C to staff kitchens, kitchenettes and cleaner's sinks. g. 60^{0}C to commercial kitchens. h. 60^{0}C non-potable supply to wet laboratory sinks (where hot water has been identified as required). i. Bathrooms and amenities must have thermostatic mixing valves or tempering valves installed to ensure the water temperature supplied to all fixtures complies with all statutory and NSW Health requirements.
Student/Public Bathrooms	a. Hot/warm water supplies are generally not provided to hand wash basins in student/public bathrooms. b. This is not applicable to student accommodation buildings.
Non Potable Laboratory Hot Water	a. The requirement for provision of non-potable hot water supplies to wet laboratories shall be minimised. b. Where provided, non-potable hot water supply to all laboratories must be independent from the potable hot water supply to the remainder of the building and/or provided with high hazard zone backflow prevention. c. The cold water supply inlet to any individual non-potable hot water unit serving a laboratory must be downstream of a backflow

	prevention device with a lockable valve to provide isolation and zone containment protection. d. Individual non-potable hot water units serving isolated laboratories must generally be continuous flow type. Where the size and/or the hot water demand of the laboratory does not permit the use of continuous flow systems, alternatives must be submitted for approval.
Operating Pressure	a. Maximum 500kPa. b. Minimum 250kPa.
Dead legs	a. Maximum hot water dead leg allowable is 10 metres. b. Maximum warm water dead leg allowable is 5 metres. c. The use of electric self-regulating heat trace for hot or warm water dead legs greater that as specified above (or where a circulated system cannot be achieved) shall be submitted to UI for approval.
BMS Monitoring	a. Provide BMS monitoring of the hot water supply and return temperatures, run and fault status of each hot water pump in the hot water plant.
Insulation	a. All hot and warm water pipes must be fire retardant closed cell polyethylene foam, having a density of not less than 40kg/m3 and installed in accordance with AS4426. b. Insulation must generally be of the sealed tube or hard drawn pre-lagged type. c. Split and taped insulation or zippered/press type insulation is not acceptable. d. Vapour barrier consisting of reinforced aluminium foil laminate must cover the insulation material with a minimum overlap of 50mm at each longitudinal joint. e. The insulation must be pulled around bends in one piece. Where this is not possible and at tees the insulation must be mitred and neatly taped with 50mm wide PVC tape of similar colour to the insulation. f. Wood blocks must be provided at each pipe bracket. g. For hot water pipework installed in plantrooms or exposed to weather, 0.5mm zinc annealed steel sheathing must be installed over the insulation in a single piece with a 40mm overlap. The lap must face down and must be secured by pop rivets at 100mm spacings.

6.5.3 Equipment and Materials

All hot water plant and equipment installed must be suitable for commercial applications and must be provided with sufficient capacity and rating required to serve the system demand.

Item	**Hot Water Services Equipment & Materials**
Hot Water Heaters	a. Continuous flow commercial water heaters with storage cylinders are preferred for all new hot water installations. b. Where mains pressure hot water heaters and storage vessels are installed, they must be complete with all necessary stop, check, drain and pressure relief valves necessary to complete the installation. c. All hot water units must be heavy duty suitable for commercial applications. d. All hot water units must be Rheem or Rinnai type, or approved equivalent. e. All hot water system must be provided with a temperature gauge on the supply to the field (flow) and for recirculating systems on the return at the plant.
Solar Collectors	a. Where solar collectors are proposed to be installed, assessment of the structure and fixing methods must be submitted for approval.

	b. Safe access for maintenance must be provided to all solar hot water panels. c. Solar hot water panels must be Rheem or Rinnai type, or approved equivalent.
Pressure Reducing Valve	a. Installed in the cold water supply pipework to each hot water heater. b. Set at 500kPa.
Insulation	a. Minimum 25mm thickness. b. Similar or equal to Thermotec or Aeroflex. c. Mineral wool or fibre glass insulation will not be accepted.
Safe Trays	a. 0.6mm copper sheet as per AS3500.4.
Gas Flue Pipes	a. Individual flue pipes must be installed to each hot water unit. b. Each flue pipe must be terminated with a flue cowl.
Hot Water Circulating Pumps	a. Dual pump system must be installed with a duty and standby arrangement and auto changeover every 12 hours. b. Certified for potable water use to AS4020. c. Supplied by a pump manufacturer as a complete packaged system mounted on a base with manifold, valves and control panel. d. Pump control panels shall provide auto/off/manual switches for each pump and a main isolation switch for the controller with traffolyte labelling indicating electrical supply details. e. Pump controllers shall provide indicator lights for each pump indicating power on, pump run, pump fail. f. Pressure gauges to be installed on the inlet and outlet of each pump. g. Enable removal of one pump while the other is in operation. h. Monitored by BMCS. – including pump 1 and pump 2 run, fault, supply and return temperatures. i. All hot water circulating pumps must be Grundfos type, or approved equivalent.
Pipework	a. As per domestic cold water services.
Tempering Valves	a. Tempering valves preferred for student accommodation facilities. b. Tempering valves must be located at a maximum height above floor of 1500mm and readily accessible for ease of maintenance without the need to climb ladders or scaffolding. c. RMC Heatguard type or approved equivalent.
Thermostatic Mixing Valves (TMV's)	a. TMV's to be placed in a lockable stainless steel box, recessed and clear of obstructions. b. TMV's must be located at a maximum height above floor of 1500mm and readily accessible for ease of maintenance or testing without the need to climb ladders or scaffolding. c. Each TMV must be labelled with a traffolyte label stating valve number and room number(s) the device is supplying warm water to. d. Where installed to serve laboratories, must be located outside of each laboratory near the main entry to each laboratory. e. Provide a traffolyte label on the box cover indicating "Thermostatic Mixing Valve – this valve requires regular servicing by a qualified person", identifying the room(s) that the TMV serves. f. TMVs to be Enware Aquablend or Gentec Flowmix Thermostatic Mixing Valves, or approved equivalent.

6.6 Rainwater harvesting and Water Re-use

6.6.1 General

For new buildings and buildings undergoing significant refurbishment, a rainwater harvesting and water re-use system must be considered for installation to suit the requirements of the University of Sydney Sustainability Framework document.

6.6.2 Design and Installation Criteria

Rainwater re-use systems must collect rainwater from building roofs only and store the water in a dedicated rainwater re-use tank separate to any Stormwater On-Site Detention (OSD) storage requirements. Stormwater collected from trafficable balconies, hard surfaces external to the building and water collected from sub-soil drainage must not be piped to the rainwater re-use tank. Fire system annubar test water may be piped to the re-use tank, however fire system drainage pipework must not be piped to the re-use tank due to the contaminants within the fire system pipework.

To reduce the possibility of contamination of the rainwater re-use tank, first flush systems must be installed on all rainwater re-use pipework prior to entry to the tank. Access for maintenance must be provided to all first flush systems.

Rainwater tanks must be suitably sized to suit the demand of the rainwater being re-used throughout the system, the size of the roof area use to capture rainwater and the Bureau of Meteorology rainfall statistics for the local area. Rainwater harvesting and re-use calculations must be submitted for approval to support the system design, as per the Sustainability Framework document.

Rainwater must be treated prior to re-use and piped to a dedicated rainwater re-use pipework system. The rainwater treatment plant must be an automated/timed system and must include a mixture of mechanical filtration, chemical dosing, backwash or disinfection processes to ensure the quality of water supplied to the system complies with current NSW Health and all applicable guidelines, regulations and standards applicable for the treatment and re-use of water.

Metering to measure the quantity of rainwater re-used must be installed.

A potable cold water supply must be provided to the re-use system to accommodate periods of low rainfall. This supply must be connected to the tank with an appropriate air gap, be protected using RPZDs and be sub-metered as a potable “top-up” supply. The potable water supply must also be piped and valved to allow the rainwater re-use tank and water treatment plant to be fully bypassed and served only by the domestic cold water supply.

Submit to UI the following information for approval, before installation:
a. Layout of the rainwater tank, first flush system and tank overflows.
b. Arrangement of pumps, potable make-up, filtration and sterilisation systems.
c. Arrangements of all tank access hatches, float switches, tank drains and connections.

Prior to the rainwater re-use system being brought into service, the re-use tank must be thoroughly flushed out with clean water and fully sterilised. In addition to the University witnessing this process, the consultant/contractor must provide documentary evidence confirming the provision of this process.

Internal access to rainwater storage tanks must be provided to allow for cleaning. Vehicle access must also be provided to allow the tank to be pumped out by a vacuum pump truck. The consultant/contractor must provide a risk assessment fully detailing the safety aspects to be applied when draining, accessing, pumping out and cleaning the rainwater tank.

Rainwater re-use may be used for the following functions, subject to University approval:
a. Irrigation.
b. Urinal & Cistern Flushing.
c. Cooling Tower Water.

6.6.3 Equipment and Materials

All equipment, materials and fixtures installed in rainwater harvesting and re-use applications must be approved for use in such systems.

Item	Rainwater Harvesting & Water Re-use Equipment & Materials
Tank	a. Rainwater re-use tanks must be 316 stainless steel (external to the building) and 304 stainless steel (internal to the building) modular panel type tanks, externally bolted. b. Panel tanks must be installed on raised supporting beams allowing access to visually inspect the underside of the base of the tank. c. A minimum clear distance of 500mm around each wall of the panel tank must be provided to allowance maintenance and inspection of the tank walls. d. Access ladders and lockable access covers to allow internal tank inspection and cleaning must be provided. e. Tank water level indicators must be installed. f. Tank filling valves must be Philmac servo type or approved equal. g. Bladder or liner tanks will not be accepted. h. Incoming pipework to the rainwater tank must be installed so that the tank can be bypassed in case of maintenance during periods of rain.
Rainwater pump sets	a. High efficiency pumps with variable speed drives. b. A minimum dual pump system arrangement must be installed with a duty and standby and auto changeover every 12 hours. c. Certified for potable water use to AS4020. d. Supplied by a pump manufacturer as a complete packaged system mounted on a base with manifold, valves and control panel. e. Pump control panels shall provide auto/off/manual switches for each pump and a main isolation switch for the controller with traffolyte labelling indicating electrical supply details. f. Pump controllers shall provide indicator lights for each pump indicating power on, pump run, pump fail. g. Pressure gauges to be installed on the inlet and outlet of each pump. h. Enable removal of one pump while the other is in operation. i. Individually monitored by BMCS including pump run and fault status. j. All rainwater water pump sets must be Grundfos type, or approved equivalent. k. All VSD drives shall be Grundfos or Hydrovar type. l. Pumps located within the rainwater tank (submersible or submerged pumps) are not permitted.
Filtration/Treatment Plant	a. Supplied by a water filtration/treatment plant manufacturer as a complete automated system to suit the proposed rainwater reuse function. b. Proposed water filtration plant and equipment must be submitted to UI for approval complete with manufacturer's maintenance requirements and budget costing over the life cycle of the equipment. c. At a minimum the rainwater filtration system must incorporate dual UV filters, dual bag filters and dual automatic backwash filters. d. Automatic backwash filters must operate on a set timer and pressure differential control with the capability for manual backwashing. No interruption to water supply to occur during backwash cycle. e. Install a by-pass pipework arrangement around each assembly to enable the system to run while one component is down. f. Monitored by BMCS to provide individual alarms for run, fault, high pressure differential and UV run time. g. Water filtration units must be JUDO or approved equivalent.

Pipework	a. The use of PE and PEX plastic piping systems for rainwater re-use is preferred. b. For further details relating to PE and PEX piping and jointing systems, refer to cold water services equipment and materials c. All pipes shall be installed at a minimum of 600mm cover, shallower cover will not be accepted without prior approval from UI.

6.7 Sanitary Plumbing & Sewer Drainage

6.7.1 General

The sewer and trade waste drainage network serving the University of Sydney is a complex arrangement of Sydney Water owned infrastructure and University owned infrastructure. During the design development phase of the project the consultant/contractor must determine the sewer and trade waste demand requirements for the project and determine if the existing infrastructure is capable of meeting the project requirements.

The consultant/contractor must allow to investigate and obtain all available details of the existing sewer and trade waste infrastructure applicable to the project, including the location and survey of underground services, dilution pits, silt arrestors, etc, as required. This includes obtaining details of the existing Sydney Water Trade Waste Agreement. Where existing information required for the design development is not available, the project team must arrange further investigative works.

Where new or modified connections to the existing sewer infrastructure are required for the project works, the consultant/contractor must provide an application for connection to either Sydney Water or UI, dependent upon which party owns the asset. Where required, this must include providing details to UI to accommodate the revised discharge trade waste into the Sydney Water sewer including Arrestor sizing and proposed loads on the system.

All sanitary and trade waste discharged to sewer must meet the requirements of Sydney Water.

6.7.2 Design and Installation Criteria

The following general design and installation criteria for sewer/trade waste/sanitary plumbing and drainage must be adopted by the consultant/contractor for all projects.

Item	**Sanitary Plumbing & Sewer Drainage Criteria**
Sewer/Trade Waste Access Chambers and Pits	a. Pits and inspection chambers must be constructed of precast or cast in situ concrete to suit Sydney Water requirements. b. Pits must be fitted with gas tight access covers compatible with gatic lifting keys or approved equivalent methods of lifting. c. Pit covers must be of Class D rating wherever accessible to any vehicle movement and Class C in all other locations. d. Pit cover identification plates must be installed on all pits lids. Identification plates shall indicate the service type (i.e. sewer waste, lab waste, grease arrestor, dilution pit, sewer pump, etc), flow direction, depth and downstream diameter. Identification plates shall be brass, epoxy resin screw set flush with the pit cover. e. Where a pit is identified as a confined space, pit covers shall be provided with standard confined space signage. f. Pit covers that accommodate infill paving are acceptable provided the edge of the frame and the cover are each a minimum of 5mm thick with the cast elements extending to the surface of the paving.

	g. Covers that utilise edge plates attached to the cast lid to enclose infill paving as the interface between the cover and the frame are not acceptable. h. Access ladders or step irons must be provided to comply with WHS requirements, where access to the pit or chamber is required for maintenance purposes. i. Cover lifting keys must be provided. j. Pits or access chambers must be installed at each change in direction of a main sewer line. k. Trade waste pits can be HDPE, Halgan or approved equivalent.
Gravity & Pumped Drainage	a. Gravity sanitary plumbing and sewer drainage must be provided for all buildings. b. Where the depths of fixtures prevent gravity drainage connections to existing infrastructure, pumped drainage may need to be considered. c. All pumped drainage solutions must be submitted to UI for approval with sufficient information demonstrating that gravity drainage cannot be achieved. d. Rising mains shall be installed in an accessible location above ground wherever possible. e. Submit calculations to UI for pit sizing, storage capacity, float levels, pump run time and emergency storage capacity.
Sizing	a. All toilet pans minimum 100mm. b. The sanitary plumbing and drainage system must be sized in accordance AS3500, based on fixture loading units with a diversity factor and 20% spare capacity for future loading.
Venting	a. Modified venting system using relief, group and branch vents must be installed for combined soil and waste stacks. b. Air Admittance Valves (AAV's) must not be installed on any sanitary drainage or trade waste drainage pipework. c. All vents including sewer, boundary trap, chamber and trade waste vents are to extend to discharge location above roof level. Low level vents, including Induct Pipe Mica Flap (IMPF) vents must be approved by the issuer of this standard. Formal requests for all variations to this Standard must be submitted using the UI Request for Dispensation Form (UI-ENG-F001).
Drainage Pipework	a. All underground sewer and trade waste drainage must be of minimum nominal size of 100mm. b. Drainage pipes must be installed straight runs, with even falls and grades and connections made to prevent pooling and blockages. c. All in ground drainage pipework must be provided with accessible clear-outs and/or pits/access chambers to accommodate general maintenance. d. Connections between different materials must be mechanical bolted gland joints, using neoprene ring gaskets, or threaded connections. e. Flexible neoprene/rubber connections with worm drive clips ie. PlumbQwik connections, will not be accepted. f. If required, PVS repair couplings must be used to connect in difficult locations. g. For existing buildings, new pipe work material must match the existing pipe.
Stacks	a. Pipework must be concealed in accessible plumbing ducts and ceiling spaces. b. Access panels to stacks must be adequately sized to enable maintenance to be performed within the shaft.
Floor Wastes	a. Floor wastes must be installed in cleaner's rooms, toilets, washrooms, showers, plantrooms and first aid rooms.

	b. Floor waste grates must be 100mm minimum internal diameter with removable chrome plated brass grate. c. Floor waste gullies in toilet areas must not be charged from a hose cock.
Laboratory Floor Wastes	a. No open floor wastes are to be provided to rooms and areas classified as wet laboratories.
Inspection Openings (I/Os) & Clearouts (C/Os)	a. All I/Os and C/Os must be minimum 100mm diameter and installed: b. At the connection to the Sydney Water sewer. c. At the connection to the University sewer infrastructure. d. Externally adjacent to the building on each branch line entering the building e. At intervals not exceeding 30m f. On the downstream and upstream end where any existing drain passes under a building g. Where any new section of drain is connected to an existing drain including a cut into the main line h. At all junctions and all changes of direction i. At the base of each stack j. At each main connection point to the stack at each level of the building k. All I/Os and C/Os must be fully accessible and where installed in ground, provided with a flush airtight cap installed at the finished surface level. Where installed in soft landscaped surface they must be installed with a 150mm concrete surround. l. Chrome plated airtight C/O caps must be provided within each bathroom at the finished floor level at the start of each drainage line.
Trade Waste Drainage and Pre-Treatment	a. The University trade waste, within the Sydney Water area of operation is bound to a "Commercial Agreement" with Sydney Water. This agreement permits wastewater to trade waste pre-treatment devices to only have trace quantities of contaminants including chemicals. Should a Sydney Water "Industrial Trade Waste Agreement" be required, it must be approved by the issuer of this standard. Formal requests for all variations to this Standard must be submitted using the UI Request for Dispensation Form (UI-ENG-F001). The dispensation application should detail the proposed processes, pre-treatment and reasons why this is required. UI will undertake all negotiations with Sydney Water, however please note, automatic approval is not guaranteed. b. Dedicated trade waste drainage must be provided for all commercial and industrial activities as determined by Sydney Water, e.g. laboratories, food preparation areas, commercial kitchens, arts/ceramics studios, mechanical workshops, etc. c. Existing infrastructure must be fully reviewed prior to increasing trade waste discharges to pre-treatment equipment. d. Approval of Trade Waste Installations - Prior to any new project, refurbishment, redevelopment or tenancy fitout involving trade waste discharges to the sewer drainage network, the proposed works, including proposed chemicals shall be submitted to UI for approval (in partnership with Sydney Water Trade Waste Inspector). e. In ALL cases the consultant, project manager, contractor (or end user) shall first submit to UI a concept proposal of the intended trade waste pre-treatment system for "in principal approval". The concept proposal shall include: i. A detailed plan (1:100 scale min) showing the proposed process & location of the works. ii. The proposed equipment/process to be installed including any chemicals to be used in the process.

	iii. Details of the proposed arrestor, treatment system, floor wastes, vents, baskets, any chemical storage associated with the treatment, etc. iv. Proposed access requirements for cleaning & maintenance v. Chemical manifest of discharge. vi. Proposed method of waste treatment. vii. Any other relevant information (number of seats in a restaurant, meals served, temperature of waste discharge, etc.) f. The contractor then must prepare a formal "application for connection to discharge wastewater" to Sydney Water. g. Minimum trade waste pre-treatment requirements are determined by Sydney Water. These include Sydney Water approved pre-treatment equipment for grease traps, dilution pits, bucket traps, basket arrestors, sediment pits, general purpose pits, plaster traps and oil separators. h. The consultant/contractor must determine with the project user group and stakeholders, the detail and quantity of the trade waste discharge in order to determine the size and type of trade waste pre-treatment required for the project. i. All trade waste pre-treatment equipment must be submitted for approval prior to installation. Where the proposed equipment is not listed as Sydney Water approved, formal confirmation of acceptance must be obtained from Sydney Water before installation. j. Install a basket arrestor on the inlet to all lab dilution pits to capture pipettes. The basket arrestor shall be SMC Lint Basket TT150 or approved equal. Arrange basket to permit maintenance without needing to enter the dilution pit. k. For ease of service, and replacement, trade waste pre-treatment equipment is preferred to be installed in above ground locations. l. For longevity and ease of cleaning, grease traps are preferred to be constructed of polyethylene materials. m. Additional pre-treatment may be required for specialised laboratories to enable laboratory certification to Office of Gene Technology Regulator (OGTR) requirements. n. Specialised requirements for treatment and storage of radioactive liquid waste must be discussed and agreed with the University radiation safety officer, UI and Sydney Water.
Condensate Drainage	a. Separate condensate drainage pipework must be installed for each item of mechanical plant producing condensate. b. Installed with continuous fall to termination point. c. Insulated and labelled to termination point. d. Minimum 25mm diameter. e. Installed in an accessible position. f. Drainage to external landscape and hardstand areas must be terminated over a gully. g. Drainage to internal/roof areas must be terminated via a tundish of appropriate size, connected above the water seal of a waste trap and installed 50mm minimum above surcharge point e.g. basin/sink.
HWU Relief Valve Drainage	a. Hot water unit temperature and pressure relief valve termination point must be via a tundish.
Building Management Control System (BMCS)	The following sanitary plumbing and drainage equipment must be connected and monitored by the BMCS in real time: a. Sewerage Pumps – individual pump run/fault alarms. b. Sewerage Pit – high/ low level alarm.

	c. Sewerage Treatment Plant - HLI connection.

6.7.3 Equipment and Materials

All equipment, materials and fixtures installed in sanitary plumbing and sewer drainage must where applicable, be approved for use by Sydney Water.

Item	Sanitary Plumbing & Sewer Drainage Equipment & Materials
Gravity Sanitary Plumbing and Sewer Drainage Pipe Above/Below Ground	a. The UI Permit to Dig Form (UI-ENG-F003) must be submitted and approved by UI prior to installing or repairing any pipework located below ground. b. Best Environmental Practice (BEP) certified UPVC, Class DWV in accordance with AS1260, AS2032 (pipe) & AS3789 (jointing), for pipes equal to and less than 300mm internal diameter and installed no more than 3m deep. c. Copper Type B in accordance with AS 1432 (pipe) and AS 3688 (fittings), for 2m downstream from hot water units, steam boilers and wherever wastewater may be discharged at above 60^{0}C. d. Vitrified Clay Pipes installed in accordance with AS 1741 and approved by Sydney Water, for pipe installed greater than 3m deep. e. The pressure class of drainage pipework, jointing methods and pit cover design must be considered in relation to the depth that the pipe is installed to. f. Underground pipe warning tape and trace wire must be installed 150mm above all underground pipes for the full length of the pipe. g. Warning tape is to be made of durable plastic with a minimum width of 300mm and colour to match AS1345. h. Line marking identification plates must be installed at pipework changes in direction and at 50m intervals. Identification plates shall indicate the service type, flow direction, depth and diameter. Identification plates shall be brass, epoxy resin screw set flush with the surrounding surface. For services in soft landscaping a concrete fixing block must be provided. i. Drainage lines must be laid at a minimum grade of 0.65%. Drainage solutions at less than 0.65% grade must be submitted to UI for approval with sufficient information demonstrating that pipe sizes, fixture unit loadings and proposed flows can be conveyed at the reduced grade.
Stacks installed external to a building	a. Copper Type B in accordance with AS 1432 (pipe) and AS 3688 (fittings).
Stacks and vents serving toilet areas and internal to a building	a. Best Environmental Practice (BEP) certified UPVC, Class DWV in accordance with AS1260, AS2032 (pipe) & AS3789 (jointing).
Stacks, vents and drainage for laboratories and trade waste	a. Laboratory and Trade Waste pipework must be installed in HDPE Pipe and Fittings in accordance with AS4401 (pipe) AS2033 (jointing) and manufacturer's instruction. b. Jointed using butt welding, electric welding sleeves or socket connections with plug in and expansion couplings. c. Geberit or approved equivalent.
Pumped Drainage	a. Pressure pipe suitable for proposed pressures.
Vent pipes installed external to a building	a. Copper Type D in accordance with AS1432 (pipe) and AS3688 (fittings).
Roof penetrations	a. Install flashing to all pipe penetrations through roofs in accordance with the UI Roofing and Guttering Standard.

Clear outs/Flushing Points	a. PVC bolted trap screws with brass lid of appropriate size as per manufacturer's instructions.
Sewage Pumps	a. Sewage pumps must be grinder type pumps installed in pits. b. Dual pump system must be installed with a duty and standby arrangement and auto changeover every 12 hours. c. Supplied by a pump manufacturer as a packaged system complete with control panel. d. Enable removal of one pump while the other is in operation. e. Guide rails and lifting devices must be installed in situ to allow the easy removal of the pump from the pit and replacement. f. The pumps must be connected to the BMCS to provide monitoring of the status of the pumps and to provide a high and low level alarm. g. An alarm bell must operate on a fault and high level alarm. The alarm bell must be located in a public area. h. Sewage pumps and control panels must be Grundfos or approved equivalent. i. Pump control panels shall provide auto/off/manual switches for each pump and a main isolation switch for the controller with traffolyte labelling indicating electrical supply details. j. Pump controllers shall provide indicator lights for each pump indicating power on, pump run, pump fail, high level alarm.

6.8 Stormwater and Subsoil Drainage

6.8.1 General

The stormwater drainage network serving the University of Sydney is a complex arrangement of Sydney Water, Council, Roads & Maritime Services (RMS) and University owned infrastructure. During the design development phase of the project the consultant/contractor must determine the stormwater demand requirements for the project and determine if the existing infrastructure is capable of meeting the project requirements.

The consultant/contractor must allow to investigate and obtain all available details of the existing stormwater infrastructure applicable to the project, including the location and survey of underground services, on site detention tanks, as required. Where existing information required for the design development is not available, the project team must arrange further investigative works.

Where new or modified connections to the existing stormwater infrastructure are required for the project works, the consultant/contractor must provide an application for connection to whichever party owns the asset.

All stormwater and sub-soil discharges must comply with water quality and discharge rates, in accordance with Sydney Water, City of Sydney Council DCP for water and flood management, and NSW EPA requirements. Erosion and sediment control plans must be adopted for all new developments and refurbishment projects which affect stormwater runoff.

WSUD principles must be considered for all new buildings and public domain redevelopments in accordance with the UI Sustainability Standard.

Overland flow paths, flood mitigation measures and communal on site detention strategies must be assessed and incorporated as part of all new developments. This includes modifying the University TUFLOW Flood Model to incorporate proposed developments, stormwater drainage modifications and landscaping affecting overland flow paths.

Further details regarding roof drainage requirements can be obtained from the UI Roofing and Guttering Standard.

6.8.2 Design and Installation Criteria

A combination of adequate drainage, tanking and waterproof membranes must be designed and installed to remove the possibility of stormwater and groundwater ingress to all buildings from roofs, gutters, balconies, planter boxes, overland flow paths and seepage.

The following general design and installation criteria for stormwater and sub-soil drainage must be adopted by the consultant/contractor for all projects.

Item	Stormwater & Subsoil Drainage Criteria
Roof & Balcony Drainage	a. Downpipes and box gutters sized to drain a 1% AEP storm event. b. Eaves gutters sized to drain a 5% AEP storm event. c. Roof and box gutter overflows suitable to relieve runoff from a 200 year average recurrence interval (ARI) storm event. d. Box gutters are not to be installed without prior approval from UI.
Stormwater Drainage	a. External stormwater drainage network in areas with sufficient overland flow paths must be sized to drain a 1:20 year (5%) AEP storm event. b. External stormwater drainage network in areas with trapped low points with no overland flow paths must be sized to drain a 1% AEP storm event. c. All calculations relating to pit inlet capacities shall allow for a 50% blockage factor. d. Drainage lines must be laid at a minimum grade of 1%. Drainage solutions at less than 1% grade must be submitted to UI for approval with sufficient information demonstrating that pipe sizes, HGL and proposed flows can be conveyed at the reduced grade.
Gravity & Pumped Drainage	a. Gravity roof and balcony drainage must be provided for all buildings. b. Stormwater drainage must not be pumped under any circumstances. c. Where the locations of water capture prevent gravity drainage connections to existing infrastructure, such as sub-soil and seepage drainage connections, pumped drainage may need to be considered. d. All pumped drainage solutions must be submitted to UI for approval with sufficient information demonstrating that gravity drainage cannot be achieved.
Stormwater Access Chambers and Pits	a. Pits and inspection chambers must be constructed of precast or cast in situ concrete to suit Sydney Water requirements. b. Pits must be fitted with access covers compatible with gatic lifting keys or approved equivalent methods of lifting. c. Covers must be of Class D rating wherever accessible to any vehicle movement and Class C in all other locations. d. Pit cover identification plates must be installed on all pits lids. Identification plates shall indicate the service type (i.e. stormwater, sub-soil, seepage, etc), flow direction, depth and downstream diameter. Identification plates shall be brass, epoxy resin screw set flush with the pit cover. e. Where a pit is identified as a confined space, pit covers shall be provided with standard confined space signage. f. Pit covers that accommodate infill paving are acceptable provided the edge of the frame and the cover are each a minimum of 5mm thick with the cast elements extending to the surface of the paving. g. Covers that utilise edge plates attached to the cast lid to enclose infill paving as the interface between the cover and the frame are not acceptable. h. Access ladders or step irons must be provided in accordance with WHS requirements where access to the pit or chamber is required for maintenance purposes. i. Cover lifting keys must be provided.

	j. Pits or access chambers must be installed at each change in direction of all stormwater pipework.
Drainage Pipework	a. All above ground stormwater drainage must be of minimum nominal size of 100mm. b. All below ground drainage pipework must be of minimum of nominal size of 150mm. c. Drainage pipes must be installed straight runs with even falls and grades and connections made to prevent pooling and blockages. d. All roof plumbing incorporating close coupling joints must be statically tested. e. Inspection openings must be installed on or below any junction or bend greater than 85^0. f. Pipes between grated inlet pits shall be a minimum of 225mm diameter. g. Stormwater drainage pipework and downpipes must not be cast into structural elements of the building (i.e. columns etc).
Syphonic Drainage	a. Syphonic drainage can only be considered on flat roofs with adequate rain heads. b. Syphonic drainage systems must be designed, installed, commissioned and certified by an approved specialist syphonic drainage contractor, by Syfon, Geberit or approved equivalent. c. Syphonic rainwater outlets must be made of robust materials, suitable for the installed location. d. Outlets must incorporate leaf guards to restrict the entry of debris into the system without restricting the flow. e. Proposed syphonic drainage system must be submitted to UI for approval complete with manufacturer's warranty and maintenance requirements and budget costing over the life cycle of the equipment.
Subsoil/Seepage Drainage	a. Installed below all slabs on ground, at the base of all retaining walls and for all stormwater pits. b. Subsoil/seepage water quality must be sampled to determine if the water quality is suitable to drain to stormwater or requires water treatment. c. Dish drains with adequate falls and outlets must be installed adjacent to all piled walls to capture subsoil/seepage water. d. Capped flushing points must be provided for all subsoil and seepage drainage systems at the end of each pipe, at 30m spacing and at changes in directions.
Inspection Openings (I/O's) and Clearouts (C/O's)	a. I/O's and C/O's must be a minimum of 100mm diameter provided at every junction, bend, change of direction and at the base of all downpipes immediately above where the downpipe penetrates the ground or slab on ground. b. They must provided at the end of each bank of toilets.

6.8.3 Equipment and Materials

All equipment and materials installed in stormwater and sub-soil drainage must where applicable, be approved for use by Sydney Water.

Item	**Stormwater and Subsoil Drainage Equipment & Materials**
Stormwater Drainage Pipework Below Ground	a. The UI Permit to Dig Form (UI-ENG-F003) must be submitted and approved by UI prior to installing or repairing any pipework located below ground. b. Best Environmental Practice (BEP) certified UPVC, Class DWV in accordance with AS1260, AS2032 (pipe) & AS3789 (jointing), for

	pipes less than 300mm internal diameter and installed no more than 2.5m deep to the invert of the pipe. c. Precast Reinforced Concrete Pipes – Class 4 with rubber ring joints in accordance with AS1342, for pipes equal to or greater than 300mm internal diameter or installed greater than 2.5m deep to the invert of the pipe. d. Fibre Reinforced Cement Pipe (FRC) – Class 4 with rubber ring joints to suit AS4139, and AS3725, for pipes with internal diameters between 300mm and 600mm and installed greater than 2.5m deep to the invert of the pipe. e. The pressure class of drainage pipework, jointing methods and pit cover design must be considered in relation to the hydraulic grade line and depth that the pipe is installed to. f. Underground pipe warning tape and trace wire must be installed 150mm above all underground pipes for the full length of the pipe. g. Warning tape is to be made of durable plastic with a minimum width of 300mm and colour to match AS1345. h. Line marking identification plates must be installed at pipework changes in direction and at 50m intervals. Identification plates shall indicate the service type, flow direction, depth and diameter. Identification plates shall be brass, epoxy resin screw set flush with the surrounding surface. For services in soft landscaping a concrete fixing block must be provided. i. All underground stormwater pipes are to have a minimum of 600mm cover where installed in landscaping or in roadways. Cover under building slabs may be reduced with UI approval.
Internal Gravity Stormwater Downpipes	a. Best Environmental Practice (BEP) certified UPVC, Class DWV in accordance with AS1260, AS2032 (pipe) & AS3789 (jointing). b. HDPE Pipe and Fittings in accordance with AS4130 (pipe) AS2033 (jointing) and manufacturer's instruction.
External Gravity Stormwater Downpipes	a. Copper Type D in accordance with AS1432 (pipe) and AS3688 (fittings).
Syphonic Drainage Pipework	a. HDPE Pipe and Fittings in accordance with AS4130 (pipe) AS2033 (jointing) and manufacturer's instruction. b. Jointed using butt welding, electric welding sleeves or socket connections with plug in and expansion couplings. c. All pipe and fittings must be verified by the approved specialist syphonic drainage contractor. d. Pipework to be Syphon, Geberit or approved equivalent.
Subsoil Drainage Pipework	a. Factory slotted HDPE, minimum 100 diameter SN8 class, similar or equal to Vinidex Draincoil, for installation to a maximum depth of 2 metres. b. Best Environmental Practice (BEP) certified UPVC, factory slotted, minimum 100 diameter, in accordance with AS1260, AS2032 (pipe) & AS3789 (jointing). c. Installed on geotextile fabric with 150mm surround of 25mm blue metal aggregate. d. Subsoil drainage pipework must be installed with a filter sock. e. Joined with solvent cement joints
Pumped Drainage Rising Mains	a. Pressure pipe suitable for proposed pressures.
Inground Stormwater Structures	a. Stormwater pits, kerb entry pits, sumps and grated drains must be precast or cast in situ concrete. b. Access ladders or step irons must be provided where access to the pit or chamber is required for maintenance purposes. c. Frames, covers and gratings for pits, sumps and drains must be provided to suit Class D duties.

	d. Cover lifting keys must be provided. e. On site detention tanks shall not contain any maintainable filters or equipment associated with water quality control measures, other than the trash screen on the OSD discharge pipe. f. Preferred structures to achieve water quality control measures include pit screens and filtration, GPT's and Humes Jellyfish. g. Enviropods are not to be installed, without specific approval from UI. h. WSUD structures to achieve water quality control measures include bio retention swales and rainwater gardens must be considered.
Subsoil Pumps	a. Subsoil pumps must be submersible type installed in pits. b. Dual pump system must be installed with a duty and standby arrangement and auto changeover every 12 hours. c. Supplied by a pump manufacturer as a packaged system complete with control panel. d. Enable removal of one pump while the other is in operation. e. The pumps must be installed complete with galvanised mild steel lifting rails and chains to enable pump to be lifted clear of pit for maintenance without entry into the pit. All pump out control valved and Non-return valves shall be located out of the pump well for access clear of the confined space. f. Bore pumps installed in a horizontal plane must not be installed under any circumstances. g. The pumps must be connected to the BMCS to provide individual monitoring of the fault and run status of the pumps, and to provide high and low level alarms. h. An alarm bell must operate on a fault and high level alarm. The alarm bell must be located in a public area. i. Subsoil pumps and control panels must be Grundfos or approved equivalent j. Pump control panels shall provide auto/off/manual switches for each pump and a main isolation switch for the controller with traffolyte labelling indicating electrical supply details. k. Pump controllers shall provide indicator lights for each pump indicating power on, pump run, pump fail, high level alarm.
Grated Drains	a. Made of robust materials suitable for the installed location. b. Grating sizes and materials must be assessed to maximise drainage potential but eliminate WHS issues relating to slips, trips and falls. c. Grates must be fixed in position to reduce potential vandalism but must enable easy removal via a key or tool to allow maintenance and replacement. d. Grates in high pedestrian areas shall be heel guard type. e. Grates in all roads and cycle paths shall be bicycle safe type.
Rainwater Outlets (RO's)	a. Circular RO's to be minimum 260mm diameter. b. Square RO's to be minimum 200mm square. c. All RO's to be provided with guards to prevent the ingress of litter, gravel and leaves.

6.9 Natural Gas Services

6.9.1 General

The gas supply network serving the University of Sydney is a complex arrangement of Jemena owned infrastructure and University owned infrastructure. During the design development phase of the project the consultant/contractor must determine the gas supply demand requirements for the project and determine if the existing infrastructure is capable of meeting the project requirements

The consultant/contractor must allow to investigate and obtain all available details of the existing infrastructure, including the location and survey of underground services, as required. Gas supply enquiries must be submitted to the University, Jemena and the University gas retailer, as required for the project, and all fees and charges applicable for this information must be allowed for. Where existing information required for the design development is not available, the project team must arrange further investigative works.

Where new connections to the existing gas supply infrastructure are required, the consultant/contractor must confirm details of the proposed consumption for all gas appliances being installed under the project works in conjunction with assessing the metering pressure available. These details must be submitted to Jemena and the University to ensure the incoming gas service, meter/sub-meter and regulator assembly is capable of providing the required consumption.

Where new gas regulators, gas meters or sub-meter assemblies are required to be installed under the project, the consultant/contractor must pay all costs associated with the supply and installation of the equipment as required for the project works.

6.9.2 Design and Installation Criteria

The natural gas service must be designed and installed to suit the requirements of AGL and Jemena.

The following general design and installation criteria for natural gas services must be adopted by the consultant/contractor for all projects.

Item	**Natural Gas Services Criteria**
Gas Pressure	a. High and medium pressure gas supply must not be installed internally within a building without prior approval from UI. b. Under and over pressure shut off regulators must be installed to suit Jemena requirements to reduce high pressure to low pressure gas supplies. c. Vent pipes from gas regulators must be installed and terminated in locations approved by Jemena.
Gas Supply Metering	a. High and medium pressure gas metering assemblies must be installed externally to the building in accordance with Jemena requirements. b. Each building must have its own University low pressure gas sub-meter assembly. Size meters for the minimum probable demand rather than maximum possible to ensure small losses are identified. c. Gas meters must be diaphragm type meters. Rotary meters shall be equal in all respects to Kromschroder or Accutherm International (EMG-EMR) and where proposed for use, shall be submitted to UI for approval before installation. Turbine meters must not be installed. d. Connection and setup to the AUMS system for all gas metering is to be provided. e. All gas meters connected to AUMS system must be assessed as either hazardous or non-hazardous for electrical installations, by an accredited hazardous area assessor. Written classification of each hazard assessment must be provided prior to connection to the AUMS. f. All gas meters assessed as hazardous must be provided with intrinsically safe devices in accordance with Jemena requirements. g. Externally located meters shall be housed within weatherproof enclosure where installed outside buildings.
Service Isolation	a. Provide individual gas service isolation points that enable isolation of each gas supply to each building. b. Isolation points must not interfere with the provision of gas services to adjoining buildings.

Laboratory Isolation	a. Provide isolation valves for all gas supplies to each laboratory. b. Isolation points are to be located at the entry to the laboratory and be clearly labelled.
Purging	a. All gas pipework must be purged with nitrogen in accordance with the Authorities requirements.
Gas Heaters and Appliances	a. All gas appliances other than cooktops and ovens must be flued to the outside of building. b. All gas appliances must be provided with flame supervision devices.
Cooktops	a. Gas cooktops and ovens must include flame supervision devices on each burner.
Automatic Gas Shutdown Devices	a. Automatic gas shutdown devices connected to fire alarm systems must not be provided unless required by statutory requirements. b. The provision of flame supervision devices on all gas appliances is proposed to remove requirements for automatic gas shutdown in fire mode.

6.9.3 Gas Metering

Each building must be provided with its own Jemena meter and/or University owned sub-meter assembly. All meters must be rated for revenue billing in commercial applications in addition to being suitable for monitoring of complex gas supply networks.

All meter and sub-meter assemblies installed must be "smart meter" type with multiple pulsed outputs for increased real time data to provide water management information. These meter assemblies must be compatible for connection to the AUMS via a set of voltage free contacts.

Meters must be suitable for measuring bulk flows of natural gas.

Sub-meter assemblies must be installed within the building to measure gas supplies for the following systems/areas:

a. Centralised Potable Hot Water Systems.
b. Centralised Non-Potable Water Systems.
c. Heating Hot Water Boilers and Humidification/Dehumidification Equipment.
d. Steam Boilers.
e. Laboratory Supplies.
f. Commercial Kitchens/Communal Kitchens in Student Accommodation facilities.
g. Spaces proposed for tenancy leasing agreements.

Where meter assemblies are connected directly to the Jemena gas supply network, the contractor must make application to and pay for all fees for Jemena to supply a new meter assembly.

Gas meters must be installed in fully accessible positions to allow for easy reading and servicing. Individual isolation valves must be provided for each gas meter assembly.

The consultant/contractor must coordinate the location, meter type and data output with other building services consultants/contractors to ensure the installed meters are fully compatible with the AUMS and adequate communication network connection points have been provided.

The University utilises the services of an energy advisor to manage changes to utility metering and accounts at The University. The energy advisor must be made aware of any changes to utility metering or accounts. This includes requests for new meters, transfer of accounts, or disconnection of existing meters. It is the project team's responsibility to ensure that the correct documentation is provided to the energy advisor within the timeframes stipulated. The process for requesting changes to utility metering or accounts is outlined at **http://sydney.edu.au/about/working-with-us/contractors.shtml**.

All new gas meters and sub-meters must be connected to the AUMS. Allowance for modifications to, AUMS programming, including meter hierarchy must be included for all new meters and sub-meters. For further information refer to the UI AUMS Standards.

6.9.4 Equipment and Materials

All equipment and materials installed in natural gas systems must where applicable, be approved for use by AGL and Jemena.

Item	Natural Gas Equipment & Materials
Pipework Above Ground	a. Copper Type B in accordance with AS 1432 (pipe) AS 3688 (fittings) b. The use of non-metallic gas supply pipe in above ground locations will not be accepted.
Pipework Below Ground	a. The UI Permit to Dig Form (UI-ENG-F003) must be submitted and approved by UI prior to installing or repairing any pipework located below ground. b. Copper Type B in accordance with AS 1432 (pipe) AS 3688 (fittings). c. Nylon tube in accordance with AS2944.1 (pipe) and AS 2944.2 (fittings), Class 300. d. To suit pressure and service in accordance with AS 4645, AS 5601-2010 and Jemena Network Operating Rules. e. All metallic pipes installed underground must be installed in polyethylene green sleeve protection bag. f. Underground pipe warning tape and trace wire must be installed 150mm above all underground pipes for the full length of the pipe. g. Warning tape is to be made of durable plastic with a minimum width of 300mm and colour to match AS1345. h. Line marking identification plates must be installed at pipework changes in direction and at 50m intervals. Identification plates shall indicate the service type, flow direction, depth and diameter. Identification plates shall be brass, epoxy resin screw set flush with the surrounding surface. For services in soft landscaping a concrete fixing block must be provided. i. Pipework shall be installed to maintain a minimum of 600mm of cover over the pipe. j. The use of alternative non-metallic pipe in underground locations will not be accepted without prior approval from UI.
Copper Jointing	a. 15% Silver soldered joints for all pipe sizes. b. Viega Propress G compression fittings for copper pipe sizes equal to or less than 65mm diameter using specialised pressing tools in accordance with the manufacturer's instructions, for above ground applications only. c. High pressure system 15% silver solder. d. Medium/Low pressure systems 15% silver solder for other services. e. Minimum 6mm lapped joints. f. Joints must be made from preformed copper tees. Site or factory fabricated copper tee joints are not permitted. g. The use of alternative compression press fittings will not be accepted without prior approval from UI.
Nylon Tube Jointing	a. Adhesive joints as per manufacturers requirements
Exposed Pipework Valves and Fittings	a. Must be chrome plated wherever they are exposed outside of plant areas.
Gas Valves	a. Spherical ball type in accordance with AS4617. b. Up to and including 50mm diameter must be screwed type. c. Above 50mm diameter must be flanged type.

Flues	a. Stainless steel flue pipes must be installed to all gas appliances with flues. b. Flue cowls must be installed to all flues.

6.10 Sanitary Fixtures, Tapware and Associated Equipment

6.10.1 General

All sanitary fixtures and tapware installed must incorporate a high level of water efficiency. Water saving devices must include aerated tap fittings, water flow restriction devices, dual flush toilets, low flush urinals and high efficiency showerheads.

Fixtures and tapware installed must be low maintenance with a design life expectancy of 15 years.

All fixtures, tapware and appliances are to have the Watermark approved certification and be provided with full product support, including spare parts and technical assistance, within the Sydney area.

The requirements for sanitary fixtures, tapware and associated equipment must be read in conjunction with the architectural room data sheets. Where inconsistencies between the equipment specified in the room data sheets and the requirements of this standard exist, the requirements of this standard shall take precedence.

6.10.2 Equipment and Materials

All materials must be first quality and the best of their respective kinds. Second quality or inferior materials must be rejected. All costs associated with replacement of rejected materials must be the contractor's responsibility.

The following materials must be specified and installed:

Item	**Sanitary Fixtures, Tapware and Associated Equipment and Materials**
Toilet Suites (Cistern, Pan & Seat)	a. Close-coupled or wall faced design with exposed cistern. b. 4.5/3 litre dual flush system with a minimum WELS 4 Star Rating. c. Cisterns must be fitted with a vandal resistant conversion kit allowing the lid to be locked onto the cistern. d. Compliant for use with rainwater re-use systems. e. White in colour. f. Seat must be vandal resistant. g. Similar or equal to Caroma Caravelle 2000. h. Silicon sealant to be provided around the pan and cistern in a colour to match the surrounding tiles. i. Pans to be sufficiently fixed to prevent substantial movement.
Accessible Toilet Suite (Cistern, Pan and Seat)	a. Dual flush and have a minimum WELS 4 Star Rating. b. Compliant for use with rainwater re-use systems. c. White in colour. d. Compliant with AS 1428.1. e. Similar or equal to Caroma Care 800.
Squat Toilets	a. A proportion of squat toilets must be considered for installation in all major student/public toilet facilities. b. Squat toilets must be commercial quality.

	c. In-ground pans must be installed complete with anti-slip sides and distinct contoured footrests. d. Minimum WELS 4 Star Rating with 4.5 litre flush.
Urinal Suite	a. Minimum WELS 6 Star Rating. b. Smart demand urine sensing flushing system. c. Where sensor flushing controls and power supply units are located within walls or inaccessible ducts, a screwed stainless steel panel must be provided adjacent to the urinal to enable access for maintenance and replacement. d. Compliant for use with rainwater re-use systems. e. White in colour. f. Ceramic in material. g. Waterless urinals will not be accepted. h. Similar or equal to Caroma Cube 0.8L Electronic Activation Urinal Suite.
Concealed Cisterns	a. Where concealed cisterns are proposed to be installed within walls or inaccessible ducts, a screwed stainless steel panel (min 400mm x 400mm) must be provided above the pan or urinal to enable direct access to the cistern for maintenance and replacement. b. Cisterns must not be mounted in ceiling spaces.
Flusherette Valves	c. 4.5/3 litre dual flush system with a minimum WELS 4 Star Rating. d. Where flusherette valves are proposed to be installed within walls or inaccessible ducts, a screwed stainless steel panel (min 400mm x 400mm) must be provided above the pan or urinal to enable direct access to the valve for maintenance and replacement. e. Similar or equal to Pubco concealed dual flush valve.
Basins	a. Single tap hole. b. Ceramic in material. c. Overflow as standard for non-sterile environments.
Accessible Basins	a. Refer to basins details above. b. Compliant with AS 1428.1.
Cleaners Sink	a. Ceramic in material. b. Nominal size of 575mm x 435mm. c. Fitted with heavy chrome plated brass hinged grating. d. Installed directly below wall mounted hot and cold taps. e. Similar or equal to Caroma Cleaners Sink.
Tapware	a. Minimum WELS 5 Star Rating. b. Water outlets must be of the aerated type. c. Valves are to be of jumper type. d. Bright chrome plated only. e. In high use public/student use areas, cold water push button timed operation tapware must be installed to all basins. f. In staff areas hot and cold water must be supplied via mixer tapware to all basins, kitchens and tea making facilities. g. Electronic sensor taps will not be accepted for general use.
Accessible Tapware	a. Refer to tapware details above. b. Compliant with AS 1428.1.
Shower Facilities	a. WELS 3 Star Rating (>6l/min but <7.5l/min). b. Shower facilities must be provided for each building greater than 1000^{2}m GFA. c. The number of shower facilities provided must be on a sliding scale determined by the number of bicycle storage facilities required under statutory planning regulations and the University of Sydney Sustainability Framework document.
Laboratory Sinks	a. Stainless steel 316 acid resistant. b. The university Project Manager to liaise with client on plug and waste needs.

Laboratory Tapware (Non-Potable)	All non-potable laboratory sinks and fixtures are to be provided with: a. Lever/elbow action tapware for hot and cold water supplies. b. All laboratory tapware must be Enware, or approved equivalent.
Laboratory Tapware (Potable)	a. All laboratory basins and sinks are to be provided with: b. Lever/elbow action tapware for hot and cold water supplies. c. Electronic sensor taps will only be accepted in high risk laboratory areas such as PC2 and radiation facilities or similar. d. Electronic sensor tapware must be battery operated (with long life battery, i.e. > 2 years) or rechargeable type. e. Sensors for all electronic tapware must be adjusted so that the tap only operates water flow when hands are placed directly under the spout. Ensure that sensor taps operate as wave on/wave off for surgical use. f. All laboratory tapware must be Enware, or approved equivalent.
Safety Showers/Eye Wash	a. Combined hand operated stainless steel safety shower/eyewash facilities must generally be installed. b. All combined safety shower/eyewash facilities must be complete with an adequately sized and positioned bowl to capture and drain the water when the eyewash is in use. c. Where laboratory layouts do not allow combined safety shower/eyewash to be installed, an adequately sized hand wash basin must be installed under the eyewash to capture the water when in use. d. A recessed stop valve must be provided to each safety shower/eyewash facility to enable isolation of the individual unit without affecting the potable water supply to other fixtures. e. All safety shower/eye wash systems must be Enware, or approved equivalent. f. For further information refer to the University of Sydney Safety Station detail.
Combined Boiling/ Chilled Water Units	a. Each kitchen/tea making facility must be provided with a combined boiling/chilled water unit. b. The tap supplying the boiling/chilled water must be located over a sink. c. The under sink control cabinet must be located within one metre of the tap, it must be adequately ventilated and provided with sufficient clearance around all sides of the cabinet. d. All boiling/chilled water units must be sized on the proposed population use. e. Model to be equal or greater to ZIP Hydrotap BC 100/75 and supplied with a minimum of 3 year manufacturers parts and labour warranty.
Dishwashing and Washing Machines	a. Minimum WELS 5 Star Rating. b. Have anti flood technology in order to prevent water damage of premises.
Hand Driers	a. Hand driers must be installed in all student/public bathrooms. b. All hand driers to be similar or equal to Dyson Airblade db.

6.11 Equipment Labelling and Identification

6.11.1 Below Ground Services

All underground services to have marking tape of correct distances above pipework complying with relevant Australian Standards for that service. Where the service is non-metallic, provide a tape incorporating locating wire.

6.11.2 Above Ground Services

All pipework must be labelled with adhesive pipe markers indicating pipe contents or system type and directional arrows indicating flow. Markers must be installed at a minimum of every five metres.

Labelling must not be restricted only to close proximity of access panel openings.

6.11.3 Asset Labelling and Bar Coding

Equipment must be provided with asset labels and bar codes as per the latest version of the COS Asset Identification and Labelling Standard.

6.12 Pipework Installation

6.12.1 Below Ground Pipework

All pipework and services installed below ground must be fully surveyed and documented in accordance with the details required for Quality Level A, as per AS5488 - Classification of Subsurface Utility Information (SUI).

The UI Permit to Dig Form (UI-ENG-F003) must be submitted and approved by UI prior to installing or repairing any pipework located below ground.

For further details and requirements of all pipe installations below ground, please refer to the COS Excavation Standard.

CCTV recordings produced by a specialist CCTV (equal to Online Pipe & Cable Locating Services) of below ground sewer, stormwater and sub-soil drainage pipework and structures, including pits, reflux valves, detention tanks, gross pollutant traps, jellyfish, etc, must be provided prior to practical completion.

6.12.2 Above Ground Pipework

All pipe work chased into masonry walls must not cross any movement joint and must be provided with sufficient insulation so that expansion and contraction can take place without damage to pipe work or to the surrounding element and its surface finish.

6.12.3 Pipe Supports and Fastening

Spacing of pipework supports must be installed to suit:

a. AS3500.1 Spacing of Brackets and Clips.
b. AS3500.2 Maximum Spacing of Brackets, Clips and Hangers.
c. AS3500.4 Heated Water Services.
d. Every 2 metres for pipework greater than or equal to 100mm in diameter.
e. Located to separately support valves within pipework of 200mm or greater.
f. Pipe manufacturers requirements.

Inlet and outlet pipework serving pumps and other hydraulic equipment must not be used to support the equipment. All equipment must be adequately supported independently of the to the inlet and outlet pipework supports.

External and under croft areas must be installed with brackets suitable for the environment.

Materials for pipework supports must be as follows:

Item	Support Type

Channels	Use purpose made galvanised mild steel channel equal to Unistrut or approved equivalent, complete with purpose made fittings. Provide plastic end caps on exposed brackets.
Insulation Barrier	Use purpose made wooden block barriers between steel clamps and copper / steel / PVC-U pipes.
Fasteners	Galvanised bolts, nuts and washers of adequate size,

Pipe Hangers rod diameters must be as follows:

Pipe Diameter (mm)	Rod Diameter (mm)
15-25	8
32-50	10
65-100	15
150-200	20
225-450	25

Heater supports to be Baytak type, or approved equivalent, of appropriate size.

Masonry fixings must be Dynabolt type, or approved equivalent, expanding type or chemical anchors, installed in accordance with manufacturer's instructions.

Timber fixings must be stainless steel coach screws.

Use of explosive type fixings are not permitted.

6.12.4 Core Holes and Sleeves

Details of all proposed core holes in floors, walls, beams and columns must be checked and approved by a structural engineer prior to coring the hole.

All pipework passing through a core hole or masonry/concrete wall or floor must be provided with a 0.6 mm thickness sheet copper sleeve having a grooved and seamed joint. Sleeves must be cylindrical having a diameter to provide a 25mm gap all around the pipe passing through the sleeve. Alternatively, copper tubing may be used as the sleeve if a 25mm gap around the pipe can be achieved. Each pipe passing through the sleeve must be positioned centrally in the sleeve to ensure the annular space between the pipe sleeve is equal and round.

Fire rating of all pipework penetration must be installed to comply with all statutory requirements. For further information regarding fire rating of pipe penetrations, refer to the UI Essential Fire Safety Measures Standard.

6.12.5 Corrosion Protection and Finishes

All surfaces exposed or susceptible to corrosion will be suitably painted, including external surfaces of all machinery, apparatus, equipment, fittings, tanks, vessels and services including supports, hangers and brackets.

Ferrous metal exposed to the atmosphere or in humid conditions is to be hot dip galvanised having a minimum coating thickness 0.1mm. Hot dip galvanising must be carried out after all welding, cutting, drilling and swarf removal has been completed. The university will not accept cold galvanising process.

Surfaces that must not be painted include:
a. All fibreglass and plastic surfaces.
b. Chrome plated and stainless steel surfaces.

c. Bearing surfaces, slides, adjusting screws and any surface that is required to be unpainted for the correct operation or adjustment of the equipment.
d. Flexible duct connections to plant, rubber or canvas hoses, flexible rubber mountings and any other non-metallic flexible connections.
e. Piping where installed in ceilings, trenches, underfloor, and similar concealed spaces must not be painted throughout their entire length but must be labelled with identification bands. However, steel piping installed in damp conditions in any of the above must be hot dip galvanised.
f. Bare copper tanks.
g. Motor and equipment nameplates.
h. Hot water or, convection heaters, unit heaters, etc, are to be pre-finished with Colorbond, powder coated or equivalent, otherwise painted to gloss finish of selected colour or colours to match the surroundings.

6.12.6 Acoustic Performance of Hydraulic Pipework

All hydraulic services must comply with the acoustic requirements of NCC through a combination of treatment to building elements and system pipework.

Acoustic treatment of all hydraulic services requires assessment and certification from a qualified Acoustic Engineer.

6.13 Materials and Equipment Selection

Only new materials, equipment and components will be installed, and these must be of good quality, fit for purpose and selected to minimise life-cycle costs and maximise efficiency. All products must be supported locally and internationally by factory trained service networks. All spare parts must be available ex-stock factory for a period of 10 years from purchase date. Equipment and materials that are obsolete, discontinued, about to be discontinued or superseded, must not be installed.

Uniformity of the type of materials must be consistent throughout all individual installations and must match, or be fully compatible, with the existing equipment.

Details of all major items of hydraulic services equipment proposed to be installed during new or refurbishment projects must be submitted to UI for approval prior to installation. This will include, but is not limited to pipe material selection, pumps, water storage tanks, pits, hot water plant, syphonic drainage systems, rainwater re-use filtration systems and sanitary fixtures and tapware.

Identification of a proprietary item of equipment will not necessarily imply exclusive preference for the item identified but indicates a deemed-to-comply item.

6.14 Service Access Requirements

The following servicing and access requirements must be provided:
a. Position all equipment and arrange access provisions at equipment, to optimise future maintenance and repairs.
b. Service access doors and panels must be hinged and lockable with a University plantroom bi-lock key. Lift off panels with screw fixings are not acceptable.
c. The University will not accept major plant within ceiling spaces and plant in tight spaces. Plant that is located in ceiling space must have free and easy access. This includes ability to service system without reaching around or over columns, beams, cable trays, pipe work, lights and duct work.
d. All motors are to be provided with isolators within 3 meters distance from motor. Isolators must be labelled with details of the source of electrical supply (DB/CB).

e. A plus 20% additional dimension access allowance is to be provided for above the manufacturers access requirements.
f. Major plant located above 3m height will have permanent stair/ladder access provisions with permanent workable platform.
g. Trip hazards to be identified and painted in yellow.
h. Electrical hazards must be identified and labelled appropriately.
i. Confined spaces to be noted and appropriate signage applied.
j. Fixed switchable lights are to be provided in all areas where essential fire safety measures are installed.
k. Access to plant and equipment must comply with all WHS regulations.

6.15 Redundant Equipment

All redundant hydraulic services systems and equipment and associated services (power, water, drainage, etc) must be removed as part of the project. Building surfaces and finishes must be made good wherever redundant services are removed. Where a service is unable to be removed appropriate tags and labelling shall be installed to indicate the service is redundant.

6.16 Interruption to Hydraulic Services

Interruption to hydraulic services must be planned to minimise disruption to existing services and University operations. This must be coordinated with the relevant COS representative at least 72 hours prior to shut down.

Where hydraulic services shutdowns are proposed, contractors must arrange to provide temporary connections to ensure operational areas of the University are not unduly affected. In cases where temporary connections cannot be achieved, shutdowns must occur outside of University operating hours.

Hot tapping and pipe freezing of University hydraulic services infrastructure must not be performed without specific prior approval from UI.

7 Commissioning

Comprehensive pre-commissioning, commissioning and quality monitoring must be specified by the consultant/designer.

A project specific commissioning plan is to be developed and provided to the University for review and approval.

Detailed testing and commissioning records must be provided for each system and each component as appropriate. All such records must be witnessed and verified by the project consultant/head contractor prior to witness commissioning by UI Engineers and COS representatives.

Project handover plan must be developed by the consultant/designer to allow the system to be handed over to The University. A 12 month building tuning process will commence at Project handover with systems monitored monthly, reported and assessed quarterly, and include assessment of feedback from the occupants.

A project specific commissioning plan is to be developed and provided to the University for review and approval. UI have developed a Hydraulic Services Commissioning Checklist (UI-ENG-F028) which should be used as a minimum guide when preparing the project specific commissioning plan.

8 Safety in Design

The contractor must consider risk during the design. A design safety report must be submitted to the relevant UI Project Manager for every design project. Contractors must confirm, so far as it is reasonably practicable, that the structure is without risks to health and safety.

Design risks must be considered for the asset lifecycle covering construction, operational and maintenance, refurbishments and decommissioning.

The design safety report must include the following:
a. Description of design element.
b. Description of potential risks and hazards associated with the design element.
c. A low/medium/high risk assessment considering likelihood and consequence.
d. Proposed measures to eliminate risks where practicable.
e. Control measures to mitigate and manage design risks.
f. Nominating responsibilities for managing the design risks.

This may be provided as a design risk register where appropriate and must include results of any calculations, testing and analysis etc.

9 Documentation and Records

9.1 Design Documentation

Prior to commencing construction of new or refurbishment projects, the consultant/contractor must fully investigate and document the requirements for each Hydraulic Services system required to be installed, altered or modified as part of the project works.

This must include:
a. Return Brief defining the systems proposed and any deviations from this standard.
b. Provision of a BCA/ NCC Compliance Report.
c. Calculations to be provided on the sizing of the pipe work. Future allowances are to be included in these calculations\sizing.
d. Calculations & selections on the proposed equipment.
e. Budget calculations.
f. Provision of Design Certification of each Hydraulic services system.
g. Requests for all variations to this Standard submitted using the UI Request for Dispensation Form (UI-ENG-F001).

This documentation must be provided by the consultant/contractor in both electronic and hard copy formats and approved by the University.

9.2 Completion Documentation

At the completion of all projects, the following documentation must be provided for each hydraulic services system installed or altered as part of the project works:
a. O&M manual(s).
b. As-built drawings (including schematics).
c. Asset schedules and labelling (as per the COS Asset Identification and Labelling Standard)
d. Commissioning test results and certificates of compliance for the following:
    i. All plumbing, drainage, gas fitting and LPG work.
    ii. Fire collars and penetrations.
    iii. Stormwater drainage.
    iv. Backflow prevention devices.

v. Thermostatic Mixing Valves.
vi. Pressure and Flow tests.
vii. Medical and speciality gases (Where applicable).
viii. Vacuum systems (Where applicable).
ix. Compressed air systems (Where applicable).

e. Product manufacturer specific information.
f. CCTV Recording - provide on completion of all drainage lines a CCTV video complete with mark up drawings relating to CCTV tape, i.e.: drawing to relate to sequence of taping (e.g. Run # 1, Pan 6 to Main Line, Run #2 Main Line to Junction, compass directions etc and as directed). Placed on a USB and labelled.
g. Warranty schedules for all major items of equipment, including but not limited to tanks, storage vessels, pumps, HWU's, solar panels, water filtration plant, sanitary fixtures, tapware, grease traps, gross pollutant traps, etc.
h. Maintenance requirements for all items of equipment.
i. Building User Guide.
j. Supply authority completion forms and inspection records.
k. Installers Statutory certificates.
l. Fully surveyed and documented underground services drawings depicting all as built water, drainage and gas pipework and services, to suit Quality Level A information, in accordance with AS5488 Classification of Subsurface Utility Information (SUI).

This documentation must be provided by the contractor in both electronic and hard copy formats and approved by the University prior to Practical Completion being granted.

10 Assets and Warranties

Assets are to be tagged in accordance with the COS Asset Identification and Labelling Standard for the purpose of maintenance and operation of University Assets. For refurbishment projects the project manage is to provide the existing asset list to the contractor to ensure modified and redundant equipment are captured in the contractors submitted asset list.

Each asset required to be collected can be found in the Form COS-ASSET-F001, each asset required to be coded will be identified by a unique equipment code.

The equipment code will be one the three following types:
a. Virtual asset (This is a concatenation *Building Code - Floor - Room number*)
b. Item count asset (This is a concatenation *Building Code - Floor - Room number*)
c. Unique bar code asset (Unique bar code in the million series number affixed to the asset)

Asset lists are to be submitted prior to practical completion of the project for review and approval by COS.

Equipment Warranties are to be provided for a minimum of 12 months from the date of practical completion. Warranties are to be provided as certificates as part of the O&M from the supplier of the equipment. It is the responsibility of the installation contractor to ensure all maintenance/servicing required to the equipment is provided to ensure warranties are valid at the end of the project DLP period.

11 Defects and Liability Period

Consultants/designers must include in the project specification detailed requirements for the defects and liability period following completion of the hydraulic services installation.

The contractor must include and allow for recommissioning of all major plant and equipment in the last month of the 12 month defects and liability period and confirm they achieve the original design requirements. In addition, all commissioning must be witnessed by UI Engineering staff with commissioning reports/results formally submitted to UI Engineering

11.1 Maintenance and Testing

For Hydraulic Services installed as part of a refurbishment project of an existing building, regular statutory maintenance and testing must be carried out by the University Hydraulic services maintenance contractor during the Defects Liability Period (DLP). The installation contractor must provide a comprehensive handover and the required completion documentation at Practical Completion.

All defects arising from regular statutory maintenance and testing performed during the DLP will be documented and passed onto the installation contractor for rectification. The installation contractor must be responsible for all defect rectification works identified during the DLP.

For new buildings, the installation contractor must provide statutory maintenance and testing of all Hydraulic Services for the building, throughout the DLP. Prior to the completion of the DLP, the installation contractor will perform all annual maintenance procedures in the presence of the University Hydraulic services maintenance contractor and provide documentation confirming the provision of all statutory maintenance has been performed during the DLP.

Any details which will affect the future maintenance and performance of the new or upgraded equipment must be supplied by the installation contractor at Practical Completion.

Prior to completion of the DLP, a final inspection of the installed systems will be carried out by the: installation contractor, appropriate UI staff, and University Hydraulic services maintenance contractor, in order to reconcile the performance of the equipment during DLP to produce a final list of project defects. All project defects identified must be rectified by the installation contractor prior to finalisation of the DLP.

12 Operations & Maintenance Manuals

Consultants/designers must include in the project specification detailed requirements for operation and maintenance manuals, including system description, operation procedures, testing and commissioning records, maintenance instructions, product support information and recovery protocols for any computer related systems. Contractors must provide these to the satisfaction of the consultant/designer. Providing a collection of manufacturers' brochures and catalogues is not acceptable to the University.

Discuss with UI to understand what format to submit the O&M Manuals. Typical submissions come via soft copy (editable) and used via a system like Aconex.

Contractors must submit the university designed MS Excel software spreadsheet (Sydney University Asset Register) designed for recording operational and maintenance activities including materials used, test results, comments for future maintenance actions and notes covering asset condition. Completed logbook pages recording the operational and maintenance activities undertaken for Practical Completion and during the Defects Liability Period must also be provided. For more information refer to the COS Asset Identification and Labelling Standard.

Facilities Maintenance must establish, document and implement procedures for operation and maintenance of fire services, plant and equipment to ensure Hydraulic services are fit-for-

purpose, provide secure, efficient, safe and reliable electrical power, and comply with requirements of this standard.

13 Authorisation of Variations

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

Variations to this standard must only be considered where:
a. The University Standard's requirement cannot physically or technically be achieved.
b. The alternative solution delivers demonstrated and proven superior performance for the same capital and life cycle cost or better.

Consultants and contractors must identify and justify requirements of the standard that do not apply to the project or which need to be varied and these which must be approved by the issuer of this standard. Formal requests for all variations to this Standard must be submitted using the UI Request for Dispensation Form (UI-ENG-F001). The issuer of this standard or their delegated authority must review and consider requirements of stakeholders from clients, projects and facilities management before deciding whether to approve variations. Their formal sign-off is required for acceptance of any non-compliances and departures from this standard's requirements.

14 Quality Control

14.1 Design Standard Compliance

Compliance with requirements of this standard must be checked throughout the design, construction and commissioning phases of projects by UI's services consultant. Any issues or deviations from this standard must be reviewed and approved in writing by the issuer of this standard.

Competent UI consultants and representatives must check compliance with this standard during design reviews and formal site inspections. Any non-conformances with requirements of this standard must be documented and provided to the UI Project Manager for issue to contractors and their consultants.

Project Managers must maintain a formal register of non-conformances and manage close out of outstanding non-conformances. Contractors and their consultants issued with non-conformances must take appropriate corrective actions. The UI Project Manager must ensure:
a. Proposed corrective actions are implemented.
b. Close out of non-conformances in relation to this standard is formally approved and signed off by the author of the standard or their delegate.

14.2 Design Standard Certification

Contractors and Consultants must certify compliance to the design standard by submitting a company Design Certification Form to the UI Project Manager at each of the following project phases:

a. Design and Documentation.
b. Tender.
c. Construction.

Notwithstanding UI' internal quality control processes, contractors and their consultants must implement their own robust quality assurance and control procedures to ensure compliance with requirements of this standard.

14.3 Construction Compliance

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

14.4 Acceptance

The University will only accept projects as complete when all of the above have been carried out, submitted and verified.

The above standards are not an exhaustive list of the relevant requirements. The consultant/contractor must incorporate all relevant standards and Authorities requirements into project specific design, documentation and installation.

Consideration must be given by the consultant/contractor to the original standard of performance relevant to the construction date of the individual Hydraulic Services.

15 Document Amendment History

Revision	Amendment	Commencing
001	First Issue	16 August 2013
002	2 Year revision a. Clause 2 Scope (amended) b. Clause 5.2 D&C Contracts (new clause inserted) c. Clause 5.3 – 5.9 Major update of information providing greater detail relating to design, installation, equipment and material requirements for water, sewer, stormwater, natural gas and sanitary fixtures d. Clause 5.11.6 Acoustic Performance of Hydraulic Pipework (new clause inserted) e. Clause 6 Commissioning (amended) f. Clause 7 Safety in Design (new clause inserted) g. Other minor amendments to wording throughout document	18 September 2015
3.0	5 Year revision h. Project Definition stage added at 5.1. referring to Project "Gate Paper" and requirement for site inspection / briefing. Requirement for "Return Brief" formalised. i. Overall document review to identify any areas where the requirements showed an excessive cost / benefit; j. Documents required for Submission & Approval updated, tightened up, aggregated and clarified. k. Safety in Design legislation reinforced. l. Commissioning Checklists added. m. Scope / Technical cover increased to include; i. RO plant requirements. ii. Rainwater system requirements iii. Updated metering and equipment details. iv. Revised tank and filtration requirements. v. Revised box gutters approvals vi. Interruption to Hydraulic Services. n. Defects period maintenance; include requirements for maintenance and testing during DLP o. Documentation and Records section updated to include new requirements p. Equipment Labelling requirements included q. Service Access and Safety Requirements section included r. Building tuning section updated to clarify Usyd requirements for tuning period in DLP s. Asset and Warranties section updated. t. Asset Standard Owner is now COS.	26 August 2020